Abstract Volume

World Water Week in Stockholm
August 21–27, 2011

Responding to Global Changes:
Water in an Urbanising World

Published 2011 by
Stockholm International Water Institute, SIWI
Drottninggatan 33
SE–111 51 Stockholm
Sweden

Cover design by Britt-Louise Andersson, SIWI.
Production by Elin Ingblom, SIWI.
Edited by Ingrid Stangberg, SIWI.

Printed by Ekotryck Redners, Stockholm, Sweden.
The printing process has been certified according to
the Nordic Swan label for environmental quality.

ABSTRACT VOLUME

World Water Week in Stockholm
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Responding to Global Changes:
Water in an Urbanising World

Contents

Presenters Photographs


Dr. J. Abbott
Workshop 3 Oral


Mr. M. Abduraimov
Workshop 5 Poster


Mr. F. Abu Hilou
Workshop 2 Poster


Mr. M. Adelman
Workshop 3 Poster


Dr. R. Aggarwal
Workshop 7 Oral


Mr. M. Al-Sanjari
Workshop 5 Poster

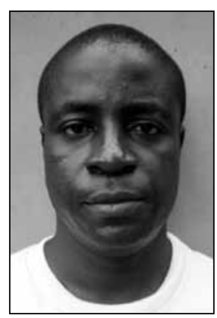

Ms. L. Amjadeen
Workshop 8 Poster


Ms. A. Anderson
Workshop 8 Poster


Mr. S. Arfeen
Workshop 5 Poster

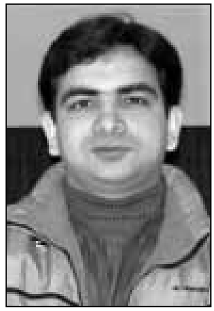

Ms. I. Avalos-Miñarro
Workshop 6 Poster


Mr. R. D. Avendaño
Workshop 7 Oral


Mr. B. Babalobi
Workshop 7 Poster


Mr. M. Barber
Workshop 2 Oral


Ms. J. Barendse
Workshop 3 Oral


Mr. N. Bassi
Workshop 8 Poster


Dr. M. Beisheim
Workshop 8 Poster


Dr. W. Bellamy
Workshop 8 Poster


Ms. S. Bhadwal
Workshop 4 Poster


Dr. K. Bhatt
Workshop 4 Poster


Ms. C. Cantú
Workshop 6 Oral


Mr. K. Caplan
Workshop 7 Poster


Ms. R. Chakraborty
Workshop 5 Poster


Mr. M. Chongo
Workshop 2 Poster


Ms. E. Colom
Workshop 8 Oral


Mr. J. Cools
Workshop 4 Oral


Mr. D. Corderi Novoa
Workshop 4 Poster


Mr. R. Ddungu
Workshop 7 Poster


Prof. L. del Castillo-Laborde
Workshop 3 Poster


Ms. K. Delfau
Workshop 6 Poster

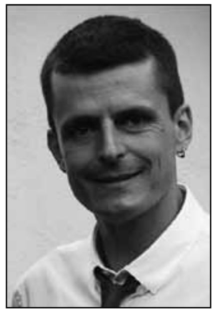

Dr. F. Durand
Workshop 1 Oral


Mr. S. N. Dwivedi
Workshop 5 Poster


Mr. A. Earle
Workshop 6 Oral


Ms. A. N. Elangovan
Workshop 4 Poster


Dr. A. El-Sadek
Workshop 6 Poster


Mr. J. Eyrard
Workshop 7 Oral


Mr. J. Feighery
Workshop 1 Oral


Mr. L. Filgueiras
Workshop 5 Poster


Mr. T. Foster
Workshop 3 Oral


Ms. J. Ganub
Workshop 6 Oral


Ms. Y. Gomez
Workshop 7 Poster

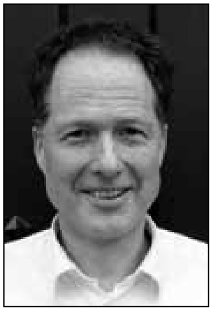

Dr. T. Gopalakrishnan
Workshop 1 Oral


Prof. I. Hadjanberdiev
Workshop 4 Poster


Ms. K. Harawa
Workshop 7 Poster


Ms. E. Hastings
Workshop 4 Oral


Dr. N. Hepworth
Workshop 8 Oral


Mr. H. Hoff
Workshop 6 Oral


Dr. R. Hope
Workshop 7 Poster


Dr. A. Ioris
Workshop 7 Oral


Mr. P. Jinadasa
Workshop 4 Poster


Mr. P. Kalbar
Workshop 5 Oral

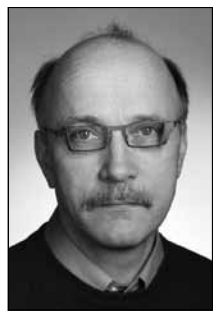

Prof. G. Kalenahalli
Gubbanna. WS 7 Poster

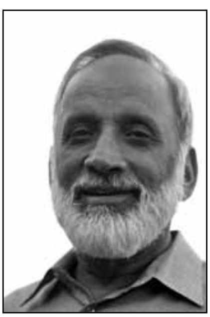

Dr. A. H. M. Kamal
Workshop 4 Poster


Dr. H. Kammerbauer
Workshop 6 Oral


Mr. W.S.P. Kankan-
amage. WS 7 Poster


Dr. G. Keremane
Workshop 8 Oral


Mr. P. Keskitalo
Workshop 6 Poster


Dr. M. A. Khan
Workshop 4 Poster


Mr. C-H. Kim
Workshop 2 Oral


Mr. B. Kurniawan
Workshop 4 Oral


Mr. V. Kuznyetsov
Workshop 3 Poster


Ms. S. Lakshmipathy
Workshop 5 Oral


Ms. F. Lanshammar
Workshop 8 Poster


Ms. E. Lavie
Workshop 7 Oral


Dr. P. Lehmann
Workshop 3 Oral


Dr. H. Lehn
Workshop 2 Oral


Mr. R. Liyanage
Workshop 3 Oral


Mr. A. Mark-Adeyemi
Workshop 3 Poster

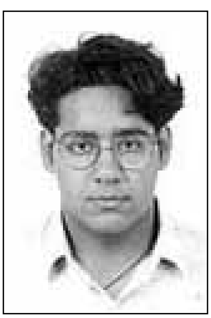

Dr. O. McIntyre
Workshop 8 Oral


Dr. S. A. Medeiros Leitao
Workshop 7 Poster


Dr. R. Mikhailenko
Workshop 5 Poster


Prof. C. M. Minaverry
Workshop 8 Oral


Mr. P. Mohapatra
Workshop 7 Oral

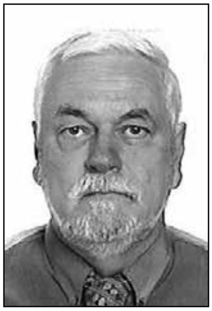

Mr. V. Monish
Workshop 6 Poster


Dr. S. Mukherjee
Workshop 5 Poster


Ms. S. Murinda.
Workshop 2 Poster

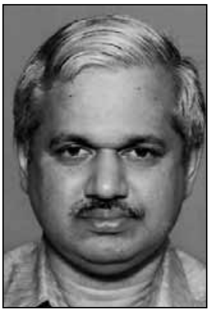

Dr. H. Mustapha
Workshop 3 Poster


Mr. P. Mwangi
Workshop 7 Oral


Dr. H-G. Mylius
Workshop 1 Poster


Prof. S. Mynepalli
Workshop 2 Poster


Dr. P. Naik
Workshop 1 Oral


Dr. S. Nair
Workshop 4 Poster


Ms. A. Namuli
Workshop 4 Poster


Dr. V. Narain
Workshop 6 Oral


Mr. V. Narayanan
Workshop 4 Poster


Dr. P. Nelliyat
Workshop 1 Oral


Dr. D. Nilsson
Workshop 8 Oral


Dr. C. Niwagaba
Workshop 3 Oral


Prof. R. Nugroho
Workshop 8 Oral


Mr. B. Obaid
Workshop 5 Oral


Dr. J. Olsson
Workshop 4 Oral


Ms. S. Packialakshmi
Workshop 6 Poster


Dr. C. Palos
Workshop 8 Poster


Ms. S. Parahakaran
Workshop 7 Poster


Mr. Md. A. A. Pramanik
Workshop 4 Poster


Dr. T. Qotaish
Workshop 5 Poster


Mr. M. Rahman
Workshop 5 Oral


Dr. S. Ramasamy
Workshop 2 Oral


Dr. V. Re
Workshop 5 Poster


Mr. M. Regelsberger
Workshop 2 Oral


Ms. R. Rop
Workshop 7 Oral


Mr. D. Rudrappan
Workshop 1 Poster


Ms. H. Rueskamp
Workshop 5 Poster

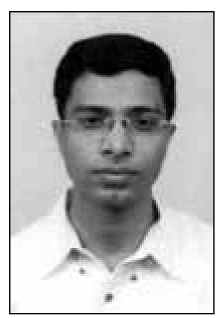

Prof. P. Sanchez-
Gutierrez. WS 5 Poster


Ms. E. Sanets
Workshop 5 Poster


Dr. I. Schauser
Workshop 4 Oral


Dr. U. C. Sharma
Workshop 6 Poster


Dr. V. Sharma
Workshop 4 Poster


Dr. C. Shekhar
Workshop 1 Oral

Ms. S Shoukry
Workshop 5 Poster

Dr. A. Singh
Workshop 4 Poster

Dr. N. Singh
Workshop 7 Oral

Mr. J. Sitton
Workshop 3 Poster

Mr. S. V. Sodal
Workshop 8 Poster

Dr. Z. Srdjevic
Workshop 5 Poster

Prof. B. Srdjevic
Workshop 7 Poster

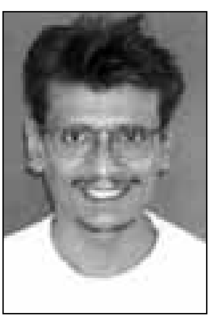
Dr. W. D. L. Stanley
Workshop 1 Oral

Ms. T. Stanton
Workshop 3 Oral

Prof. V. Starodubtsev
Workshop 6 Poster

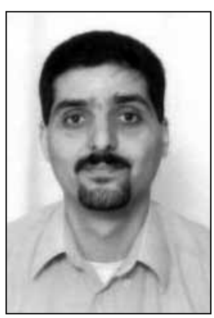
Prof. R. Stevens
Workshop 5 Poster

Mr. A. Subah
Workshop 1 Poster



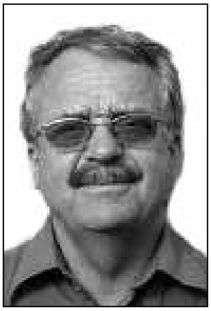
Mr. S. Subramanian
Workshop 1 Poster

Ms. L. Subramanian
Workshop 7 Poster



Mr. M. Tawil
Workshop 3 Oral

Mr. P. Thörn
Workshop 4 Poster


Mr. B. Troedsson
Workshop 5 Poster


Mr. I. Tumwebaze
Kamara. WS 7 Oral


Mr. F. Twinomucunguzi
Workshop 5 Oral


Mr. N. Tyagi
Workshop 5 Poster


Mr. D. Udayanga
Kumara. WS 7 Poster


Ms. E. Ulep
Workshop 7 Poster


Dr. K. Wall
Workshop 8 Poster


Dr. M. van Afferden
Workshop 3 Poster

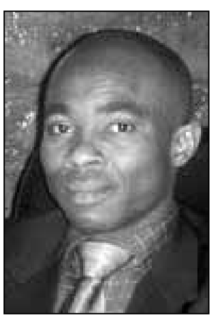

Mr. P. Weber
Workshop 6 Oral


Dr. D. Wickramasinghe
Workshop 5 Oral


Ms. S. Vijayaraghavan
Workshop 6 Poster


Mr. E. Wijma
Workshop 5 Oral


Mr. J. Witherspoon
Workshop 5 Oral


Mr. A. Vodounhessi
Workshop 8 Poster


Ms. T. Xiao-juan
Workshop 2 Poster


Mr. Z. Yong
Workshop 2 Poster

Ms. L. Zelaya
Workshop 8 Oral

Prof. L. P. Zhang
Workshop 5 Oral

Prof. L. Zires-Gomez
Workshop 5 Poster

Ms. S. Åkerman
Workshop 5 Poster

Workshop 1: Cities in a 3-D Landscape Perspective – Hidden Risks

Environmental Status Monitoring System Implemented in the Context of the Matanza Riachuelo Basin Integrated Environmental Sanitation Plan, Argentina

Author: **Mr. Andrés Carsen**, Matanza Riachuelo Basin Authority (ACUMAR), Argentina

Co-Author: **Mr. Eugenio Coconier**, Matanza Riachuelo Basin Authority (ACUMAR), Argentina

Keywords: Argentina, Riachuelo, integrated, monitoring, system

Introduction/Problem Identification

Matanza-Riachuelo Basin is the most urbanised of Argentina. It includes part of Buenos Aires City and the Metropolitan zone, with a population of 5 million people. The environmental degradation of the basin has affected specially poor and vulnerable communities. The Matanza-Riachuelo River also floods frequently, due to rainfall and/or high levels in La Plata River. A significant problem is groundwater table rise, mainly due to imported drinking water without appropriate sewerage system and uncontrolled urbanisation in former wetlands. One of the main constrains identified by the River Basin Authority, ACUMAR, to implement the Integrated Environmental Sanitation Plan (PISA) is the lack of reliable information of hydrological variables (including discharges to the river) and quality of the water, soil and air. The implementation of an integrated monitoring system on water, soil and air started in 2010 and the first results into a consolidate system are nowadays a reality.

Analysis/Results and Implications for Policy and/or Research

The Integrated Environmental Sanitation Plan (PISA) – under implementation by ACUMAR – complies with the Supreme Court request into a national and political priority framework for the environmental and social recovery of the M-R Basin. In this section we will present the water montoring system developed and implemented by ACUMAR, how is data stored and disseminated, organisation of databases for along certain target audience, emphasising who the users are and how to understand the water quality information and its relationship to other environmental factors such as flow changes, and discharges to the Matanza Riachuelo River. The M-R has a very variable flow (mean flow of 5 m^3/s with a highest registrated value of 1160 m^3/s in 1967). The Matanza Riachuelo discharged its waters into he La Plata River that is one of the leading estuaries in the world, connecting the Río de la Plata Basin (the second largest basin in South America, mean flow of 24,000 m^3/s and fourth largest worldwide) to the Atlantic Ocean. The Environmental Quality Coordination of ACUMAR is supporting the establishing of a Monitoring Network to assess the quality of the water, soil and air of the Matanza Riachuelo Basin in order to comply with PISA goals that are to ensure a good quality of life of the people living nearby it. ACUMAR has identified significant information gaps that need to be considered. The knowledge of the hidrology of this basin needs to be improved and for first time in 40 years the flow of the Matanza Riachuelo river will be measured at regional scacle, this measurements will be correlated to the surface water data generated by ACUMAR water quality monitoring network. In the context of the Integrated Environmental Sanitation Plan (PISA) activities, for first time water a surface and groundwater monitoring network has been established for the Matanza Riachuelo Basin and water quality and flow is being measured in a regular basis. This information will allow us to have a better understanding about how this ecosystem works and implications of the actions taken by ACUMAR to improve the environmental status of the Matanza Riachuelo Basin. The surface water quality monitoring network includes 38 monitoring stations in the Matanza Riachuelo basin and 52 monitoring stations in the south coastal border of La Plata River. From june

2010, surveys are carried out on a regular basis and once every three months, 76 physicochemical (nutrients, heavy metals, organic compounds, etc) and 17 biological (phytoplankton, phytobenthos, and macroinvertebrates) parameters are assessed. Additionally to these surveys and to fulfill information gaps, ACUMAR leads, in the context of the World Bank Project "Sustainable Development of the Matanza Riachuelo Basin", the instalation of 50 Hydrometric stations in different sections of the Matanza Riachuelo Basin. This will allow, for first time in forty years, to count with systematic flow measurements the Matanza Riachuelo Basin at regional scale, and therefore a better understanding of its hydrology. Additionally a continuous surface water quality and quantity monitoring stations are being installed in cooperation with the National Water and Sanitation Company of Argentina (AySA). Moreover, 17 continuous monitoring stations will be installed with support of the World Bank Project. This continuous monitoring stations network, according to its location, will measure up to 14 variables (temperature, levels of dissolved oxygen, nutrients, chromium, hydrocarbons, etc.) always associated to flow measurements. The data generated by these continuous monitoring stations will improve the knowledge of the environmental status of the basin and help ACUMAR to identify industrial and illegal discharges to the Matanza Riachuelo waters and its impacts. Regarding groundwater monitoring, ACUMAR counts with a monitoring network of 30 phreatic wells and 15 Puelche wells. Surveys are carried out once a month from July 2010 for measuring of water levels and once every three months assess the levels of total of 50 parameters (physicochemical, organic compounds and heavy metals). The surface and groundwater monitoring network involves coordinating mechanism among: a) 5 different technical organisations in charge of carrying out field and laboratory activities, d) water and sanitation organisations, e) Governmental Agencies of: Buenos Aires City, Province of Buenos Aires and of National level and municipal level. The data generated by the surface and groundwater monitoring network are being stored, processed and disseminated to key stakeholders and integrated into a three-dimensional system water, soil and air. These information will allow to assess the environmental status of the water, air and soil and help decision makers to define the actions needed to address the environmental problems identified for the Matanza Riachuelo Basin and to improve the quality of life of its inhabitants.

The Impact of Mining on the Water Security of the Witwatersrand, Gauteng, South Africa

Author: **Dr. François Durand**, University of Johannesburg, South Africa

Keywords: water security, karst aquifer, acid mine drainage, gold mines, uranium

Introduction/Problem Identification

More than 40% of the population in South Africa live on the Witwatersrand, the economic hub of South Africa. The Witwatersrand is situated on top of an extensive dolomite deposit, adjacent to a vast gold repository which poses a unique and profound challenge to the conservation of the ecology and human health. Johannesburg was founded in 1886 to accommodate tens of thousands of people converging on the newly discovered gold reef which turned out to be the richest gold deposit in the world. Over a few years many towns were established along the Main Reef as it was traced along the length of the Witwatersrand. The towns grew into a continuous strip of habitation stretching over more than a hundred kilometres. Settlement patterns were driven by opportunism and avarice that matched the spawning of mines and industries on the Witwatersrand. Urbanisation took place in a haphazard and reactive way rather than with careful planning with the eye on long term sustainability.

Analysis/Results and Implications for Policy and/or Research

The rock ore is brought to the surface where it is ground to a powder and treated with chemicals to extract the gold. The remaining slimes is then pumped to slimes dams where it dries. At present there are over 270 slimes dumps on the Witwatersrand, covering an area of approximately 400km^2. In the past slimes dumps were built on the dolomite itself because this caused it to be more stable due to the draining of the water directly into the karst system below. This strategy caused the pollution of the vast groundwater resources in and around the Witwatersrand with acid mine drainage. The karst aquifer is large enough to supply an urban area many times the size of the Witwatersrand if it were not for the continued and worsening pollution of this important resource.

Due to the karst aquifer which occurs in the dolomites, the gold mines have to be dewatered constantly in order to allow deep mining to take place in the adjacent or underlying gold-bearing Witwatersrand Supergroup. The pumping of massive amounts of groundwater from kilometres underground into surface streams turned small streams into sizeable rivers or in some instances clogged waterways with mine silt to form swamplands. Groundwater levels and flow were also affected adversely, one being the drying up of the springs from which the name Witwatersrand ("white water ridge") was derived. Sinkholes started to form over a large area due to this extraction of water.

Pyrite occurs in gold-bearing quartzite in the Witwatersrand Supergroup. During the mining process pyrite is exposed to water and oxygen which results in the formation of sulphuric acid. Sulphuric acid, in turn reacts strongly with the silt, gravel and exposed rock it comes into contact with which releases and mobilises metals contained within. This effluent, containing sulphuric acid, sulphate salts and metals is called acid mine drainage (AMD). The run-off from slimes dumps and rock dumps on the Witwatersrand which enters the surface water bodies and groundwater typically contains AMD.

Most of the mines on the Witwatersrand were closed down after they reached their operational limits. After the pumping ceased the mine void, which in the West Rand alone has a volume of over 45 million cubic meters, was flooded with groundwater allowing the water table to return to its original level. Springs, originally fed by the groundwater, started flowing again after a century, but this time it was not water that issued from them but AMD. The AMD decant from the mine void started in 2002 and is currently issuing from 15 active and 29 abandoned gold mines into the Vaal River which is the main water supply of the Witwatersrand.

The Witwatersrand Supergroup contains more uranium, thorium and radium than gold. The first uranium oxide extraction plant was built in 1949 at Blyvooruitzicht as the strategic importance of nuclear weapons became clear during WWII. This was followed by the first commercial uranium extraction plant in the world at West Rand Consolidated Mines in 1952. Subsequently other uranium extraction plants were erected and by 1959 approximately 5000 tons of uranium had been produced by South Africa exclusively for the nuclear weapon industry of the West. By 1980, during the peak of the Cold War, South Africa produced 7000 tons of uranium per year.

Over the past century more than 1 100 million tons of ore was brought to the surface during gold mining on the West Rand and Far West Rand, containing approximately 150 000 tons of uranium. Only a quarter of the uranium was extracted while the rest was dumped in the slimes dumps which therefore contain over 100 000 tons of uranium at present while more is added daily. Approximately 50 tons of uranium is discharged from the mines into the rivers on the Witwatersrand annually. Uranium is one of the most dangerous heavy metals emanating from mining areas. Uranium may enter the body through ingestion, inhalation and absorption through the skin.

Uranium and other metals such as thorium, radium, aluminium, cobalt, copper, iron, lead, manganese and nickel also accumulate in the river sediment and will continue to have a serious negative impact on the water chemistry as long as it leaches out of mine works. The rural communities in Gauteng and Northwest Province depend on mostly on groundwater for drinking and irrigation. The crops and animal products from these farms contain high levels of bioaccumulated metals.

Although comprehensive environmental guidelines and legislation exist, the implementation of these guidelines falls short due to a lack of human resources, resources, funding and time and a reluctance to enforce existing policies concerning mining and its impact on the environment. The situation has deteriorated to such a degree that it could be considered to be one of the greatest social and ecological threats facing South Africa.

Improved Approaches for Determining Safe Latrine to Well Setback Distances May be More Effective in Rapidly Urbanising Areas

Author: **Mr. John Feighery**, Columbia University, USA

Co-Authors: **Dr. Patricia Culligan**, Columbia University, USA
Dr. Alexander van Geen, Lamont Doherty Earth Observatory of Columbia University, USA

Keywords: groundwater, bacteria, latrine, well, sanitation

Introduction/Problem Identification

Guidelines for septic field to well setback distances are derived from either minimum travel times (e.g. 25 days) or distances (often 10 to 15m), after which microbial pathogens are assumed to be removed or inactivated. However, several recent studies including our own findings presented herein find that microbial risk to wells continues to much greater distances. In addition, investigations of microbial transport through aquifers generally find that predictions based on laboratory tests greatly underestimate the actual measured travel distances in field studies. Improvements in infrastructure needed to meet the intersecting MDG targets to improve access to safe water and sanitation and improve the lives of slum dwellers must take place in rapidly developing coastal megacities. Since these areas increasingly rely on shallow groundwater resources and low-cost on-site sanitation infrastructure, it is important that guidelines evolve to incorporate emerging research on groundwater safety.

Analysis/Results and Implications for Policy and/or Research

We conducted a two-year field study in the Matlab region of Bangladesh in several villages that varied in population density. Sanitation infrastructure in this area consists primarily of ventilated improved pit latrines while the water supply is mainly provided by shallow (<30m) tube wells, providing a unique opportunity to observe the microbial contamination of a sandy aquifer by on-site sanitation systems. We monitored over 100 shallow wells for 18 months, using a culture-based method to detect *E. coli* and on one occasion the coliphage MS2 was enumerated using a plaque assay. In addition, a survey measured the location and type of latrines, wells, and the population in each household. We have shown that in this region, high risk for microbial contamination correlates with lower arsenic levels, probably because the lower arsenic water was more recently recharged (van Geen *et al.* 2011).

To further explore this correlation, we measured the transport of the indicator bacteria, *E. coli*, both in the field (1-m scale) and in laboratory columns using field sediment (0.1-m scale). The field and laboratory test results do not explain transport on the scale required to account for the widespread seasonal contamination of nearby wells. In spite of this discrepancy, a geostatistical analysis of the 18-month dataset using a first order decay function shows that *E. coli* levels correlate most with distance to latrine and population density, which are both indicative of surface sources (Akita 2010).

This presentation will explain the most current microbial transport theories and then use our field and laboratory data to explore some possible explanations for the discrepancy between observed aquifer-wide contamination and the limited travel distances observed. These explanations include: (i) the presence of a small portion of less sticky bacteria that can travel much further than the bulk population, (ii) preferential flow pathways through which bacteria can travel much more rapidly, and (iii) the possibility that the aquifer is episodically contaminated due to drilling of new wells or backflow during floods and these bacteria are released when flow rates or water chemistry changes occur. Explanation (i) will be explored using a transport model that accommodates the existence of two populations of bacteria that have different reversible (meaning they can become attached and can subsequently detach) and irreversible interactions with soil grains. Explanation (ii) will be treated using a dual-porosity model that allows for a portion of groundwater moving more rapidly than the bulk flow. The third possibility (iii) will be examined indirectly based on observations made during column experiments.

Finally, we present a simple geospatial analysis of our well monitoring data in several villages of varying population and latrine density, using various guidelines currently implemented in sanitation planning. For example, the ARGOSS guidelines from the British Geological Survey (Lawrence *et al.*, 2001) used by many NGOs and development agencies assume groundwater with a travel time from surface to well of greater than 25 days can be treated as low-risk. Other guidelines are based the assumption that harmful microorganisms are attenuated after certain distances of travel through sandy aquifers (Webber 2009). The observed microbial risk in each village will be presented as a function of the guideline used, along with measures of latrine density and population density for each village. In conclusion, a conceptual framework will be presented that incorporates new knowledge gained from this research and other sources that could be used to improve upon existing guidelines for on-site sanitation, with particular emphasis on aquifer protection in slums and other high density urban areas.

Groundwater Use Policy in Developing Cities – Balancing Risks and Benefits

Keynote Speaker: **Prof. Stephen Foster**, World Bank GW-MATE, UK

Analysis/Results and Implications for Policy and/or Research

In developing cities there is growing dependence on groundwater to meet escalating water-supply demands arising from expanding population, increasing per capita usage and higher ambient temperatures. Integrated policies towards such use are required that carefully balance the risks against the benefits. This presentation will draw on GW-MATE experience during 2001-10 (acquired from World Bank projects and GWP networks) in many cities worldwide (especially in Brasil and India).

The types of risk arising fall into two very distinct groups according to whether the groundwater in the principal aquifer underlying the urban area is:

- confined by superficial aquicludes – eliminating vertical recharge but subject to compaction with major groundwater abstraction leading to land subsidence.
- unconfined and open to direct infiltration – often resulting in enhanced recharge but vulnerability to subsurface pollution pressures.

Urban groundwater quality is widely threatened by uncontrolled pollution pressures – especially the nexus with wastewater disposal or reuse, which must be recognised and managed. In most aquifer types, except the extremely vulnerable, there will be sufficient natural groundwater protection to eliminate faecal pathogens in percolating wastewater – although the hazard can increase markedly with sub-standard construction of waterwells and sanitation units. However, N compounds (usually nitrate) and DOC (dissolved organic carbon) will invariably reach groundwater to varying degrees according to hydrogeological setting and population density served by in-situ sanitation. Groundwater contamination can be reduced by correct operation of in-situ sanitation units, and eventually eliminated by the use of dry (eco)sanitation facilities (which separate urine and prevent its ground discharge) or the provision of mains sewerage but such solutions are impeded by the high retro-installation cost and various other factors.

Where urban centres are underlain by high-yielding aquifers, water utilities have been able to expand mains-supply incrementally at modest capital cost – usually resulting in greater water-source security, better water-service levels and lower water-supply prices. However, there are rarely sufficient groundwater resources within urban areas to satisfy municipal water-supply demand – and localised excessive abstraction can lead to deep cones of piezometric depression causing secondary problems (induced pollution, saline-water intrusion and land subsidence). Various measures can be introduced to mitigate the associated risks including:

- developing protected 'external' municipal wellfields to generate secure high-quality sources of supply and allow planned conjunctive use with surface water-sources.
- proactive land-use and sewerage planning to reduce the pollution load, and using hazard assessments to identify and close municipal waterwells with high risk of toxic contamination.

This will require overcoming fragmentation in the powers for land-use and pollution control between metropolitan municipalities and state government agencies, and establishing incentives for the water resource interests of urban areas to be assumed by neighbouring rural administrations.

Growth in urban groundwater use is not restricted to cities with ready access to high-yielding aquifers. Private waterwell construction has often mushroomed as a result of poor municipal water-service levels (as a 'coping strategy') and/or high water-supply prices (as a 'cost-reduction strategy'). A related policy question arising is under what circumstances do the risks justify banning in-situ residential use of groundwater. Where water utilities have excess supply capacity (and are subject to commercial incentives) they may market substitution of mains water-supply for private self-supply (residential, commercial and industrial) rather than deploying surpluses to improve water-supply in low-income areas – and thus distort rational policy dialogue. The large majority of private urban waterwells in the developing world are illegal – which is counterproductive for both the private user and the public administration. A more constructive approach would be (as far as appropriate) to legalise this use such that sound advice relevant to pollution risks/alerts, use precautions, etc can be provided, sanitary completion standards for waterwells can be improved, and the public administration can obtain better data on the dynamics of private use.

Changing Shoreline Due to Coastal Erosion, Accretion and Saline Water Intrusion Due to the Construction of Madras Harbour

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Keywords: harbour, erosion, accretion, mitigation, remedies

Introduction/Problem Identification

India has 6000 km coastline with 11 major ports for the purpose of trade, passenger transport, military, shipbuilding, recreation and marine resources. The port of Madras planned and executed by the British regime from the year 1876 became one of the major ports in South India. This man made interference with the nature has created ecological imbalance, altered sediment transport phenomenon and shoreline dynamics as well as environmental issues. Since the port is protruding 1.5 kms into the sea from the shoreline resulted in blocking the movement of littoral drift playing a vital role in changing the morphology of the beach and coastline with severe erosion in the north of the harbour endangering the urban community near the coastline.

Analysis/Results and Implications for Policy and/or Research

In order to control and mitigate the natural and man-made problems of beach erosion and accretion, protective coastal structures are constructed. However, these measures against the forces of nature have sometimes proved not only to be futile but also expensive and destructive. In India, for example, the construction of Madras Harbour has resulted in severe erosion of the beach to nearly 8 kms stretch along the coast and 1 km width on the North of the harbor and tremendous accretion leading to increase of 1.5 kms beach width and 10 kms length and heavy siltation of the mouth of river Cooum in the South of the harbor blocking the natural drainage resulting in severe pollution of the river due to domestic and Industrial waste disposal requiring periodical dredging of river mouth. Coastal sediment movement is of particular importance because what may be beneficial to a harbor may prove detrimental for the preservation of a Coastal strip threatened by erosion.

The frequent changes in the shorelines and beaches are due to the changes in the littoral transport. Littoral drift which mainly manifests itself parallel to the coast as long shore sediment transport plays a vital role in changing the morphology of beaches and coasts. The long shore transport is directly related to the direction of wave approach or the angle of the wave attack to the shore. The long shore movement of sand on beaches manifests either as accretion or erosion wherever this natural movement is obstructed by the construction of man-made structures like jetties, breakwaters, groins etc. Such structures act as barriers to the littoral drift, causing a build up of the beach on the up drift side and simultaneous erosion on the down drift side.

The process of urbanisation along the North and South Madras coastal belt caused considerable lowering of water table elevation as a result of decreased recharge and increased withdrawals. During 1950's there used to be a quantitative balance in the hydrologic system due to rainwater recharge, due to less paved area and return of the domestic waste water to the ground water below in the absence of domestic and storm water sewer systems.

Due to the presence of the conditions like 1) Increeased ground water extraction by pumping wells. 2) Reduced groundwater recharge due to urban paved surface areas and installation of storm sewers as well as waste water collected by domestic and sanitary sewers in the coastal region results in not only to a decline in water table but also to ground water pollution and seawater intrusion.

Artificial recharge efforts like rainwater harvesting in and around every domestic house, installation of spreading basins along the coastal belt and certain regulation by the Government in pumping by private agencies for exporting ground water from the basin are underway to counteract these undesirable results of urbanisation. Saline water intrusion in coastal aquifers is the most common pollutant in fresh ground water. Intrusion of saline water displaces freshwater in an aquifer.

Over the past century due to severe costal erosion along the north of Madras Harbour, the shore temple was submerged under the sea and the coastline advanced 1 km up to the state highway near the well built up North Chennai metropolitan area connecting Chennai and Calcutta and severely eroding the highway endangering the safety of the multistoried buildings. This paper will discuss about the measures undertaken by the Government progressively to prevent the severe erosion along the North Chennai coast by constructing breakwaters made of randomly laid rock boulders and break waters made of cylindrical concrete pipes of 1.5 m diameter and 3 m lengthy vertically sunk rip-rap along the coast and filled with sand and plugged with 0.3 m depth concrete at the top and bottom to resist the severe breaking wave forces. Since this method was not found effective in preventing coastline erosion, later tetra pods of each weighing 10 metric tones were placed randomly in the gaps in front and back rows of cylinders interlocking with each other as hybrid break water, which was found more effective in preventing costal erosion.

This paper will also address about the graphical display of the advancement of shoreline towards sea in the south side of the harbour every decade from 1876 to 2010 to the distance of 1.5 kms forming a beautiful Marina beach to a length of 10 kms. This paper will also present hydro-geological map showing extent of seawater intrusion along South Chennai coast to a distance of 3.5 kms inland over 50 years due to indiscriminate pumping of groundwater in the coastal urban areas to a stretch of 15 kms making the entire ground water saline in the southern metropolitan areas. This paper will also discuss in detail about the ways and means of mitigating this environmental issues and technological solutions.

Safeguarding the Drinking Water Supply of the Cities of Beirut and Damascus by Water Resources Protection in Karstic Environments

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Keywords: groundwater, wastewater, karst, land use planning, water resources management

Introduction/Problem Identification

The water supply of the capitals of Lebanon and Syria, Beirut and Damascus, depend to a large degree on springs that emerge from nearby limestone aquifers, which are highly karstified. These springs are already or face a high risk to become polluted, mainly by wastewater.

Four projects, funded by German development cooperation (BMZ), aim to reduce the pollution risk for Jeita spring in Lebanon and Figeh spring in Syria. In both cases the respective technical cooperation projects work, on the German side, hand in hand with financial cooperation projects to achieve the best possible protection of drinking water resources. The technical cooperation projects provide advice to the financial cooperation projects especially in geoscientific aspects related to the site selection for WWTPs, collector lines, effluent discharge locations, wastewater reuse, and concerning environmental impact assessments (EIAs) for the wastewater facilities to be established by the financial cooperation projects.

Analysis/Results and Implications for Policy and/or Research

Safeguarding the drinking water supply for today and tomorrow

Wastewater in the groundwater recharge areas of the water resources for Beirut and Damascus is until now mostly discharged into the environment without any treatment. Due to the rapid and uncontrolled expansion of residential areas in the groundwater recharge areas bacteriological contamination of drinking water sources has become widespread. Currently there are several decentralised wastewater treatment plants in planning.

However, under the given difficult conditions in Lebanon and Syria (lacking institutional capacity for operating wastewater treatment plants, limited availability of electrical power supply, steep slopes, active tectonic movements, highly karstic underground) the planning of such wastewater facilities is a challenge. The Jeita and Kashkoush springs in Lebanon discharge on average around 200 Mm^3/a and provides around 75% of the water supply for the Greater Beirut area.

In Syria, Figeh is the largest spring with an average discharge of around 200 Mm^3/a and accounts for approximately 60% of the water supply of Damascus.

Due to the low storage capacity and quick drainage of the karstic aquifer systems, discharge in both cases varies considerably during the year between 30 m^3/s during the high flow period and 1 m^3/s in the low flow period. Due to the large seasonal variation of discharge, both springs cannot meet the demand of the cities towards the dry season.

Securing a safe and sustainable water supply poses a major challenge that can only be met with a comprehensive strategy to optimise water usage and reduce contamination risks. The financial (FC, implemented by KfW) and technical cooperation (TC, implemented by BGR) projects therefore are closely coordinated with the aim to assess available resources, identify sources of contamination, implement protection measures as well as design an exploitation strategy for the sustainable use of available water resources.

The FC projects in both countries implement related wastewater schemes and geotechnical measures. A wastewater master plan established by the FC consultant for the entire catchment areas forms the basis for related investment decisions. Based on groundwater investigations carried out by the TC projects proposals have been made how to collect, where to treat and where to potentially reuse wastewater in the groundwater contribution zone. High-risk zones were delineated, indicating where investments in wastewater projects should commence. Groundwater protection zones were established for all springs and wells used for drinking water supply. The related land use restrictions in the most sensitive area, protection zone 2, will include special regulations for the construction of wastewater facilities in declared protection zones, among others with the obligation to connect households to existing sewer lines or to build closed septic tanks and regularly empty them. The TC projects assist municipalities in the catchment area in integrating water resources protection aspects into their local land use plans. Currently the need of water resources protection is not integrated into the related planning process.

Concerning the site selection of wastewater facilities for the FC component groundwater colorations (tracer tests) proved to be highly valuable. They showed where direct and fast infiltration pathways exist and indicated that in certain areas flow velocities in the saturated part of the groundwater system are extremely high (up to 2,000 m/h and more). They also made it possible to adapt accordingly the planning of wastewater facilities.

In order to estimate future water availability a climatic forecast modeling for Figeh spring has been undertaken. Results indicate a shortened rainy season with less rainfall that falls during more intensive events. Together with an increase in temperature these climatic changes have direct consequences for the cities' water supply. Strategies to cope with these changes were developed.

In order to improve the water resources management, a best management practice guideline for wastewater facilities in karstic areas has been prepared by the TC projects. It lists which investigations need to be done in order to properly address all issues of the hydrogeological parts of an EIA. The FC projects will provide assistance for improving the monitoring of the springs.

Waste Disposal in Mzuzu City, Malawi – Environmental Friendly Solution

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Keywords: household waste disposal, geological barrier, groundwater protection, treatment leachate water, selection process

Introduction/Problem Identification

Within the Malawian/German development cooperation the Geological Survey Department (GSD) in Zomba, Malawi was assisted by the Federal Institute for Geosciences and Natural Resources (BGR) in Hanover, Germany in Environmental Geology for urban and regional development planning (EnviGeo).

In Mzuzu City, Malawi, waste disposal was done in an unplanned way filling a former borrowing site for road construction raw materials. The rapid housing development in the neighborhood of the area prompted unrest under the new dwellers.

To solve the conflict the City assembly was assisted in the selection of a new waste disposal site.

With the concept of a waste disposal based on a geological barrier for the protection of groundwater from contamination five areas were tested with field surveys and specific laboratory tests on soils. Two locations were found suitable for the development of a new waste site.

Analysis/Results and Implications for Policy and/or Research

Mzuzu City is the urban centre in northern Malawi with fast growing population and industrial development. The specific topographic and geological situation of the city in an area close to the escarpment towards Lake Malawi with steep slopes, large swampy areas and a difficult subground for construction made up of clay rich and sandy soils, geotechnical problems are difficult to resolve.

With the increase in waste generation (average half a kg per person per day with an actual population of 165 thousand), the unplanned dump site at Mchengautuwa which runs for about 400m parallel to Mchengautuwa river needs to be replaced as soon as possible by a suitable site.

The Mchengautuwa site, were weathered rock was obtained for road construction, was once outside of the city, but now is surrounded by residential areas. Unpleasant bad smell affects the neighborhood and the river is already contaminated. There should be a control of the soils used in nearby irrigated gardens for vegetable supply of the people.

Since 2003 protests started against the city assembly demanding an urgent solution for the environmental problems. Searching for a solution there was an offer by the forestry department to use an area at Lusangadzi within the state forest reserve. At that time, with the help of the World Bank and other donors, the Malawi government had established already laws and rules and regulations for development projects, including guidelines for environmental impact assessment studies. With the lack of experience to realise such projects the EnviGeo project got involved to realise the necessary geological investigations needed in the selection process for a waste disposal site. Two areas were tested in Lusangadzi, approximately 10km west of Mzuzu and a uniform clay rich soil cover of greater 7m thickness with large aerial extent was found at site 2. Unfortunately the decision process to change the land-use from forest reserve to municipal land took a long time and finally early 2010 the decision was taken not to accept the change of municipal land for the forestry area. Therefore in April 2010 tree proposed alternative sites were subject of a geological soil survey conducted again by GSD and BGR. The results from laboratory tests on the samples were received in December 2010 and recommendations on the only suitable site in Dunduzu in the NW of Mzuzu are under discussion with the technicians from Mzuzu City Assembly to establish the new dump site as soon as possible.

The concept of the new facility includes measure to minimise waste and maximise recycling. Discussion where held with some industry sectors to find specific solutions for their problems. First it was intended to find a way to use the broken glass from a soft drink bottling company, but the nearest glass smelter, which can use recycled material in South Africa. As the glass can be used at the base of the waste dump as filter material, there is no need for a specific intermediate storage facility.

The issue of hazardous hospital waste needs further discussion with health officers to apply the needed pre-treatment to avoid the spreading of HIV.

Parallel a proposal for sanitation of the old dump site in Mchengautuwa was worked out. At least the concentration of the waste and coverage with soil shall help to minimise the contamination as much as possible.

Impact of Urbanisation on Groundwater Regime in a Fast Growing City in India

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Keywords: India, urbanisation, population, groundwater, pollution

Introduction/Problem Identification

India, with a population of ~1.2 billion is the second most populous country in the world. Despite numerous efforts to improve rural facilities, there is a rapid migration of rural population to urban areas for better work opportunities and living conditions. The urban areas are fast getting densely populated putting unwanted stress on the natural resources. The present investigation is an attempt to study the impact of urbanisation on the groundwater regime in Solapur city, a rapidly growing medium-sized city in central India in the State of Maharashtra. Special emphasis has been given on the management of the present and ultimate demand of water in 2020 AD. Pollution threat to the groundwater regime has also been studied. The purpose is to apprise the world readers of the hydrogeological changes that occur due to urbanisation in a growing medium-sized city in a developing country so that proper planning could be done beforehand to counter the ill effects, if any.

Analysis/Results and Implications for Policy and/or Research

Solapur, with a population of 907,400 (2003), is the 37th most populous city in India. From a population of 75,290 in 1901, its population increased to 873,010 in 2001, a rise of 1160% in 100 years. Until about early nineties, it covered an area of 33.03 km^2, but major expansion of the city took place in 1992 with the inclusion of 13 adjoining villages within the city limits. The city now has an area of 178.57 km^2 – a five-fold increase in its previous area. With such a sudden expansion, Solapur was soon identified as one of the fast growing cities in India in terms of geographical area in the decade 1990-2000 and it still maintains this status.

Only 20% of Solapur city area is fully developed giving ample scope for the future development. It receives a recharge of about 24 million m^3 of groundwater from various sources annually. Land surface sealing from pukka houses, metalled roads and other such structures has resulted in about 7-23% reduction in direct infiltration of rainfall depending on city's growth. Also, city growth in a span of about a decade or two has caused about 6-8% decrease in recharge from rainfall infiltration. But, indirect recharges due to pluvial soakaways from roofs and paved surfaces, reduced evaporation, leakages from water-supply pipelines and seepage due to the irrigation of agricultural land by wastewater inside the city limits have compensated the effects of surface sealing and have caused additional recharge to groundwater. Reduction in recharge, as conventionally assumed due to the impact of urbanisation, could not be well established. Shallow groundwater levels inside the main city limits are indications of decreased groundwater abstraction due to higher reliance on surface water and increased groundwater recharge due to additional supply of surface water. However, outside the main city limits, there is a general decline in groundwater levels compared to mid-70s due to increased groundwater utilisation for irrigation purposes.

Groundwaters in Solapur city are generally dominated by alkaline earths and strong acids. Quality deterioration in certain pockets has been due to gross misuse and disuse of stagnant well water. Shallower groundwater has been abused mostly during the past decade due to the use of dugwells as waste dumping sites. However, in case of borewells, comparison of the present water quality with that in mid-70s and early 80s does not show any perceptible change. Deeper groundwater tapped by borewells can still be used for drinking purposes with caution. Both shallower and deeper groundwaters are, however, good enough for use in other household purposes, such as washing and bathing.

Solapur city is poised to have a population of 1,725,000 by 2020 with availability of a quantum of 200 MLD of water while the actual requirement is 269 MLD. The shortfall of 69 MLD can be easily met by groundwater, which has a potential of 113 MLD of water excluding the vast reserve of deeper groundwater. Considering the future demand of water, old dugwells once used for water supply in Solapur city may be renovated and new wells may be constructed at strategic locations. Borewells with a yield of more than 5000 L/h may be fitted with electric motors and groundwater may be supplied locally from these wells through water supply stand posts for general use. Intensive projects may be taken up for artificial recharge of aquifers and also for dilution of harmful chemical constituents through construction of several water harvesting structures at suitable locations adjoining the city. Rainwater harvesting is an option authorities may possibly like to make mandatory for the newly constructed buildings within the city.

This paper concludes that there is an increase in groundwater recharge as population in a city grows and more and more water is supplied to the city to meet the growing demands. Impervious surfaces cause only limited decrease in recharge in a young growing city and can very well be neglected. Groundwater quality deterioration is not due to urbanisation, but due to general apathy of the public towards this valuable resource. If there is adequate usage of groundwater, its natural circulation would increase and the quality deterioration could be checked.

This paper apprises the city planners and administrators of the effects of urbanisation on the ground water regime in a fast growing medium-sized city in a developing country where the infrastructure developments are not in conformity with the rapid growth in population, so that advanced action can be taken up beforehand in similar cities around the world while planning for water supply and sanitation facilities.

Need for 'Integrated Water and Land Resources Management' Approach for Sustainable Ecosystem and Water Security in Third World Cities

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Keywords: urban ecosystem, water security, unplanned urbanisation, land use change, stakeholders

Introduction/Problem Identification

Developing countries are experiencing structural transformations in terms of a decreasing role for agriculture and the increasing dominance of the industrial and service sectors, especially in urban areas. Furthermore, globalisation has led to increased foreign capital that is substantially invested in urban areas. While employment generation and livelihood creation is the aim of such investment, urban infrastructure has not kept pace with such investment.

Urban populations are heavy users of land and water resources. Hence natural resources like wetlands, agricultural land, tanks and lakes, and the associated flora and fauna have been significantly lost. Moreover, wastes generated in urban areas are more concentrated and hence more serious in terms of environmental damage. This must be understood in the context of significant urban population growth.

Analysis/Results and Implications for Policy and/or Research

In India the urban population has increased from 11% (1901) to 17% (1951) and further to 28% (2001). Similarly, the number of towns has also increased from 1916 to 2422 to 4689 in these same respective years. Among the states Tamil Nadu has the highest level of urbanisation (44%).

The research progressing under the Crossing Boundaries Project of the Centre for Water Resources, Anna University, examines various issues related to urbanisation and its impact on water resources in Chennai, the capital of Tamil Nadu, also one of the major metropolises in India. This interdisciplinary impact-oriented research attempts to analyse real life water sector issues pertaining to society through stakeholder dialogues and participatory research along with technical and scientific investigations. Chennai's growth has been rapid since the 1970s. Its population has increased from 3.5 million (1971) to 5.8 million (1991) to 9.8 million (2011). Unplanned urbanisation with unscientific land use changes has created enormous impacts on Chennai's water sector.

Mobilising huge quantities of water for meeting the increasing urban need is a big challenge. The efficiency of the public water supply system is questionable as sources are highly uncertain. Groundwater in most parts of the city is severely contaminated. In areas where public water supply is not efficient or does not exist people depend on peri-urban groundwater transferred through tankers and packaged cans, where accessibility depends on the consumers' ability to pay. This informal water market has led to excessive exploitation of groundwater and in many areas the groundwater table has diminished and water quality has deteriorated both which adversely affect the livelihoods of marginal farmers and agricultural labourers. Moreover, coastal areas of the city are experiencing sea water intrusion even up to 10 km from the coast.

The deterioration of groundwater and surface water sources in the city and its suburbs is due to the indiscriminative discharge of sewage, industrial effluent and poor disposal of solid wastes. Groundwater quality analysis indicates that water is often not suitable for domestic purposes particularly drinking. However, socially vulnerable communities are compelled to use this water hence and as a result are exposed to various water borne diseases. Solid wastes, on the other hand, are disposed in low-lying public lands and groundwater pollution in the surrounding areas is severe due to leachate transfer. Multi-functionality of the socio-ecological services of water bodies has also diminished considerably. Many of them are even filled for various developmental purposes. It is the urban poor who suffer the most from these developments.

Unplanned urbanisation with rigorous land use changes has also had significant impacts on storage structures and drainage canals, which have historically discharged flood water to the sea. The Pallikarani marsh (with its cascading tanks) and the Buckingham canal used to play a significant role in moderating the floods in South Chennai. Recently the marsh has been considerably encroached and only 10% of its original area exists. Its storage capacity has reduced from 55.78 Mm^3 to 14.73 Mm^3. The reduction in the natural recharge options increases the runoff in the city and makes the city more prone to inundation.

Urban ecosystems, in other words, are built environments and sustain various economic activities including the industrial, commercial, residential and institutional sectors. Hence Infrastructure has to be planned not only for the population but also according to the requirements of economic sectors. What is needed is a paradigm shift in urban water and land management through the coordinated efforts of various stakeholders. The following is suggested:

- Strict enforcement of (a) Groundwater Regulation Act (b) Municipal Solid Waste Management Rules and (c) Protection of Tanks and Eviction of Encroachment Act;
- Wastewater should be collected and treated in properly designed treatment plants. Recycling and reusing treated water must be considered;
- Water supply and sanitation facilities should be enhanced with affordable pricing systems, where cross subsidisation for the poor should be a priority;
- Proper land-use planning and management is essential. Natural assets like wetlands can be protected by limiting development in ecologically sensitive areas;
- Rainwater harvesting should be encouraged with incentive mechanisms for improving groundwater quantity and quality; and
- The public, NGOs, educational institutions, media and citizens have a major role to play. They should collectively put pressure on local government to enforce land-use and other rules, and maintain public property like rivers and tanks. Citizens should also pay the appropriate property/local taxes and user charges so that the urban bodies have the financial resources to improve and extend their services.

Hidden Risks of Pako Dump Site in Lagos, Nigeria

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Keywords: hidden risks, environmental challenges, contamination of water, modern dump sites, health hazards

Introduction/Problem Identification

Cities are exposed to several types of hidden risks namely continuous contamination of land surface and ground water as a result of inadequate management of waste dump sites and poor urban governance. Rapid urbanisation has taken place all over the world as a result of not only faster economic development but also due to population explosion particularly in developing African nations. Though cities are described as engines of modern economic growth, they also brought forward many hidden risks making the people's life miserable and the cities livable. Growing populations, rising incomes, and changing consumption patterns combine to complicate solid-waste problems and remains as an environmental problem identified in Nigeria. The paper highlights the need for good urban planning and better governance which would lead to risk reduction, resilient supply of water, equitable delivery of services and technologies for resource prudent life styles of people in urban centres.

Analysis/Results and Implications for Policy and/or Research

The problem of adequate solid-waste management in Nigerian cities and urban cent res has reached mammoth proportions, as heaps of refuse are found along major roads, riverbanks, and in open spaces, while in developed countries, due to technological advancements, the sites are able to cater for every type of waste that is produced and disposed of including hazardous waste from both households and industrial areas. Traditionally, slums and shanty neighborhoods receive least attention in regard to waste collection and disposal services. Waste management is defined as the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste planned waste disposal can be traced to the Ancient Greek World where disposal was done not less than 1.6 km away from the city gates. Domestic waste generation is increasing and is compounded by a cycle of poverty, population explosion, decreasing standards of living, bad governance, and the low level of environmental awareness. Cities generate more solid wastes than they can manage, and this situation tends to increase with income levels and the economic development of the area.

Descriptive Research Method has been used for the analysis with the help of field surveys oral interviews and questionnaires. Perception of respondents in Pako dump site reveals that almost 80% of the respondents agree with the notion that the Pako solid waste dump site can force them to relocate. The analysis on environmental effects of Pako dump site points out that 90% respondents agree that the dump site releases bad odour into the environment which means burning activities take place often on the dump site. Further, 85% respondents agreed that the dump site caused insects and pests invasion in the neighborhood.

It is observed that disposal of industrial hazardous waste with municipal waste exposes people to chemical and radioactive hazards; uncollected solid waste obstructs storm water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of disease. Wastes dumped near a water source also causes contamination of water bodies or ground water sources.

Results

Respondents revealed that dump sites pose health problems to them because of dump sites attraction of mosquitoes, rats, cockroaches, and flies leading to malaria and cholera outbreaks. Direct dumping of untreated waste on dump sites close to these places result in the accumulation of toxic substances in the food chain through the plants and animals that feed on it, they alter the edaphic and aquatic environments whose geographical extent is difficult to determine. Birth defects or infant mortality can also be caused by direct contact with pathogens or hazardous constituents in solid waste, inhaling of air contaminants, or drinking of contaminated water. Waste treatment and disposal sites can also create health hazards for the neighborhood. In a modern dump site, refuse should be spread in thin layers, each of which is compacted by a bulldozer before the next is spread. When about 3 m (about 10 ft.) of refuse has been laid down, it is covered by a thin layer of clean earth, which also is compacted. Pollution of surface and groundwater is minimised by lining and contouring the fill, compacting and planting the cover, selecting proper soil, diverting upland drainage, and placing wastes in sites not subject to flooding or high groundwater levels. Gases are generated in landfills through anaerobic decomposition of organic solid waste. If a significant amount of methane is present, it may be explosive; proper venting eliminates this problem.

Implications for Policy research

The study recommends extension of service coverage, especially in low-income areas and the use of low-cost, community managed primary collection systems. Regarding the transfer systems in Nigeria, the design and expansion of transfer facilities and equipments such as waste trucks and temporary dump sites must match the characteristics of local collection systems and the available capacity of environmentally safe disposal facilities. Regarding the final disposal of municipal solid waste, the technology of landfills is fairly simple, but involve complex organic processes and therefore to ensure their efficient operation and to limit disturbances and environmental pollution, landfills need to be carefully sited, correctly designed and well operated. Urban authorities should ensure that appropriate sites for new solid waste disposal are made available, and that these sites should become accessible for the timely execution. The need of the hour is to design urban development and planning so that it satisfies basic needs, and does not transgress the limit imposed by the absorptive capacity of the environment.

The Dynamics of Household Environment and Its Influence on Child Health among Urban Poor in India

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Keywords: slum, diarrhoea, acute respiratory infection, drinking water quality, toilet facility

Introduction/Problem Identification

Millennium Development Goals cannot be achieved without taking into account the health of urban poor in India. Among urban poor, slum dwellers are the most vulnerable as they face several health risks due to absence of basic amenities, unhygienic living conditions and filthy environment.

Analysis/Results and Implications for Policy and/or Research

As a result, especially children under age five are exposed to diseases like Diarrhoea, Pneumonia and Acute Respiratory Infections (ARIs), which are major killer among them. First time in India, the National Family Health Survey (2005-06) provides the individual and household level information on living conditions, household environment and children's health status of urban slum dwellers living in eight cities of India. Apart from five mega cities namely Chennai, Delhi, Hyderabad, Kolkata and Mumbai, the data on slum and non-slum are available for three million-plus cities Nagpur, Indore and Meerut. A sample of 2803 children under age five years from slum area is analysed in this paper. Both bivariate and multivariate analyses are carried out in the present study. The study reveals that children from households not having any separate room for cooking are 1.5 times more likely to get acute respiratory infections. Type of toilet facility and drinking water quality and child's feces do affect the prevalence of diarrhoea significantly. Poor toilet facility coupled with unsafe with drinking water raise the odds for children suffering from diarrhoea. Household crowding does not make any significant to the prevalence of diarrhoea and ARIs. By socio-cultural and economic background, children from scheduled castes and scheduled tribes are more likely to suffer from any of the diseases. The study recommends that shortly expected National Urban Health Mission (NUHM), promised by Congress led new UPA government, should have provisions for sanitation and hygiene along with improved primary healthcare infrastructure.

Physical Risk in a City of Sri Lanka – Strategies to Manage Raw Water

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Keywords: urbanisation, raw water, population, industrial activities, strategies

Introduction/Problem Identification

Rapid urbanisation, people, ideas and commodities are intensively mobilising and as result architectural innovations spring up while slums continue to grow in their shadow. Also urban areas concentrate people, wealth and knowledge but they are increasingly exposed to risk of too much and too little water. But water is getting scarce as observed above. Population growth and consumption increase have moved the human kind to over exploit existing natural resources. Further the human and industrial activities of economies growing at a phenomenal rate have made many places in the world a hot spot of atmospheric aerosol and green house gas concentrations. The delicate balance among different components of materials, water and energy cycles that sustain life on earth is disturbed. Studies on atmospheric pollution indicate that there are major changes in quantity, quality and distribution of rainfall. Due to this atmospheric pollution, raw water is problem and needs sustainable management.

Analysis/Results and Implications for Policy and/or Research

Sri Lanka is an Island located in the Indian Ocean to the East of the Southern tip of India from which it is separated by the Park Strait and lies between the latitudes 50 55' N&90 55' N and longitudes 790 42' E & 810 52' E. But pathetic and unhealthy situation of the cities designed without using the knowledge about geographic information, remote sensing, information technology and also without efficient urban management results in badly constructed roads, drains filled with garbage and sludge results in problem of controlling flood which again a kind of physical risk linked to the need for more raw water. There are several ways to address the situation. The overall goal in addressing water resource management is sustainability but this should also be accompanied by social equity and economic efficiency. The accepted approach to improving water resources management should also be based on stakeholder involvement in the planning and decision making process. Therefore preparing water resource management plans can be more involved than conventional government planning. The studied city of Sri Lanka is provided with government controlled water supply scheme for domestic purposes. The city population is about 90,000 according to the recent survey. One water way in the city supplies 100,000 m^3 per day during drought. The recent continuous and rapid developments in the city was a significant driver of change for individuals, for social relations and for people's life support systems on local, national and regional scale and brought about rapid economic growth, social mobility together with modified consumption patterns and glaring socio economic differences. As a whole these changes were associated with growing urban foot prints, physically, economically and politically far beyond city borders. Change was multidimensional with various facets interwoven in a complex web. Differences and inequalities between and within city are likely to become more pronounced. However City dwellers who could afford for water supply connection were given raw water supply but there were taps of water supply installed at random points accessible to unaffordable communities. As time passed it was observed that water was being wasted unnecessarily. Then the government institution controlling the distribution started to introduce a scheme to charge a nominal rate from water users. Water measuring meters were installed at every house holds. For a house hold and agencies using water less than $10m^3$ the charge was 0.9US $. This was sufficient for a family of 5 members. From time to time charges were revised. The present revised charge varies 0.05-0.5US

$ for units 1-25, while service charge is 0.5-1US $. For units 26-75, it is .75 – 1.1US $ while service charge is 2US $ – 10US $. For more than 75 units charge is 1.2US $ while service charge is 16US $. The above method was found to reduce wastage and more consumers were benefited. In the same city there are community living about 2km away from the coast. Here they used ground water for domestic purposes. Because the region is considered to possess non artesian (unconfined) aquifer, the replenishment is by rainfall (inflow, runoff etc). The study showed the ground water depth in domestic wells ranged from 0.5m to 2.1m during the drought period and therefore the recommended wells had diameters ranging from 1m to 1.5m. Hence it is concluded that water resource management to provide raw water to the city concerned must be cyclical and accompanied by the regular evaluation, assessment of progress and re planning. Further local authority should strengthen the capacities of urban management, information, administration and urban design so that flood will be properly managed without disturbing water resource management to provide raw water required by the inhabitants of the cities. Authority could also convince the people the importance of conserving water by organising awareness programme of how to use their tap water sparingly for washing and also reduce the time of bathing by few minutes and thereby in a city of 90,000 inhabitants, the amount of water that could be conserved will be more. If this is practiced by the population of the world, the world will not feel any scarcity of water and future generation will be happy. The above strategies are useful for the surface and ground water management. The combination of population growth, environmental degradation, climatic change bring new challenges to water management and regulation (Ramboll 2010).These challenges could be met successfully by proper urban development plans. High irrigation demands and polluted drainage flows from agriculture mean less fresh water for drinking or industrial use. Contaminated municipal and industrial waste water pollutes rivers and threatens ecosystems. If water has to be left in a river to protect fisheries and ecosystems less can be diverted to grow crops. Therefore domestic consumers cannot waste water.

Application of the National Water Planning in Jordan

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Keywords: nationl water master plan, land-use planning, water information system, WEAP, water management

Introduction/Problem Identification

Jordan is considered to be one of the four poorest countries worldwide in water resources and has a population growth rate of about 2.2% in 2009, the available renewable water resources are dropping drastically to an annual per capita share of about 150 m^3 in recent years, compared to 3600 m^3/cap/a in 1946. Competition between demands on limited fresh water quantities is ever increasing. Currently irrigated agriculture is the largest consumer constituting around 63% of the overall uses compared to only 37% for municipal, industrial and tourism (MIT) purposes.

The expanding population and the thus accelerated urbanisation in combination with the climatic and topographical conditions of the country have caused enormous pressure on the limited water resources and created a severe water supply-demand imbalance with high deficits. Competition between demands for the limited fresh water quantities between the different water users is increasing.

Analysis/Results and Implications for Policy and/or Research

Due to severe water shortage and the challenges that Jordan is facing in its water sector a common planning framework is needed to better manage our water resources and to safeguard that resources are available for future generation. This framework is given by the Water Master Plan.

The Formulation of a Digital Water Master Plan (DNWMP) is performed by the Ministry of Water and Irrigation in close cooperation with the German International Cooperation GIZ. This Plan provides a framework for the future development of the water sector, and helps assessing future impacts of measures in the water sector and supply projects on the water budget and proposes solutions for achieving a balance between available water resources and demand managment, thus assuring the availability of sufficient water supply to all users.

The DNWMP of 2004 was based on a set of interactive software modules applied to forecast water resources and demands for future development scenarios the so-called the Digital Planning Tools. These forecasts were using recent monitoring data as a starting point from the Water Information System. The results were stored into a Scenario Tables Pool (STP), which is part of the central ORACLE database administered under the WIS (water information system). From there, the information on future resources and demands is taken for nation-wide water balancing.

Currently the National Water Master Plan Directorate in the Ministy is approaching the evalutation of the future water resources, the water demand, balancing, allocation and transfer using WEAP as a sophisticated planning tool which has been implemented internationally in many countries and it was selected after thorough investigation for an appropriate tool to fulfil all the requirements of NWMP-directorate to enhance strategic water resource management and planning.

The Water Resource Evaluation and Planning Tool (WEAP) which was selected is supported by different institutions (GIZ, BGR, ACSAD, SEI and others), the work is done by two consultants (External & local) in close cooperation with the WEAP team of the Ministry.

The approach of this new tool is to build up detailed models for surface water basins level. Thus the necessary water information can be allocated and ditributed to the national water management units inside the basins which are the governorates. Thus the output of any planning scenarios will achieved be per surface water basins but also on governorate level. WEAP-models of Amman Zarqa Basin, Azraq-basin and Jordan Valley have been prepared. The Yarmouk River Basin model is in process.

The aggregation of the basin models to one model for the whole country will be implemented after finalising all the basins models. In addition to that an economic optimisation tool will be integrated into WEAP based on the fixed and variable costs of the water abstraction and water transfer between managment units. This approach will help in evaluating the efects of the big future water supply projects in Jordan such as the Disi-conveyor and the possibilities in re-allocating water to different uses and areas.

Complex Interactions across the Water and Sanitation Domains in a Coastal City: Some 3-D Perspectives from Kochi, Southern India

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Keywords: coastal cities, water, sanitation, drainage, ecology

Introduction/Problem Identification

The City of Kochi, in Southern India is a fast growing and a major tourist hub for the State of Kerala, dubbed in tourism promotions as "God's Own Country. An ancient coastal port city with a backdrop of spectacular backwater systems, and Kerala's other exotic attractions, the City is a mecca for visitors from overseas. At the same time, Kochi faces a host of 3-D risks to its water resources and systems, hidden sanitation and drainage challenges, as well as a host of related resources, institutional and management complexities which will require coordinated efforts and responses at multiple levels to address. Among the critical unseen issues Kochi faces is a high groundwater level, and barely 5 percent of Kochi's municipal areas being sewered – with the rest of the city depending on some form of on-site sanitation or other, mainly septic tanks, these pose a major risk to the canals and backwater systems and ground water.

Analysis/Results and Implications for Policy and/or Research

The municipal limits under the Corporation of Kochi covers an area of 94.88 sq. Km and a population density of 6,300 persons per sq. km compared to an average population density of 819 persons per sq. km. in the state; total population in 2001 in the CoC area was around 6 million, expected to go up to 6.4 million by 2021.

Primary source of water in this area is the Periyar River, which is located approximately 20 kilometres northeast of the municipal area. With high humidity ranges and average annual rainfall of 2900 mm, the city experiences two distinct periods of higher than average rainfall from June to August and October to November. But with ageing infrastructure under considerable pressure, current supply of water to many areas in the city is limited and distribution is uneven. Duration of water supply across the municipal limits ranges anywhere from ½ hour per day to eight hours per day, and with water quality problems reported from many areas. About 25% of the industries of the state located along the banks of River Periyar and concentration of these is within a stretch of 5 km in the Eloor-Edayar area, only 10 km north of Kochi port. These depend on the river for intake of process water and disposal of effluents. Most physiochemical water quality parameters exceed desirable limits of downstream stations during all the seasons. Bacteriological analysis carried clearly indicates the microbial contamination of the river. Likewise, surveys of groundwater carried out by the CPCB show the following results for Kochi. The bacteriological analysis of the samples collected from the metropolitan city of Kochi indicates bacterial contamination at few sites. Two samples even exceed the permissible limit for drinking water and are not suitable for drinking water. Some amount of pesticide concentrations too have been found beyond permissible limits.

The present drainage system depends on canals as primary drainage source, secondary drains which discharge to primary canals or backwaters, the drain along road sides are the area drains with or without covering slabs. They discharge directly into road side area drains these drains are silted to very high degree and clogged due to solid waste especially plastics and construction debris. The city has a large network of area drains, which act as major storm water receivers. There is no regular pattern for this and lies along small roads and bye lines. The area drains are absent in many of the areas especially in areas with urban proliferation, leading to serious water logging in the monsoon season. Additionally, only about 5 percent of the city is sewered (and part of this network is dysfunctional); the City generates about 190 MLD of sewage, but only has a 4.45 MLD treatment facility. Since only 5% of the city is covered by the existing sewerage network, and considering the fact that almost every household excepting a few in certain slum areas have a toilet, 95% of the city is dependent upon some form of on-site sanitation facility. Typically, wastewater from households is routed to a septic tank. Since the water table is so high in Kochi, the soak pits connected to septic tanks are ineffective. Due to this, many households have directly connected their septic tanks to nearby drains and canals. With no clear institutional responsibility of on-site sanitation, this sector is virtually unregulated, and management of septage is a grey area. Transportation and dumping is a huge problem, as land is scarce and there is no designated area for septage disposal. As a result, septage is usually illegally dumped in any open space, typically in some type of water body.

Kochi is also a coastal settlement interspersed with backwater systems inseparably linked with wetlands of Vembanad estuary. Large-scale reclamation of land has reduced the area occupied by water bodies, putting a strain on the water resources as well as ecological balance of the region. The human intervention in the Vembanad Lake area, reclamation of wetlands for agriculture, development of the Kochi harbour and industries north of the estuary, development of hydraulic barriers during 1976-82 and other such anthropogenic activities have lead to pollution and declining bio-resources of the estuary. The exchange volume of the estuary has also reduced from 125 Mm^3/tidal cycle during 1960 to 35 Mm^3/tidal cycle during 1985. The eutrophication imposed severe stress on grazing organisms (zooplankton) and ultimately has resulted in the disappearance of many endemic species of fishes from the estuary.

As such, this paper aims to present the multiple and three-dimensional facets of the water and sanitation related complexities in the City of Kochi, the largest urban agglomeration in Kerala, and the state's commercial capital, and then present implications for policy, planning and research.

Workshop 2: Need for a Paradigm Shift: New Technologies and New Lifestyles

Prepaid Water Meter (PWM), a Matter of Debate (Assessment Study for a Pilot Project in the Palestinian Water Sector)

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Keywords: prepaid water meter PWM, cost recovery, water right, water demand management, Palestinian water sector

Introduction/Problem Identification

Prepaid Water Meter (PWM) brings a large debate, this new technology as one of the potential Cost Recovery and easy-to use practices certainly emerges a number of important challenges and questions regarding the influence on the water demand management and the effects on residents, particularly in the poor communities. Yet, with the limited use, as well as the lake of comprehensive comparable studies, critical investigation and cost benefit analysis, the concerned specialist, influenced and relevant stakeholders were found divided between support, approve and opposition. In our case, the use of PWM in Palestine is consider as a pilot project and reflects an individual attempt to solve part of the water problem; low water revenue collection with outstanding increasing debt (high percentage of non-payment). In September 2010 a year passes since first PWM – more than 1000 PWM in the first phase-implemented in Northwest villages in Jenin District north of West Bank, to be worth a comprehensive study and put under light spot.

Analysis/Results and Implications for Policy and/or Research

The research gives a big deal to a household interview (based on questionnaire) conducted on the study area. The aim is to revise this pioneer experience of using the PWM, hoping that this report will offer useful information and lessons. The response to the PWM implantation was oriented and subjective to the earlier water supply condition and biased on the functional role; consumers, providers and authorities. It is risky to implement a non-know new metering concept without having convincing data, legal affirm and General Technical Specification for the PWM. It obliges the authorities to create a system with clear regulatory legislative framework along with monitoring institution. It is highly recommended to continue this study, to expand the survey including all the cases in the Palestinian society to initiate a 'Knowhow' on the PWM.

This works does not aim to support nor strengthening resistance to the logic of PWM, it aims to contribute to the access to evidence and recommendations illustrate the effects of using this new technology, and give a brief to the stakeholders for any future similar cases in the coming PWA projects.

Invigorating Strategy Design and Organisational Adaptability in Government Water Agencies in Response to Critical Uncertainties

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Keywords: water futures, adaptability, critical uncertainties, scenarios, strategic planning

Introduction/Problem Identification

Flaws in strategy development: In terms of strategy development and planning, forecasting methodologies are commonly used by water utilities to establish expected targets for supply volumes, population increases, water demand and infrastructure expenditure. Typically these forecasts use a baseline with 'easy to manage' +/- variables used within the target range and utility planning then establishes policy and strategy to fit their expected future outcomes. Forecasting is by nature a 'predictive' approach that when used within strategy and planning development, frame the Organisation's future operating conditions. Within short term time frames of less than two years, forecasting can play a useful part in guiding a number of actions undertaken by Water Utilities. But even within that time frame, and certainly beyond it, climate variabilities and other factors quickly render Organisational strategy obsolete and in many cases, even harmful to to the Organisation's desired outcomes.

Analysis/Results and Implications for Policy and/or Research

A reliance on the commonly used forecasting approach places significant restrictions on the Water Organisation's ability to consider, prepare for and adapt to the unexpected and even non-considered event or events. In such cases, funding infrastructure upgrades, managing restricted or excessive water availability and responding to sudden spikes in consumer demand is severely hampered by strategy that had been developed for a far more predictable (and agreeable) future.

This paper assesses the use of the Accelerated Scenario process (ASp) by Central Highlands Water, a semi-autonomous Government agency charged with supplying water to over 120,000 people across a wide geographic landscape in Victoria, Australia. Unlike other scenario based assessments, the ASp ties the longer range future assessments to specific actions that an Organisation can take today. In doing so it enables the Water Utility to accept the need for and build up its adaptive capacity across a range of future potential outcomes. A Strategic Planning team can generate an array of potential Organisational responses to both consistent developments and rapid events using an Environmental Scanning approach which leverages community, Government and Organisational inputs, maintaining alertness to signs of potential change in their operating conditions.

For Central Highlands Water the ongoing results from the process have been widespread with significant improvements to the way in which strategy is developed and resources are used in response to changing conditions. Indeed in recent months our operating conditions have shifted dramatically from severe restrictions on usage, to an abundance not seen for over a decade.

The ASp is not specific to CHW and its steps can be readily replicated across geographic locations and operating conditions and regardless of the size of the entity looking to develop better strategic thinking around their water assets and management. As this paper shows, the process is an innovative step that takes future assessments and ties them specifically to actions for today. It is an ideal way for Water agencies to generate strategy more able to adapt to a wide variation in conditions both internally and externally driven across equitable service delivery, meeting demands of urban growth, adaptability to climate variabilities, responding to new lifestyle demands and to improving responsiveness to social contexts in how we perform as an Organisation.

The Use of TDEM and CVES to Map Groundwater Salinity in the Barotse Sub-basin, Zambia

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Keywords: TDEM, CVES, groundwater, salinity, geophysics

Introduction/Problem Identification

This paper describes the results from the application of two geophysical exploration techniques (Time Domain Electromagnetic (TDEM) and Continuous Vertical Electrical Sounding (CVES) that have proved effective in mapping groundwater salinity variations within the sedimentary formations of the Barotse sub-basin in the Western Province of Zambia. TDEM was used to map groundwater salinity variations on a regional scale, while CVES was used at the local scale, in combination with TDEM, to investigate freshwater-saltwater distribution in an ephemeral river valley.

Analysis/Results and Implications for Policy and/or Research

Regionally, salt water occurrence was shown to be present mainly on the south-eastern portions of the basin, which are situated in a rift that forms a tripe junction with the East African Rift Valley. The general geophysical model indicates an aquifer with saline water, having order of magnitude thickness of about 40m with resistivity variations less than 35Ωm (more than 500 mg/l of Cl-based on a formation factor of 5), overlain by an unconfined freshwater aquifer of about 10m thickness with resistivities in excess of 70Ωm (i.e. less than 250 mg/l of Cl-based on a formation factor of 5). It is assumed that the resistivity variations exceeding 150Ωm, underlying the saltwater aquifer, are representing underlying Karoo Basalts or Katanga formations, which may comprise a confined freshwater aquifer. The origin of the saline water is hypothesised to be related to the evapo-concentration of salts in inter-dune deposits, which were subsequently buried due to dune migration about 32 to 4 ka with possible linkages to evaporation of a former Lake Paleo Makgadikgadi, an extensive endorheic lake system that once covered large parts of Southern Africa. Locally, a thin freshwater aquifer was observed in an ephemeral river valley, indicating recent recharge of river water into a pre-existing saline environment. These results imply that the fresh water occurs in the first 10m of the Kalahari system and closer to river valleys. Hence the approach to rural water supply would be to construct shallow water points close to the recharging streams.

Safe and Sufficient Drinking Water in Fast Urbanising India; Meeting Government, Geophysicists, Water Diviners and Barefoot Hydrologists

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Keywords: drinking water quality, sanitation, barefoot hydrologists, groundwater, stakeholder interaction

Introduction/Problem Identification

Aim of the barefoot hydrologist project is a bottom-up approach to sustainable groundwater management in Orissa, India, and in the same time improving the interaction with responsible government departments and other water stakeholders.

In this presentation, we discuss the results of three years of groundwater management practices in Orissa, India. Focus of this research project was on a paradigm shift from finding sufficient groundwater to protecting and maintaining sufficient and clean drinking water. We also discuss the nearly neglected impact of sanitation programmes on drinking water quality. Proper well and lavatory infrastructure siting can reduce this impact considerably.

Analysis/Results and Implications for Policy and/or Research

A better understanding of hydrology and groundwater flow is crucial for efficient siting of wells and determining the interaction with sanitation service points. This understanding is particularly important when striving for more (up scaling) and better (sustainable) rural water supply and sanitation. This is now more relevant then ever, because of anticipated trends as a growing population and climate change. These trends are major threats for water supply, as they cause: (1) increased pollution of the main drinking water resources, through pollution of surface water and groundwater and (2) erratic rainfall patterns and more severe dry years.Since recently, the Government of India also speaks about village water security in its National Rural drinking water policy.

The barefoot hydrologist programme explicitly focuses on achieving long-term impact by better human capacity, tools and understanding of the importance of clean and sufficient groundwater management for improved water supply and sanitation.

Since 1979 the Indian NGO Gram Vikas has been working to bring about sustainable improvement in the quality of life of poor and marginalised communities in Orissa. Orissa's villages are an example for developing areas where agricultural, industrial and urban pollution create major threats to safe and sufficient drinking water. This is why barefoot hydrologists are trained in basics of water behaviour, to understand the influences of agriculture and human influenced pollution on drinking water quality.

The barefoot hydrologist programme is based on 4 pillars: (1) training of barefoot hydrologists, (2) active interaction with water stakeholders, NGO's, governments and research institutes, (3) development and use of a simple water monitoring toolkit and (4) field demonstration projects.

Trained barefoot hydrologists can determine safe new well sites and are responsible for water monitoring (quality and quantity) and proper well management. This fills a gap, which is presently not functioning up to the required efficiency by the government – i.e. local community involvement in designing and maintaining water projects and having a role in quality monitoring.

In bi-lateral contacts and a broad exchange meeting active interaction between water stakeholders, like governmental departments responsible for implementation of water and sanitation service points, research institutes, universities and NGO's working at the grass root level, has been established. This is important to ensure knowledge exchange to ensure that newly developed knowledge actually strengthens initiatives at the grass root level and vice versa.

The developed toolkit is easy to use and contributes both to the practical field work of the barefoot hydrologists and to the understanding of so far 'invisible' water quality parameters.

During the project the NGO Gram Vikas built up a stronger responsibility towards water quality issues and gained a better position in relation to government responsibilities.

Seawater Desalination and Water Purification Technology Harnessing over 200 Degree Celsius from Direct Concentrating Solar Thermal Energy

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Keywords: seawater desalination, water purification, concentrating solar thermal, evaporating, condensing

Introduction/Problem Identification

WHO and UNICEF report everyday over 3,900 children are dying because of water-borne disease. To reduce this mortality of innocent and helpless children, affordable and reliable seawater desalination and/or water purification device has been demanded urgently. Conventional devices such as Reverse Osmosis Membrane System in the market are like a luxurious Rolls Royce automobile that few extremely rich people can utilise. Unprecedented seawater desalination and water purification device harnessing over 200 degree Celsius from direct concentrating solar thermal energy is like a bicycle which is affordable for most of the people. This is a very simple technology so initial purchasing price and operating and maintenance cost are a fraction of those of conventional devices. Especially, it can be utilised in the remote coastal and island area where no access to grid-line electricity unlike other systems and solve the vicious circle of poverty, water crisis and CO^2 emission.

Analysis/Results and Implications for Policy and/or Research

The seawater desalination and water purification technology harnessing over 200 degree Celsius from direct concentrating solar thermal energy is simply comprised of two main parts, one is a concentrating solar thermal energy device which uses a Concentrating Linear Fresnel lens, Concentrating Fresnel Solar Reflector, Concentrating Parabolic Trough Solar reflector or Parabolic Dish Solar Reflector, etc. and another is a combined pipe made of non-corrosive metal which has three chambers.

The combined pipe has three chambers;

- First chamber where seawater or polluted water flows, boils and evaporates. One surface of the first chamber as a concentrated solar thermal energy absorber is located on the linear focal plane of the Concentrating Solar Thermal energy device.
- Second chamber where cold, deep seawater flows, and its low temperature helps condense the evaporated steam into fresh and purified water rapidly under the sloped ceiling of the first chamber.
- Third chamber for collecting condensed fresh and purified water from the sloped ceiling of the first chamber.
- The first and the third chambers are attached by a partition and its top part has a very narrow opening under the sloped ceiling so the condensed water under the sloped ceiling of the first chamber can pass to the third chamber for fresh water reservoir.

What utilises

Present technology is utilising costless, unlimited, clear solar thermal energy and an unprecedented Combined Pipe for low capital cost, low producing and maintenance cost Seawater Desalination and Water Purification facility unlike the conventional Seawater RO membrane system and the MSF, MED Distillation systems which are not just the huge expensive capital-intensive facilities but also consume enormous amount of electric and/or fossil fuel energy to produce water.

How it works

One surface of the first chamber facing the centre of a concentrating solar thermal energy device perpendicularly as an solar thermal energy absorber is located on the elongated linear focal plane of the concentrating solar thermal energy device.

The absorber surface can be reached to over 200 degrees Celsius (392 degree Farenheit) temperature and boils and evaporates seawater or polluted water.

The evaporated steam will become condensed water under the sloped ceiling of the first chamber rapidly by the low temperature of the second chamber where low temperature cold, deep sea water runs as it functions as a condenser and the condensed water flows over the partition of first chamber and third chamber and collected in the third chamber as fresh and purified water.

Application:

- Residential, commercial, agricultural and industrial water supply
- Centralised or decentralised municipal water supply
- Non-gridline-powered coastal and island region water supply
- Domestic, Plant and Mobile sized water supply
- Emergency water supply for disaster area

Expected effect

From the time this product becomes available in the market, reduction from daily mortality of over 3,900 children and helping economy in Africa and reducing enormous fossil fuel consumption world-wide and total amount of carbon dioxide emission to be expected.

In addition, as seawater desalination and water purification cost will be reduced, it will reduce global warming and global shortage of drinking water which are the MDG of UN.

Water Born Recreation in Urban Areas as Link between Ecological Needs and Socio-Economic Wants

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Keywords: water based recreation, cities, catchment, technologies, life style

Introduction/Problem Identification

A still growing global population and the increasing percentage of urban residents is associated with a fast growing urban metabolism worldwide. The growing urban footprint of energy, goods, by-products and wastes in solid, liquid and gaseous form poses a major threat on the urban environment and diminishes quality of life in the cities' hinterlands. Therefore urba people often is forced to find recovery, leisure and quality of life long way away from the city and thus consuming additional resources. This paper deals with the option of converting water bodies close to cities from mere receiving waters into recreational areas using adequate technologies and thereby creating new lifestyle elements.

Analysis/Results and Implications for Policy and/or Research

The unbroken trend of growing urban population worldwide leads to rising pressure on the urban environment and on urban hinterlands. More and more material and energy resources are consumed, more exhaust fumes, more waste and waste water are generated and released to the remaining natural systems. Thus urban comfort is achieved at the cost of its hinterlands as long as cities are considered as throughput systems. Because growing economic activities in the cities are connected with rising noise, heat, dust, smell, etc., increasing efforts are performed to insulate the working or living place within the city from the urban environmental conditions (heat: air condition; noise: special window glasses; air pollution: filter technologies; polluted water bodies: swimming pools; etc.). Because these technical solutions only prove limited success, recovery, leisure or quality of life increasingly are sought and found long way away from the city. This local division of creative and recreational phases of living consumes additional resources (e.g. construction and operation of holiday villages, additional traffic volume).

The impacts of the present way of today's "way of life" in big cities on water resources of the related catchment area(s) are twice: On one hand, urban dwellers exploit fresh water resources upstream the city for their domestic and industrial activities. In cities under arid or semiarid climatic conditions this leads already today to a situation of severe water stress or water scarcity where rivers run dry and ground water tables are falling (see examples of Californian cities, of Santiago de Chile or Urumqi in China). The situation will worsen in many parts of the world if – as a result of global climate change – the quantity of water resources will decrease in the future e.g. in regions where water supply is depending on snow fields and glaciers in mountain areas. On the other hand, cities release an enormous amount of sewage with a huge negative impact on receiving waters downstream. One example for this is the Bogotá river downstream the Columbian capital. But even in the developed world rivers are no longer apt for recreation due to microbial contamination resulting from conventional waste water systems with incomplete treatment in purifications plants and combined sewage overflow events.

One option to bridge the obvious gap between socio-economic demands within the cities and ecologic needs in the serving catchment areas is to transfer water courses close to the city into recreational areas where – among others – swimming can be permitted. In the case of Santiago de Chile it could be shown (Stork 2010) that a suchlike transformation of the Maipo river by a cascade of smaller dams close to the city could combine several positive effects:

- Sedimentation of gravel (important building material in a growing megacity) in the upper basins
- Establishment of a recreational area for bathing, surfing, canoeing… close to the city in the lower basins
- Use of renewable energy (hydropower)
- Reduce speed of river run off
- Increased ground water infiltration
- Upgrading of the parts of the city close to the river which today are less wealthy
- Avoids or reduces recreational traffic between the city and the Pacific ocean

In case of cities and villages along the Neckar river in the south-west of Germany the reestablishment of the river as a water body for recreation could not only improve considerably the quality of life but could also make a relevant contribution to ease the communal budgets for construction and operation of public swimming pools.

In both cases river based recreation close to the city create new life style elements. Because of the required bathing quality of the water body ecological needs and some socio economic wants can be achieved together. With respect to cultural habits sometimes people have to get used to rivers as water bodies for swimming. As far as technologies are concerned the whole water based urban metabolism should be converted gradually from a throughput system into a network of reuse and recycling of the different water qualities including new technologies for storm water management, waste water treatment and irrigation. This paradigm shift concerning the role of water within urban settlements can't be performed within the water sector separately but implies an integrated urban planning and management because there exist very close relations to other urban sectors e.g. to land use management, traffic systems and waste management.

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Exploring the Effectiveness Community Health Clubs for Improving Water, Sanitation and Hygiene Conditions in Rural Areas. Case of Zaka District

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Keywords: community, health, participatory, hygiene, sanitation

Introduction/Problem Identification

Participatory approaches were first used in the water sector in the 1980s as a means of community mobilisation. A Community Health Club (CHC) is a community based organisation constituted by men and women dedicated to improving the health and welfare of the community through common knowledge, common understanding and the practice of safe hygiene in the home which leads to common unity and welfare. Promotion of interactive learning is critical to the CHC methodology and this is led by an acceptable community based facilitator. Experience from refugee camps in Uganda and informal settlements in urban South Africa has shown that Community Health Clubs are effective modes for changing knowledge, attitude and practices on health issues. Zaka district a typical semi-arid Karanga smallholder mountainous farming area receiving erratic rainfall averaging 6–800 mm/yr was selected to be study area, it was also one of the district that was hard hit by the cholera pandemic during period 2007-2008.

Analysis/Results and Implications for Policy and/or Research

A baseline study was conducted inorder to assess the need for the Community Health Club approach intervention in Zaka district. A quaestionnaire was designed which sought to assess the knowledge, attitudes, behavour and prcatises of the community people pertaining to issues of health and hygiene. It also assessed the availability of adequate and relevant water and sanitation infrastructure and management committees. The assessment revealed that health and hygiene education among communities was very low and one of the recommendations from the assessments was that there was need to scale it up (IWSD, 2009). About 95% of the people in the community had no toilets and this was largely due to the 2000 cyclone Eline that destroyed their properties including toilets and since then they have never managed to build toilets. There was absence of water point committes and village health workers were there but because of lack of resources they were inactive and very insignificant in the communities. Community leadership which included all the key people in the community was called and trained on participatory health and hygiene for five days. This training aimed to capacitate and sensitise the leadership on the need for good hygiene behaviour, proper sanitation facilities and stimulate the need for establishing health clubs in their respective villages. After four weeks the project team went back to Zaka district and a total of 35 health clubs were formed with a minimum of 9 members and maximum of 51 members in each club. The promoters were then capacitated on the need to have a club constitution. Membership cards with topics of lessons that they could start with, with the assistance of the environmental health technician and the trained village health workers were distributed to the chairs of the clubs. They were encouraged to form dramas, poems about water sanitation and hygiene. Four weeks after this session all health clubs were involved in competitions which included dramas, poems, choir, slogans and prizes were given to the best performers. Attendance to these competitions was outstanding and this was also a platform for community sensitisation on the need for proper hygiene and sanitation. Before exiting the district it was realised that there was peer motivation for improvement of WASH infrastructure in the communities through the construction of water, sanitation and hygiene enabling facilities like pot racks, digging refuse pits and temporary toilets. As a sustainable strategy, the CHCs were already engaged in fundraising activities so as to build toilets for its members. This study was an applied research and the intervention has shown that community health clubs are relevant for every community in a developing country because they reduce communicable diseases through good home hygiene, they modify habitual, detrimental hygiene behaviour through group consensus, they build a 'common unity' of purpose within a community, they empower women in particular to become confident and also they are sustained by communities after exit of donors. Therefore this paper advocates for the use of the community health club approach before implementation of development projects such as water sanitation or food security as it will provide a vehicle for all the development.

Water from Source to Vendors: A Growing Urban Shift in Lifestyle for Coping Water Stress in Nigerian Communities

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Keywords: drinking water, communities, solar disinfection, sand filter, household treatment

Introduction/Problem Identification

The Nigerian Government encourages provision of water supply and sanitation services to be the domain of the Federal, State and Local governments. However, the public sector has not been successful in meeting even half of the targets for residential and commercial users numbering over 85 million in the urban and peri-urban areas. Services are in critically short supply. Many households, often the poor and middle income bracket, end up purchasing water from private vendors when local sources are inadequate. These vendors obtain their source water from boreholes, shallow wells, streams, and unprotected springs and are of low quality. This paper describes the methods recommended to the communities to treat their water whether obtained from the sources or from the vendors in their homes. As a result, there have been increased episodes of diarrhoea and typhoid. This paper describes results of a comprehensive study made in three major Cities in the country selected purposively.

Analysis/Results and Implications for Policy and/or Research

The sampling populations were purposively selcted from Ibadan (involving 375 respondents), Kaduna (875 respondents), Katsina (711) and a town Amassoma (10 respondents) in Niger Delta regionwith a view of finding out water needs, sources, and the water quality deterioration (over 230 samples were analysed) from source to the household. The data was collected through questionnaire, FGD, KII and water sampling and analysis. Experimented were conducted on treatment efficiencies and translated into community application.

The study confirmed that in the four communities, the source waters were shallow boreholes, dug wells, streams and springs. The water quality deteriorated as it reaches the communities in their households particularly with respect to iron, manganese, lead and bacterial indicators. To augment the water demand, these communities depended on the water from the vendors at least for drinking at home and at work places. This is a new accepted trend in the communities in the recent years as evident from the increased sale of sachet water and others. The available water from these vendors is in the form of (a) bottles (of varying volumes 500ml, 1500ml, or 20 litres), (b) sachets sealed at source (500ml), (c) water manually packaged in 300ml or 500ml polyfilm sachets and tied and (d) bulk supply of water through 3000 or 5000 litre tankers (less or least expensive). While water supplied by (a) group from multinational companies is fairly good, these are very expensive and patronised mostly by upper socio-economic group of the communities; those supplied from (b), (c), and (d) are unhygienic and contain various pollutants including toxic chemicals (lead, fluoride) and faecal coliforms and are most patronised for other socio-economic strata.

Water supply services, where they exist, are unreliable and of low quality and are not sustainable because of poor management, operation and pricing and failure to recover costs. Many water supply systems show extensive deterioration and poor utilisation of existing capacities, due to under-maintenance and lack of funds for operation. Our studies further indicated that while there is need for maintaining the general sanitary conditions at the households, a very important factor is the hygiene maintenance during storage, during drawing of water and frequency of cleaning the storage pots. Where communities draw water directly from a community sources, they should re-treat the water in the household using methods like domestic sand filter, solar radiation and use of Moringa seed extract, and / or a combination of these. Where possible, use of simple chlorination will be economically viable and sustainable. In this context, we developed a simple household sand filter with locally available materials which was field tested and found adaptable in the communities. This method, though improved the quality from physicochemical point of view, bacteriological quality was still unsatisfactory and therefore was supplemented with solar disinfection devices which were accepted in the comminities with various cultural backgrounds.

It was observed that while using bottled or sachet water, they should be disinfected by exposing to solar radiation at least for 6 to 7 hours. This method was promoted among the vendors who were advised to expose their water to sun light either on the roof tops or on the wall surfaces prior to sales. This practice promoted the destruction of faecal and other coliform organisms to zero. Even when the day light is scanty or cloudy, the effectiveness was significant. The communities in turn were also advised to expose their water bought from the vendors to sunlight, a day prior to their use. We are encouraging these practices in the communities and institutions through training programmes, models and awareness programmes. A feedback from the communities revealed that they were adopting and promoting in their neighbourhood.

Socio-economic Consequences of the Groundwater Pollution on Socially Deprived Communities: Remediation of Groundwater Resources

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Keywords: groundwater pollution, textile effluent, plume, well head protection, socio-economic impact

Introduction/Problem Identification

Domestic and industrial wastes disposed both in liquid and solid forms in land and water bodies percolate into the groundwater and get transported in the direction of groundwater flow. As a result, different pollutants reach into the groundwater system and pose a threat to groundwater quality, which ultimately affects the socio-economic life of the people, who depend on groundwater for various purposes. The Orathupalayam reservoir is constructed across the river noyyal receives effluents from about 750 dyeing and bleaching units located in Tiruppur which discharges around 85 MLD of untreated or partially treated effluents. In course of time, this reservoir became highly polluted and the water stored at reservoir was rendered unfit for irrigation and fisheries owing to the high TDS and other pollutants. Hence, a study was carried out to study the socio economic consequences of the groundwater pollution, particularly the poor and the socially deprived communities.

Analysis/Results and Implications for Policy and/or Research

The sampling locations were identified using groundwater flow and contaminant modeling for effectively locating the boundaries of the plume formation. The water in the wells in and around the peripheries of this plume formation, numbering about 50, was tested for the extent of groundwater pollution. The quality of groundwater was analysed in and around the reservoir which reveals that it falls under highly polluted zone. The socio economic conditions were enumerated through a socio-economic survey of the affected 10 villages. The PRA tools and focus group discussion were adopted for the survey. The results of this survey indicates that the Fishing has dwindled, agriculture has been affected, drinking and domestic water has become extremely difficult to access, people face health problems due to the pollutants in the water, and unemployment and migration have escalated. The research identified the techniques for reducing the plume formation and arresting its expansion in further by involving the affected people, the effluent producers and the monitoing authorities through a public Private partnership with the involvement of local stakeholders for improving the socio-economic conditions of the socially deprived communities.

This case highlights conflicts – between industrialisation and ecological sustainability, between industrial development and people's livelihoods – and the need to achieve a balance.

Water for an Urban Cradle-to-Cradle Resource Management

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Keywords: sustainable sanitation, sustainable urban drainage sys, mass flow management, cradle to cradle, household centred approach

Introduction/Problem Identification

We face increasing water scarcity, phosphorus depletion and environmental damages due to steadily growing production of reactive nitrogen: urban water use plays a significant role here. On the other hand increasingly extreme rainfall events overstress our urban water infrastructure and threaten our settlements and aquatic environment. Innovative technologies and system approaches in urban sustainable water management, allowing reuse of water and nutrients, have been developed but need further research and trans-disciplinary integration.

Given the threat of climate change and modified patterns of water availability or pressure, this paper is striving to put a new impetus to our dealing with the challenges presented to water in the urban context. The expertise of water experts, architects, urban planners, agronomists, sociologists and economists is used to develop cradle to cradle concepts turning waste into resources and working towards zero emission sustainable systems.

Analysis/Results and Implications for Policy and/or Research

Many European countries, especially along the Mediterranean shore, experience water scarcity, not least due to climate change, and suffer from shortages to the point of considering recycling wastewater for potable use. Population fluctuations and changes in user behaviour cause large variations in water demand and consequently serious problems to water utilities. Farmers are confronted with the depletion of the world phosphorus reserves while coastal zones are degraded by the input of nitrogen from sewer outlets and land erosion. Architects are appalled by the destruction caused to the environment by our infrastructure and seek to develop restorative buildings and settlements. Wastewater contains water, nutrients and energy, which widely remain unused.

Endeavours in the building sector so far nevertheless mainly target energy efficiency. Research about "restorative buildings" in Australia, "green buildings" in Europe, America or Asia lack the aspect of re-using nutrients from human excreta for food production while Sustainable Urban Drainage Systems (SUDS) focus on stormwater alone.

The examples show that in order to reduce the urban footprint an integrated multi-disciplinary approach has to be used. Experts from various disciplines ought to combine their knowledge to identify links between and beyond water sectors and mobilise synergies along these links in order to realise cradle-to-cradle solutions of an urban water infrastructure with a maximum positive impact on the environment and relying on exclusively reusable or renewable resources.

Infrastructure for energy and water supply, as well as waste and wastewater management in contemporary cities are based on complex centralised supply, collection as well as discharge and disposal systems – most of them representing end-of-pipe-solutions. They still mainly focus on a flow of energy and substances. Besides the well-known advantages, they have system immanent disadvantages, which are barriers for effective integrated resource management, e.g. inflexibility, high implementation cost, slow adaptation to changing technologies. Hence, enhancing the efficiency of centralised systems cannot solve the basic problems. In contrast, the decentralisation of infrastructure systems and an integrated trans-sectoral supply of services instead of materials can contribute to a more sustainable development.

The extent of the global crisis in respect of our natural resources is only beginning to trickle down into the consciousness of society. New ways are necessary to re-connect citizens to nature – also in order to make them more sensitive to a provident handling of natural resources. Urban green spaces, including open water, play a major role in this since they have huge importance and potentials not only in purely ecological (biodiversity) or aesthetic terms but also on a socio-cultural and a health promoting level, documented by various studies. They could and should offer citizens more possibilities for an appropriation of urban space and thus more immediate contact with nature.

For urban agriculture in particular, there is considerable activity that is not being captured or critiqued, while concurrently there is growing demand to know what actions are in place and to gauge their significance. They have yet to be combined with the urban water cycle within a risk management approach.

Cities could be recognised as extremely complex systems with many processes and interactions, a plethora of interests and objectives. As in cleaner production approaches to industry, processes in cities can be rethought along a cradle-to-cradle approach. A goal is to imitate natural cycles within the human built environment and provide two types of cycles, one organic and one industrial, where all materials are constantly kept in use and are not consumed and disposed of.

Presently cities more or less use a common set of infrastructure systems with only a very simple user interface and professional management with a top-down decision making structure. While these systems are subject to evolutionary change, users are not expected to be directly involved. This has changed for solid waste management where source separation has become common practice and is discussed in the energy sector with smart metering and similar appliances. A rapid change and fundamental improvement of our cities towards cradle to cradle flows will not only have to rely on a high acceptance for new approaches but request the participation of users at all levels. This comprises decision-making, with new forms of participatory processes, as well as new operation and management models being explored. This may require on the one hand the active involvement of residents and on the other hand the emergence of new forms of service supplies. Service providers, municipal or private utilities may own decentralised facilities and provide the required services.

Research and Demonstration Appropriate Technology of Rainwater Harvesting for Safety Drinking Water in Northwest Township of China

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Keywords: appropriate technology, safety drinking water, purification equipment, rainwater harvesting, northwest township of China

Introduction/Problem Identification

Project team has accumulated a large amount of laboratory data by collect broadly representative water purification technology existing in the currently market and analysis the rainwater quality, which results showed that: water purification products on the market mainly suit for secondary purification from urban water supply, but not suitable for rainwater harvesting water quality purification, own many disadvantageous, such as high-level management demanding, complex operation and high-cost maintenance and purify-cost per cubic water. Therefore, research and demonstration of rainwater harvesting for drinking water safety technology in Northwest township of China is significance for development sustainable water resource.

Analysis/Results and Implications for Policy and/or Research

The rapid development of rainwater harvesting technology, has led to renewed interest in improving safety drinking water quality. Research is focused on the development of new types of purify equipments by system research and summed up runoff performances and storage structure design to perfect method and standard of rainwater harvesting under the condition of different reliability. The rapid development of rainwater harvesting technology, has led to renewed interest in improving safety drinking water quality. Research is focused on the development of new types of appropriate technology of rainwater harvesting for safety drinking water in northwest township of china,proposed engineering measures for prevent the water from polluted and successfully developed a series of high quality low cost, easy to use,durable and water purification systems, in which key technology net buckets,water purification agent and water purifier filter has the many advantageous, such as contains high technology,low manufacturing cost,long service life, easy to operation and extension. The entire system cost about 2,000 RMB,if it can be produce by industrialisation, the cost can be reduced to less than 1,800 RMB, the purification of water per cubic meter costs only 0.3RMB. The entire system can be used for 30 years, the treated water quality is better than common city tap water. At present, for the aforementioned research results, the three patents pending. This technology can be widely applied to in the township of northwest of China where without good water source and central water supply conditions,as well rainwater harvesting as the only potable water source. The investigation and study has been done by analysis water amount and water quality in the selected representative project area in Gansu province to address safety drinking water in the western region and dispersed rural water catchment protection as the goal, analysis of various decentralised model and management of rainwater harvesting technology, demonstration area and development of small-scale water purification, based on the formation of a Northwest town rainwater harvesting for drinking water safety technology system. More than a year, researchers made a breakthrough model, especially on the aspects of develop the small-scale purification equipment supporting the construction of the development and demonstration has been made to solve the drinking water quality and water amount problems. The resulting social and economic benefits far exceeding the expected goal of our project.

Study on Key Technologies of Multipurpose Utilisation for Urban Rainwater and Flood Water in Loess Plateau

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Keywords: rainwater and flood water, multipurpose utilisation, artificial lake, urban, loess plateau

Introduction/Problem Identification

With growing global water shortages more attentions is being focused on the dual challenges that the global water and related food crisis pose in the 21st century. In response to urban rainwater and flood control has been developed in China with spectacular results.

Analysis/Results and Implications for Policy and/or Research

Research is focused on the relationships between runoff and rainwater, as well as collection efficiency and rainfall, the establishment of rainfall runoff relationship in typical medium-sized city in the Loess Plateau. The groundwater recharges way and the basic laws of lake evaporation and control water quality in the lake has been summed up by in-site test and calculation, the multi-objective integrated technology has been proposed to meet rainwater utilisation and flooding control demands and solve the problems of the modern urban water shortage by launch the multi-functions pilot areas, such as built a city green irrigation, efficient water-saving agriculture irrigation, flood control, soil and water conservation, aquaculture, groundwater recharge, landscape tourism as one of the multi-functional demonstration area for urban use of water resources in the Loess Plateau, to improve the quality of urban management to provide a model for similar areas and the scientific basis for further extension and application. The problem of urban rainwater and flood contradictions has been solved by the construction of artificial lake solution to urban rainwater in the Loess Plateau; The research solved key technical problems, which are the construction of artificial water in urban planning, design, construction, management and other aspects has enriched and developed the theory of urban hydrology, and urban flood control, environmental hydraulics, water treatment technology, water conservancy and construction technology, as well as the innovation in suchfields as water resources and the establishment of this new industry in the planning design methods and standards in Medium and small cities of the Loess Plateau.

Workshop 3: Financing Urban Infrastructure

Financing Sustainable Urban Infrastructure in Africa's Secondary Towns: A New Approach Using an Integrated Financial Model in Ethiopia

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Keywords: financing sustainable urban in, social sustainability, secondary cities in Africa, Ethiopia, affordability of infrastructur

Introduction/Problem Identification

This paper traces the evolution of a new approach to the financial management of urban infrastructure that was developed in Ethiopia. Piloted in 18 secondary towns across the country, the programme looks at the management of urban infrastructure across all services from the perspective of local government. It covers the programme from its initiation in 2004 to its successful implementation in 2009, when the 18 towns initiated their first 3-year rolling programmes of capital investment and on-going management. The success of this programme, and its innovative approach, provides valuable lessons for other secondary towns as well as a replicable and scalable financial model. In addition the paper provides the first practical proposal for re-integrating the financial management of urban water supply into the wider financial management system of urban infrastructure as a whole, arguing that this provides a more sustainable approach than the current one based upon sector-based financing.

Analysis/Results and Implications for Policy and/or Research

In 2003, the Federal Government, with the support of the World Bank, initiated a capacity building programme across all tiers of government. A major component of this study was directed specifically at local government, where its objective was "to start and facilitate the process of building local governments that are financially sound and have the ability and incentives to improve service delivery, especially the poor." Physical infrastructure was a major component of this study and it is this aspect which is explored here.

The programme extended across 18 of Ethiopia's major secondary towns (i.e. the urban areas outside of the capital, Addis Ababa), with populations in the range of 45,000 to 250,000 people. The stated objective was to define the infrastructure base, and its condition; and to develop processes and procedures for rehabilitation, training staff in the municipalities to develop project and financial management skills that would enable them to develop capital investment plans for individual projects, based upon a traditional approach that used conventional economic criteria based upon calculating financial and social rates of return.

The initial analysis of the towns found that they existed within a planning paradigm where there was a negligible understanding of infrastructure, both institutionally and financially, outside of the water departments, and even there management capacity was extremely weak. The first objective was therefore to create an institutional framework and organisational structures that would be capable of providing long-term operational and financial delivery and management of the entire infrastructure base.

This eighteen-month project proved so successful that the Government and the World Bank introduced a follow-on programme, whereby the Bank provided what is termed a 'Specific Purpose Grant' of USD100M to support local government capacity building through investment in infrastructure in the 18 project cities plus Addis Ababa. This required Regional Governments and ULGAs each to provide 20% of the amount awarded in matching funds. By that time though the knowledge of infrastructure, and the capacity to create a realistic budget, meant that the SPG was able to leverage three times the amount in local funds, a figure significantly beyond its donor's initial expectation. In addition ULGAs also made a successful transition from a static 5-year planning process to a much more dynamic 3-year rolling investment programme.

Finally, this project raised important issues about the relationship between the financing of water and sanitation and the financing of other urban infrastructure. For whereas the World Bank and the Water and Sanitation Programme (WSP) sought to separate these, placing both water and sanitation financing is separate silos, the ULGAs argued strongly for an approach that integrated them with other infrastructure services. That debate is described in the paper.

There were two external factors that contributed to the success of this programme. The first was that it was accompanied by a reform of municipal financing, which enabled the cities to identify income sources and mange cash flows more effectively. The second was the support given to the Government by the German Agency GIZ, through its Urban Governance and Decentralization Programme. At the same time though the project also showed that capacity building will only be effective if the underlying development construct is appropriate. If this construct is flawed then even the best capacity building programme will have great difficulty in achieving its objective, as the Bank discovered in its parallel Water Supply Investment Programme.

There has to be the right conceptual development framework in place: this is the real key to success. In this project there were five critical innovative elements that underpinned the conceptual model:

1. The Government's decentralisation strategy, which gave legal powers to the ULGAs for all infrastructure services, through Regional Urban Proclamations.
2. An integrated approach to the financial management of urban infrastructure, independent of who actually operated the various services, with a single financial management plan.
3. A completely new approach to asset management, building an innovative methodology specifically suited to Ethiopian needs. This represented a major break with conventional thinking on capital investment planning, which is project based and relies upon defining a positive Rate of Return on investment.
4. A radical shift in the way that affordability is conceived, moving this from the level of the individual to that of the ULGA as a whole. Below that there is social equity at the level of the individual. This again was aided by the fact that the Government is committed to a socially equitable approach.
5. A shift from a delivery-based approach built around targets to a systemic approach that looked at overall management across a life cycle.

Quality Drinking Water from Economically Sustainable Municipal Infrastructure: Examples from Aguaclara in Honduras

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Keywords: drinking water, centralised treatment, economic sustainability, urban infrastructure, developing countries

Introduction/Problem Identification

Surface water is an important drinking water source for many cities and towns, but water treatment is often inadequate or nonexistent in the developing world. Improperly treated surface water is responsible for a large portion of the global health burden caused by poor water quality.

Townships and cities are growing rapidly around the world, but the development of safe, sustainable, adequate and equitable water treatment has lagged behind. Centralised water plants are common in developed nations but prone to failure in the Global South because of shortfalls in technology, finance, and governance. Point-of-use options also exist, but they are often hampered by low usage rates even when they are technically effective.

The AguaClara programme has demonstrated a novel approach to municipal water treatment with projects in Honduras. In this model, engineering innovation and good governance are combined to produce effective and economically viable infrastructure at the municipal scale.

Analysis/Results and Implications for Policy and/or Research

The technical effectiveness, economic sustainability, and social acceptability of water infrastructure are highly interrelated. Infrastructure that is well engineered may fail if the institutional structures to implement it are not effective. At the same time, even a well organised project may fail because of prohibitive operating costs. Experience in practice suggests that both of these problems are widespread in the area of drinking water treatment in the developing world.

The economic sustainability of an infrastructure system may be understood in terms of a break-even analysis: the consumer willingness to pay (WTP) for the service (as manifest in tariffs or service fees) must at least equal the average total cost per consumer. The quality of service largely determines the WTP – research has shown that beneficiaries in many areas consider water to be inexpensive, and consumer preference is often an improvement in water quality over quantity. As a result, urban water systems that distribute untreated surface water often struggle to raise enough money for maintenance, even with relatively low costs per customer. On the other hand, mechanised water treatment plants capable of delivering quality water often fall into disrepair because their O&M costs are too high, even when customers are willing to pay higher service fees for quality. Some point-of-use technologies fall victim to a similar problem: household water treatment devices may be left unused when the customer considers the economic cost, including the accounting cost for materials and maintenance and the opportunity cost of time to treat the water, to exceed the benefit from using the device.

The AguaClara programme seeks to surmount the obstacles facing municipal scale water treatment in the developing world through a combination of innovative technology and good governance. Several flocculation/sedimentation plants have been implemented in Central America, and good results to date suggest that these projects are effectively addressing the twin challenges of water infrastructure: providing good quality service while keeping costs low enough to be affordable and sustainable in context.

The physical facilities are one important component of this solution. Over the past five years, AguaClara has designed and helped to implement five water treatment plants in Honduras, in large towns and small cities including Ojojona, Amarateca, Agalteca, and Támara in the Francisco Morazán department and Marcala in the La Paz department. These facilities range from 6 to 30 L/s capacity, and serve a total population of approximately 15,000. They do not use electricity to treat the water but rely on innovative hydraulic designs to carry out the unit processes of coagulant addition, rapid mix, flocculation, sedimentation, and disinfection. These plants have succeeded in taking water with turbidity up to 750 nephelometric turbidity units (NTU) and treating it to meet World Health Organization standards for clarity, color, fecal bacteria, and residual chlorine. The success of the plants so far has generated proposals for new facilities in other cities in Honduras and elsewhere in Central America.

The organisation and governance of the projects are also important to their success, and community capacity building is a major focus. The capital cost of a new plant, which ranges from $10 to $30 per customer, is funded through outside donations and recipient community contributions, and the construction of the plant employs local labor and materials and is coordinated by in-country partner organisations and contractors. From the beginning of the project, the beneficiary community takes ownership of their infrastructure. Longevity of the plant is further ensured by knowledge transfer – once the plant is built, community education and training of full-time plant operators become a priority. Throughout implementation, AguaClara assists in the strengthening of a municipal level Water Board. This board has the final responsibility for the plant: they set and collect service fees, employ plant operators, and oversee the operation and maintenance of the facility. They receive ongoing support in this task from in-country partner organisations.

Experience suggests that these projects are economically sustainable, as the Water Boards have continued to operate the plants effectively. Operation and maintenance costs have been observed in the range of $20 per household per year, which is lower than the cost required to run a comparable mechanised facility. The monthly water service fees in AguaClara communities have risen on average from $1.80 per household before AguaClara implementation to $3 per household post-implementation. However, customers claim to accept paying the additional fees for higher quality water. Fewer people are avoiding their payments since the AguaClara plants were built, and interviews with customers suggest that they consider rates to be fair.

African Finance Facility to Mobilise Sustainable Local Finance for Water and Sanitation for All

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Keywords: sustainable finance, pan African bank, investment fund, Africa, bottom of the pyramid

Introduction/Problem Identification

Investing in sanitation brings very significant economic returns. The Global Water Partnership (GWP) estimates that the expenditure for basic sanitation to meet the 2015 MDG sanitation target is USD 17 billion annually. This indicates a significant deficit in the current funding allocation.

The lack of a commercial market for sanitation services undermines the sustainability of the sector. Sanitation is often seen as a field with low creditworthiness and low potential for income generation and aid programmes and governments may lack the focus on policies and incentives that make sanitation services more attractive for the commercial sector. A recent studies found that the reach of the private sector was a significant factor in improving the cost effectiveness and scale of programmes.

There is a need for smart investments, initiatives that develop the market at the bottom of the pyramid and initiatives that facilitate local business development and entrepreneurship.

Analysis/Results and Implications for Policy and/or Research

Many entrepreneurs operate in the water and sanitation, often at the BOP and of the market. These entrepreneurs possess the skills essential to operating a successful though often marginal business: personal motivation and incentive; high risk tolerance; a good knowledge of their products, markets, and competition; the ability to learn from failure; and a passion to succeed. Unfortunately these (informal) entrepreneurs are poorly acknowledged or even "invisible", although their work provides municipalities in developing countries good opportunities for up-scaling of water and sanitation services for the poor.

Local private initiatives are not supported by the conventional supply chains, including the financial sector. The reason is not so much a lack of funding: many local financial institutions record excess liquidity. Local financiers have the the perception that small-scale water and sanitation businesses and products are too risky:

- The watsan sector is unknown for banks; they do not know how to assess the context, the regulation issues and profitability of the SMEs involved (MSME ??)
- Many of the MSMEs involved, even if sustainable, are not capable of producing a presentable bankable proposition
- The obscure image of the sanitation sector,, contributes to limit the access to finance institutions for MSMEs
- Local banks have not internalised the fact that more and more consumers are actually willing and capable to pay for watsan services
- Social constraints, water and sanitation connections do not constitute assets that are seen as can be collateral

Results so far

The issue for new funding mechanisms is understood by a number of donors. In recent years WASTE has experimented with the WASTE Venture Fund which provides guarantees to local banks on (for?) loans to small scale entrepreneurs in waste and sanitation. The lack of financing for small scale water and sanitation is also recognised by the EU / EIB who have requested VITENS, the manager of several EU / EIB funding water projects, to develop ideas on how to fund household water connections. Recently, also UNDP expressed the need for access to financing for water facilities on a household level. Furthermore, Output Based Aid (OBA) programmes of the World Bank are seeking for financial mechanism linked to local finance options.

An opportunity: a Finance Facility

The idea is to establish a Finance Facility at/with an African wide commercial operating bank, a financing instrument supporting and encouraging local (micro)finance banks to invest / lend to entrepreneurs and households working on the improvement or installation of small-scale water and sanitation facilities. The Finance Facility will develop adequate financial instruments (e.g. guarantees, subordinated loans, possibly linked to health insurance such operational in the FINISH project in India) to fulfil its task.

Following the objective formulated in MDG 7, the starting points of the Facility includes:

- Local watsan finance is an important condition for sustainable development and has encouraging effects on the local economies;
- Watsan needs to be linked and directed to society as a whole but especially also at the poorest, the most vulnerable and with various aspects of risk reduction;
- New (improved) forms of public-private partnerships strengthen the capacity of development organisations to respond to the MDGs and the challenges ahead

Water + Work: A Successful Programme of Low-Income Population Participation for Drinking Water Services Expansion in Buenos Aires, Argentina

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Keywords: water infrastructure, marginal areas, drinking water facilities, users participation, Water Works Cooperatives

Introduction/Problem Identification

In 2006, the newly established Buenos Aires and Greater Buenos Aires water and sanitation facility, the State-owned corporate AYSA, faced the challenge of coping with the needs of urban or semi-urban areas lacking water and sanitation services. Currently provides AYSA water and sanitation in an area of 1,800 sq km, with a population of roughly 10,000,000 inhabitants. Of this amount, 80% are connected to the drinking water infrastructure, while 60% are connected to sanitation. Delving into innovative solutions, the water company decided to replace procurement for cooperatives. For this purpose, it set up the Water + Work programme, involving prospective users in infrastructure construction. The programme is organised around the concept that, in order to be successful, the community should participate and cooperate with the initiative. In fact, since 2007 through this programme over 500,000 people have been provided with drinking water infrastructure in the Greater Buenos Aires.

Analysis/Results and Implications for Policy and/or Research

The Buenos Aires water company, AYSA, set up the Water and Work programme in order to accelerate the provision of drinking water to socially depressed areas lacking water and sanitation infrastructure. The Water and Work programme was developed within the institutional framework of the Under Secretary of Water Resources, Secretary of Public Works, Ministry of Federal Planning, Public Investment and Services, of Argentina. While the programme aimed to quickly and efficiently expand the water and sanitation infrastructure to neglected outskirts of the Metropolitan Area, it also fostered awareness, social cohesion and skills, important additional values to the provision of safe water access.

The facility has been in charge of the necessary understanding with the county authorities and proposed the model for a registered association of users organised as a cooperative. It is also in charge of the entire project, the technical feasibility of the infrastructure and the water provision service. The voluntary participants are trained to do the work, under professionals' direction and supervision. There is a school established for that purpose, with model households, and the attendance required is about two weeks. Then, the process allows former unskilled and unemployed people to broaden their jobs opportunities, and this is an additional benefit of the programme. Once the construction starts, each participant receives a salary and social security during the whole process. Pipes, tools and materials, from the households to the mains, are entirely provided by the facility. The installation quality and standards are those of the actual infrastructure of the Buenos Aires Metropolitan area. After the works are tested and approved, the facility provides the water service and takes care of the operation and maintenance of the system. While the infrastructure is free of charge for the forthcoming users, charges for the service are in accordance with the legal framework of the country, which foresees partial or total subsidies according to the social needs of a specific sector. A special legal framework has been drawn to channel payments from the facility to participants. Groups of beneficiaries are organised as Water Works Cooperatives, which receive the payments from the facility, AYSA, once each stage is completed.

In 2007 compacts were entered into with thirteen districts, (Almirante Brown, Avellaneda, Esteban Echeverría, Ezeiza, Hurlingham, Ituzaingó, Lanús, La Matanza, Lomas de Zamora, Morón, Quilmes and Tres de Febrero) in order to implement the programme. According to the figures as of December 2010, 536,319 persons had been connected to the drinking water system, and in one more year the number will almost double, reaching more that 900,000 inhabitants.

The next step will be the programme involving Sanitation + Work, which has started in six districts so far. It is more complex than drinking water infrastructure and requires skilled participants, but even with this shortcoming it will steadily proceed.

Adoption and Implications of Mobile Phone Banking for Urban Water Services in Kenya

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Keywords: Sub-Saharan Africa, mobile banking, mobile bill payments, collection efficiency, urban poor

Introduction/Problem Identification

By 2012, more Africans will have a mobile phone than access to an improved water supply. Whilst this convergence highlights the slow progress being made towards the water MDG in Africa, it is also a tipping point that presents new opportunities to harness mobile technology for more financially sustainable water services throughout the continent.

This paper examines the impact and potential of mobile banking as a means of revenue collection for urban water services in Kenya. Cost recovery is a constant battle for Kenyan water utilities, with $US16.8m worth of bills going uncollected every year. At the same time, the country's mobile phone revolution continues to gather pace, with more than 15 million Kenyans now using mobile banking services. By enabling low-cost money transfers and micro-savings, this platform is dramatically increasing financial inclusion amongst the poor and unbanked, and offers exciting opportunities for innovative payment applications in the water sector.

Analysis/Results and Implications for Policy and/or Research

This study investigates the dynamics of mobile water bill payments, and includes insights from analysis of empirical data from a water supply scheme near Nairobi, and an examination of the broader implications for the African water sector. We reveal the levels of uptake of mobile phone water bill payments, evaluate how the benefits are shared amongst the utility, mobile network operator (MNO) and water users, and discuss the broader opportunities for mobile banking platforms to unlock innovative pro-poor models of water provision in Sub-Saharan Africa.

1. What is the uptake and who adopts mobile bill payments in Kiamumbi?

We evaluate the success of a mobile bill payment option introduced by the Kiamumbi Water Trust (KWT), managers of a piped-water scheme serving 550 households on the outskirts of Nairobi. In December 2010, KWT established an M-Pesa bill pay account with Kenya's leading MNO, Safaricom, enabling households to settle monthly bills via their mobile phones. The strong customer demand for this payment channel arose due to the time and cost associated with the traditional approach to bill payment, which involves a 40-minute round trip on public transport, a wait in a lengthy queue to pay a bank deposit, then presentation of a deposit slip at the KWT offices.

Based upon analysis of billing data, we present the level of mobile bill pay adoption amongst Kiamumbi households, including disaggregation by metered water consumption and bill size. Our findings reveal that within just two months, half of all customers adopted M-Pesa as their preferred payment method, with levels of uptake continuing to grow. Notwithstanding a relatively flat M-Pesa tariff structure, levels of adoption are highest amongst households with lower water bills and thus lower consumption, lending support to the notion that mobile payments offer important benefits for low-income households. On average, those paying with M-Pesa also manage to settle their bills earlier than those paying by bank deposit.

2. Where do the benefits flow?

The introduction of the mobile payment option in Kiamumbi is a win-win-win situation. First, customers enjoy the cost savings both in time and money that are usually incurred when paying by bank deposit. Second, KWT benefits from the automated bill payment information which can be securely accessed via a web-based account and downloaded into the billing database, thereby reducing administrative costs. Moreover, initial data suggests that M-Pesa use leads to timelier bill payments by customers and possible increases in collection efficiency. Third, the MNO draws revenue from transaction fees, as well as other revenue streams associated with the retention of subscribers to their service. The broader continental trend of how these benefits will be distributed amongst MNOs, utilities and consumers remains to be seen, but will no doubt differ according to the local competitive landscape and pre-existing bill payment transaction costs. If and how water service regulators engage in utility-MNO agreements may also influence how the spoils are shared.

3. Unlocking pro-poor models of water provision

It is important to note that only 19% of Kenyans have a household water connection, and thus water users in Kiamumbi are the exception rather than the norm. Nonetheless, for the millions who rely on communal water points such as standpipes and kiosks, mobile banking could open up new models of operation and fee collection. Standpipes are the cheapest way to expand utility services, yet the profit margins of middlemen lead to informal water prices that are often many times higher than water from a household connection. However, when coupled with smart metering technology, mobile banking could provide the gateway for a formal relationship between utility and standpipe user, thereby circumventing middlemen and their mark-ups. This could ensure social tariffs reach the poor, and revenue reaches the utility. The high level of mobile payment adoption in Kiamumbi therefore provides promising signs for the potential of mobile payments to catalyse new modes of pro-poor water provision. With 85% of urban Kenyan households using mobile banking and blanket mobile network coverage in urban areas, an exciting opportunity presents itself to transform the way in which equitable water services are delivered to the urban poor.

Financing Water Projects and Cost Recovery: Kolkata Case Study

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Keywords: bulk supply, floating population, rain water harvesting, water cess, water vendors

Introduction/Problem Identification

The rapidly growing cities of many developing countries suffer from lack of basic services in water and sanitation. Inherent high deficits, replacement of old systems and provision for new growth areas are immediate demands. Limited investments in infrastructure and increasing costs have created difficulties. Kolkata is one of the megacities of Asia with wide spread water borne diseases. The World Health Organization took the initiative to propose a Master Plan for water supply, sewerage and drainage and simultaneously with the help of Ford Foundation, a Basic Development Plan for Calcutta Metropolitan District was prepared. The objectives were to arrest deterioration, preserve existing facilities and make provision for new growth. With help of the World Bank massive investment was made with loan and grant for augmentation of facilities and construction of new water works. By the time issue of cost recovery came up, capital cost, operation and maintenance costs had become very high.

Analysis/Results and Implications for Policy and/or Research

About 25% of people in Kolkata (Calcutta) live in slums and squatter colonies where supply of water is very little. Levying fees for improved services could not be considered. Due to the democratic multiparty system, it was not advisable politically to impose water cess. After completion of the projects municipalities or urban local bodies were asked to take over but they were reluctant. The master plan provided 3 standards which were subsequently revised i.e. about 200 litre per capita per day in central Calcutta municipal areas, 150 lpcd in other areas and 135 lpcd in outlying areas. Some estimates were also made for floating population. But present real estate boom has caused unforeseen severe water problem. Only the bulk supply to industries has yet been charged and there is a recent proposal to get some cost recovery from private housing estates. In outlying areas, individual house owners are being nominally charged for water connection. The older neighbourhoods in central cities suffer from water scarcity due to nonfunctioning of old deep tube wells and ban on new sinkage. While people have to depend on water vendors, rainwater harvesting has been proposed and building rules are being amended but implementation is poor.

The city of Kolkata as other large cities has attracted many people from rural areas who with little or no means of income cannot be charged for water supply. In central of parts of cities, municipalities imposed water tax but withdrew due to political reasons. Installation of water meters has been found to be capital intensive and only in some housing estates fees are being charged. The private developers who sell properties at very high rates are yet to be charged systematically. In most Indian megacities the O&M cost are higher than capital costs.

There is absence of research in cost recovery. The water supply plan is not linked with drainage. The disposal of wastewater is expensive even as some of it could be utilised in irrigation, horticulture and aquaculture. Identification of pockets of scarcity, introduction of rainwater harvesting system and storm water management are some of the long-term plans. Water management in urban local bodies may lead to rationalisation of staffing pattern, include cross subsidy and introduce rational tariff structure to get financial sustainability.

Assessment of Financing Different Sanitation Options for Peri-urban Areas of Temeke Municipality, Dar Es Salaam, Tanzania

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Keywords: peri-urban areas, sanitation options, financial mechanisms, affordability to pay, construction costs

Introduction/Problem Identification

The growth of peri-urban areas in recent years is unprecedented. The problem of sanitation in these areas is critical and complex because of, among others, poor and lack of urban infrastructures. Sanitation plays a central role in achieving all the MDGs and more pertinently the slum target 11 of MDG 7. This is the case with the Temeke Municipality where about 70% of settlements constitute slums with poor sanitation services. Centralised sanitation schemes are very expensive to construct, operate and maintain. Therefore appropriate financial mechanisms for alternative sanitation options are needed. This study was therefore conducted to inventorise the existing sanitation options, to identify the current financial mechanisms for construction, operation and maintenance of the same and explore the potential of alternative financial mechanisms in four peri-urban areas of Temeke municipality using structured and semi-structured questionnaires, interviews and field observations tools

Analysis/Results and Implications for Policy and/or Research

The study showed that 90% of the households in the peri-urban areas of Temeke use pit latrine and 10% use flush toilets. Sludge empting methods were manual hand empting (60%), vacuum truck (25%), and simple mechanical means (10%) while 5% release to natural water way during rains. Using the selection criteria, VIP latrine and Urine diversion dry toilet were identified as the best and appropriate sanitation options while the Mechanical pit empting technology (MAPET), Gulper technology and min vacuum tank were recommended as pit emptying methods. The cost categories that were compared for different sanitation options were construction cost, collection and transportation of sludge to treatment plant and operation and maintenance. These categories resulted into the following costs for different excreta disposal facilities; singe vault ventilated pit latrine (VIP) US$750, single vault urine diversion dry toilet (UDDT) US$ 1230. For more applied excreta disposal facility, the following current financial mechanisms were identified to be operative in the study areas of peri-urban in Temeke which are national authorities, external support agency and regional and local authority, with the type of funding being subsidies, loans, grants and salary payment (7%), private sector which provides loans and financing (23%), NGOs, CBO with the type of funds being grants, soft loan, donations of material, salary payment (47%) and community/user which provides taxes and tariffs constituting (14%) with others which include household contribution and in kind contribution was 9%. For peri-urban areas of Temeke is seen that the main contribution of financial mechanism is NGOs, CBOs followed by private sector and least from regional and local authorities. Furthermore, a willingness to pay for sanitation services analysis reports that 35% of households interviewed are willing to pay in cash for improving sanitation services in their area, 40% are willing to contribute through labour charge (man power) and 25% of the people interviewed are not willing to pay for improving sanitation in their area due to the fact that they are aged and don't have enough money. On affordability to pay analysis, the study shows that few people can afford to pay for sanitation if service is to be provided to them because of low level of income and wages they earn. The current income levels of the residents of peri-urban areas show that capital costs of the sanitation system are unaffordable for the residents, thus low income toilets which promote use of local available materials should be developed, soft loans, government subsidy, public finance and fund mobilisation is needed to improve sanitation in peri-urban areas.

Financial mechanisms that have a potential for future in peri-urban areas of Temeke Municipality include micro credit savings, government subsidy, public financing, and private sector in complimentarily nature. The study concludes that there is no one financial mechanism that suits all sanitation options but a combination of different financial mechanisms is crucial for sustainability of the financial mechanisms. Which model (financial arrangement) is appropriate for a given setting should be considered to be a case specific. It is further recommended that the role of religious groups in financing the sanitation options have to be explored as it has been the case with water supply. The role of private sector has also to be further explored as its contribution is still minimal.

The study is further recommending that the service providers for pit empting should promote low cost technologies which are affordable to the poor people but still meeting the objectives of sustainable sanitation. Financing ways to minimise subsidies, mobilise resources for the motivational and non-hardware aspects of sanitation promotion, should be established. Adequate public finance and fund mobilisation are needed to improve sanitation in peri urban areas like those of Temeke Municipality.

World Financial Crisis and Its Impacts on Ability to Attract Investments into Urban Water Sector – The Case of Ukraine

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Keywords: water, investments, sovereign guarantees, budgets, infrastructure

Introduction/Problem Identification

Paper discusses issues of funding and investments attraction into municipal water sector of Ukraine. Discussed are current state of municipal water services and infrastracture of Ukraine. Analysed are constraints in attraction of investments into the water sector, especially aggravated by the recent world economic crisis which led to absence of loans and credits, radical increase of loans interest rates, especially by local banks, tightening of the budget policy of the country, the need to incrtease water tariffs to socially dangerous level, but which is still not enough to secure self-sufficiency of water sector and its ability to expand, maintain proper level of operation, repair and maintenance. Discussed also are issues of public-private partnership application in Ukraine, which seems to be a good option for investments attraction, but politically and socially is not well accepted,

Analysis/Results and Implications for Policy and/or Research

Global financial crisis has led to decrease in quality and quantity of banking products available in Ukraine, including availability of financial loans for communal and municipal utilities. The main causes of poor development of municipal utilities are the failure to generate required level of profits and inability of many cities and towns to attract credit resources to be secured by their own soverign guarantees.

Current situation. There are 127,400 km of water mains, of which 37,600 km (35%) are in the state of disrepair and need replacement. Sewers network has a length of 37,600 km, of which requiring urgent repairs or replacement are 11,600 kilometers, or 31% of the total. Average daily consumption of drinking water in Ukraine makes up 320 litres per capita. Water losses in the external (street) networks and in-house water losses make up more than 30% and, in some cases, may reach 60% of the volume of water delivered to the system. The level of depreciation of fixed assets is over 60%. There is a need to replace 90% of pumping units, which are outdated and excessively energy consuming. Poor technical conditions pumping equipment causes losses of electricity estimated at 40% of the total supplied to them. Centralised water supply in Ukraine is provided to citizens living in nearly 12.8 million flats and individual houses. Cold water supply and sewerage systems are available to 92,3% of housing stock, hot water supply to 50% of houses. In the recent years, virtually no investments were attracted into municipal water services sector development. Recent analysis, conducted for assessment of the needs of the sector in investments shows that the minimum required investments into the urban water sector is estimated at UAH 10 billion 434 million.

Possible sources of investments. Potential source of funding to the water sector include national and local budgets allocations, loans, obtained from the local banks, bilateral technical support agreements, the World Bank, European Bank for Reconstruction and Development, European Investment Bank, NEFCO Environmental Finance Corporation (NEFCO), German Bank for Reconstruction (KfW) and investments attracted through public-private partnership arrangements. The latter practically do not exist in municipal water sector of Ukraine. Raise of water tariffs has reached quite a high level and, if going up even more it may cause social upheavals.

Problems of investments attraction. Attraction of investments into municipal water services sector faces obstacles, such as:

- Lack of access to credit local credit resources (expensive loans of the "Ukrainian origin", with annual interest rate up to 20-25%;
- Restrictions on the minimum volume of money lending imposed by the international financial institutions;
- Inadequate development of the programmes of socio-economic development of the regions in respect of the needs of the sector (master plans of cities, scheme of water supply, etc.);
- Lack of mechanisms to capitalise municipal utilities (the sector is not represented at the stock markets);
- Low level of profitability of enterprises of the sector (due to tariff policy persued by local governments, poor solvency of the population, high depreciation of fixed assets);
- Poorly developed and regulated forms of private-public partnership in the sector;

Experience in investments attraction. Currently carried are works on implementation of joint investment project supported by EBRD on "Development of water supply and sanitation in the city of Mykolayiv". The project aim is to bring the system of drinking water treatment and supply to customers in compliance with European standards. Total project cost are estimated at Euro 31.08 million, including the EU grant of Euro 3.4 million, own funds – Euro 12.14, the EIB loan – Euro 15.54 million. The authority in charge of the project implementation is the Ministry of Housing and Communal Services of Ukraine, Beneficiary – Municipal communal enterprise «Mykolayivvodokanal, the Borrower – Ukraine, the lender – the European Investment Bank (EIB).

Conclusions

All above-mentioned issues require a comprehensive solution through improvement of budgetary, monetary and fiscal policies of the state. Also what is urgently needed is to develop some mechanisms enabling capitalisation of municipal utilities (through their listing at stock markets). Measures should be taken to improve profitability of the urban water sector through introduction better tariffs, energy saving measures, optimisation of technological processes, better overall management practices. Special attention should be paid to the issue of private-public partnership in the water sector which may need upgrading legal regulations base, better public awareness about this approach and availability of political will, which so far is not really there.

Making Water Affordable to All – A Typology and Evaluation of Options for Urban Water Pricing

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Keywords: water pricing, urban water supply, developing countries, affordability, efficiency

Introduction/Problem Identification

The basic right of all humans to have access to clean water at an affordable price is often emphasised. It implies that prices for urban water supply have to be designed such that the poor are able to satisfy their basic water needs. Very diverse approaches of affordable water prices have been developed in theory and implemented in reality. A comprehensive discussion of these approaches is lacking. This paper provides a review of alternative approaches to address affordability of water and reveals general guidelines for designing urban water prices. For this purpose, the paper first of all derives a typology of water pricing options. Secondly, it discusses to what extent different approaches can address affordability effectively – in theory and in the real world. Thirdly, the paper addresses possible trade-offs between affordability and other criteria guiding water pricing policies.

Analysis/Results and Implications for Policy and/or Research

To guide the discussion of urban water pricing options, an analytical framework is used. This framework introduces the elements of a water pricing system which have to be taken into account to assess the performance of water prices. First of all, the system is characterised by different components of water price design (assessment base, average level, tariff, implementation process). The water pricing system also includes the technological, socio-economic and institutional environment which prevails in urban agglomerations and into which a water price is embedded. Apart from the water pricing system, the framework specifies the criteria for assessing the performance of water prices. Next to affordability, the analysis addresses efficiency (regarding water consumption), financial sustainability (regarding the water supplier's as well as the government's expenditures) and administrative simplicity of each approach.

Along the different components of water price design, the paper develops a typology of urban water price options to address affordability. First of all, options are differentiated with respect to the assessment base. They may either reduce the water bill of a customer (expenditures per connection or consumption) or increase his ability to pay (income transfer irrespective of the actual water use). Secondly, decision-makers may choose an average price level below actual cost. Thirdly, the tariff may be differentiated (e.g., by consumption levels, income, geographical areas or economic activities). Fourthly, affordability may also be addressed by lax enforcement of implemented water prices. Obviously, these different approaches are not exclusive and are combined in many countries.

The performance of all identified pricing options for urban water supply is subsequently evaluated with respect to affordability as well as the other criteria chosen. The analysis is not restricted to a theoretical evaluation but explicitly considers technological, socio-economic and institutional restrictions that may be important in reality. Two examples illustrate the paper's results:

General income transfers which are not directly related to water use and paid in addition to water prices are usually the instrument preferred by economists to address distributional issues. From an affordability perspective they appear promising as they are the only approach which allows supporting the poor irrespectively of whether these are connected to the water network or not. However, income is usually transferred through a social system, and it is often unclear to what extent this system actually covers the poor in reality. Income transfers perform well regarding efficiency as they do not distort the incentives to consume water. Financial sustainability is satisfied for water suppliers as their revenues remain unaffected by the subsidy. However, income transfers may place a significant burden on the government's budget. The most important barrier to implementing income transfers is their lacking administrative simplicity. They require a functioning social system, which is virtually absent in many developing countries.

Increasing block tariffs, an example of price differentiation by consumption levels, are the most common water pricing scheme world-wide. A major rationale behind their implementation is their theoretical advantage with respect to affordability. As consumption is assumed to be positively correlated with income, poor customers are expected to benefit particularly from price discounts for basic consumption levels. However, this tariff scheme usually disregards the number of persons depending on one connection. Since poor families are often larger in size than wealthier ones, increasing block tariffs may actually impair affordability. In fact, poor customers may end up subsidising wealthier ones. Moreover, such tariff differentiation also violates the efficiency requirement of uniform pricing. Theoretically, increasing block tariffs can be designed financially sustainable. Yet, it is often politically difficult for decision-makers to limit the size and price discount for the first block. As a result, revenues from consumption in higher price blocks are often not sufficient to compensate the price discount for the initial blocks. The water supplier is unable to recover its costs and depends on government support. Certainly, one reason for the popularity of increasing block tariffs is their administrative simplicity.

The review in this paper reveals that in order to address affordability effectively, different pricing options may have to be combined. There is no scheme that could be labelled as generally "optimal". The choice of an appropriate pricing option can be made on a case-by-case basis only, considering the specific conditions of implementation. And even then decision-makers will have to make a compromise between affordability concerns and trade-offs related to other criteria.

Implementation of Wellawaya Urban Water Supply Scheme with User Involvement

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Keywords: user involvement, sustainabilty, training, community contribution, cost sharing model

Introduction/Problem Identification

The Asian Development Bank assisted the Water Supply & Sanitation Sector Project was implemented in the six districts of Sri Lanka, through community participation by the National Water Supply & Drainage Board. Each district one Urban water supply scheme was implemented with community involvement. Wellawaya Urban water supply scheme is located in Moneragala district the scheme was implemented to supply water to 50000 (Fifty Thousand) population in the city with user involvement. Total cost for the scheme with full treatment was 2.5 Million USD and user contributed 20% of the cost by cash or kind. To get contribution community based organisation (CBO)was established and comprehensive training and awareness was conducted from planning to implementation phases with operation and maintenance training. Also, local contractors were involved to minimise cost. The project was successfully completed with community involvement and capital cost recovery is more than 20%.

Analysis/Results and Implications for Policy and/or Research

Methodology adopted to get 20% of project cost contribution;

A number of village clusters were selected from the Urban City in each area and appropriate water supply options were proposed by the community itself with community agreement to a 20% financial contribution as per cost sharing model. Then the sustainability of the proposal was analysed, with an appropriate operation and maintenance model. The total project cycle was divided into several phases as explained below and the project staff (a team of technical and community development experts) were involved in the complete process with the active participation of community.

a) Social Mobilisation phase. The following processes were completed in this phase:

- Establishment of the village coordination committee and the selection of village level animators.
- Formation of an active group and the establishment of a community based organisation.
- Organisation of the village participatory survey, the collection of self assessment information and a situation analysis report.
- Identification of reliable water sources and preparation of a work plan.

During the above process careful attention was given to data collection e.g. village maps, population coverage, rainfall pattern, farming information (where available), existing surface water sources, water quality and the yield of existing (deep and shallow) wells. In addition to this, information was given to the community in the catchment development about water pollution and reduction issues, sanitation and hygiene and environmental education.

b) Participatory planning and design phase:

- Selection of reliable water sources and participatory planning of alternative options for each village cluster.
- Preparation of tentative estimates for each option including probable O&M costs.

- Selection of the most suitable option considering technical, financial and O&M viability issues with the concurrence of the community for a 20% (cash and kind) contribution.

c) Collection of community contribution and signing of MOU (Memorandum of Understanding) with the CBO to commence construction work once the community contribution is collected.

d) Construction and supervision phase: Construction work was carried out through community participation. All technical support was given by the project staff. While submitting the project proposals decisions were taken by the community with the help of the project staff to identify which part of the work, was to be carried out to cover the community contribution (cash and kind).

e) Operation and Maintenance phase. This phase consists of the following processes:

- Training of CBO personnel in plumbing, pump operation and small scale water treatment plant maintenance.
- Setting up of technical support units in each local administrative area to support the CBO's whenever necessary. These units will function continuously with the help of Local Administrative Authority in order to ensure the sustainability of the water schemes.

Results and Conclusion

While estimating the total cost of the project, unskilled labour component of each and every item was separated and cost of these were calculated depending on the work norms and day work rates. These works were carried out by the community itself, for instance excavation, backfilling of pipe trenches and well pits and helping to masonry, concreting works etc. Then the cash contribution was decided by deducting the kind contribution amount from the total contribution. Some of the poor community had difficulties in contributing the cash at once, in such instances Rural Banks and Community Development Foundations helped the community by providing concessionary payment loan schemes.

Experience of Wellawaya stressed the opportunity of CBO (Community Based Organization) to develop as a pressure group after handing over the scheme to National Water Supply and Drainage Board for maintenance as they involved planning to implementation phase. It is recommended to involve CBOs as pressure groups; by handing over agreed responsibilities of Urban Water Supply Schemes in order to assure sustainability, When establishing suitable CBOs as pressure groups in urban areas, it is necessary to consider the socio economic status of the members of the CBO and the degree of involvement in management., Therefore, community who involved project with 20% community should developed as pressure and support group for maintenance authority for maintain quality of standards. and manage water resources issues.

The Public-Private Sector Partnership Transaction Structure/Finance Option in Water Service Delivery in Developing Countries

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Keywords: sources of finance for water, abysmally low level of finan, risk analysis, PPP transaction structure/fi, political will

Introduction/Problem Identification

In developing nations, personal income is low, resulting to low GDP and taxes. Government revenue falls short of demand for infrastructure and transfers are dwindling. This leaves Tariffs. But low collection cannot sustain utilities. Repayable loans and PPP models are considered appropriate in this wise but the PPP operator need to be able to charge fair tariff.

Water supply is not a straight process of transfer of risk to the private operator, revenue and demand issues including international advocacy against monopoly PPP, lead to cautious, risk shy private sector, seeking comforts from policies, laws and regulatory structures.

Nevertheless, the gap in water infrastructure finance makes the role of the private sector in inevitable necessitating development of hybrid transactions structures that delicately allocates risks and responsibilities, combines various financial options for specific projects and countries.

Analysis/Results and Implications for Policy and/or Research

Situation Analysis

- Comparison between per capital investment in Water in Europe and Africa.
- Water Investment demand/National GDP ratio in Nigeria
- Financial sources for water projects
- Ability and willingness to pay studies

Risk Analysis

There are a number of potential project risks, the applicability of which varies from sector to sector and indeed from project to project. Revenue Risk, Design risk, Construction, Operating and Maintenance, Demand, Political, Currency, Interest rate, Regulatory risk, Force Majeure, Contractors performance Risks etc.

Making PPP Work; Pertinent Questions

- What are the Government and Utilities interest in the Contract
- How is the investment provided
- How do we ensure that service delivery targets are met e.g production, transmission and distribution targets
- How do we ensure that plants maintenance are carried out according to a detail technical plan to ensure a desired state plant after end concession
- How do we ensure that operator honors all payments to creditors
- Transaction Structure and Finance Options

PPP Structure

The principle is increasing risk transfer to the PPP as the year runs by. An hybrid transaction structure is envisaged. Government should consider provision of subsidies by providing guarantees, taking up some equity or compromise in terms of the life of the contracts.

The first five years could have an enhanced management contract or lease, which will be improved to a full lease with more risk transferred to the PPP. In the latter part of the project, a full concession is envisaged.

Source of Funds
In order to improve the project's financial viability or to strengthen the risk management aspects of the project to be successful some form of credit enhancements available are, increasing tariff (or govt subsidy), raising more equity, introducing mezzanine financing or subordinated debt Cheaper funds from Multilateral Agencies (project finance of laon subsidisation, Mezzanine) to finance plants and possible pipe lines, while other funds with shorter life could finance, metering, O&M etc), utilising escrow agents, funding reserve accounts, as well as employing partial risk guarantees (PRGs) and partial credit guarantees (PCGs) from multilateral development banks (MDBs) or from international donors. Political will is required from Government in sub-Sahara Africa to ensure that the projects become bankable.

PPP Contract's Sanctity
The key provisions of the contract between Utilities and Operator are highlighted to wit:

- Interpretation: The Contract duly set forth the definition of important terms and providing guidance on the interpretation of the contracts provisions
- The contract clearly describes the term of the project: It defines the duration of the contract and makes provision for conditions existing for extension;
- The objective of the contract is stated: Describes the intent of the undertaking;
- The requirement for performance bonds: Insurance requirements: Provides security for the insurable matters within the ambit of the project
- Delay provisions: Describes what is and is not an excuse for a delay in construction or operations, and describes the remedies and penalties for such delay;
- Government action: Describes what actions by government that affect the contract may give rise to a change in the terms and conditions of the contract, and how these are effected;
- Government warranties: Describes what warranties government is making in terms of the project
- Private sector warranties: Describe the warranties that the private sector is making in terms of the project;
- Change in the law: Similar to Government action – describes what the consequences are if the law is changed;
- Variations: Sets forth the procedures to be followed when either party to the PPP contract wishes to change any material portion of the contract;
- Termination: Describe the conditions under which either party may terminate the contract;
- Indemnification: Describes how and under which circumstances either party may be called upon to indemnify the other because of given circumstance;
- Intellectual property: Describes the right of each party to any intellectual property brought to the project or created during the project
- Claims: Sets forth the procedure to follow when either party has a claim against the other;
- Financial Security: Defines the actions of either party that may give rise to a breach of any financing agreement by which project financing was obtained, and the remedies for such breach;
- Dispute resolution: Describe the steps to be taken by either party to resolve any dispute that may arise as to the interpretation of the PPP contract.

Ecological Cost Benefit Analysis of Urban Water Projects – Methodological Issues and Challenges

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Keywords: cost benfit analysis, sustainability indicators, water development projects, externalities, policy recommendations

Introduction/Problem Identification

A major difficulty of conventional cost benefit analysis is it allow choosing an alternative among others only on criterion of economic efficiency the selected project or activity proven to produce economic benefits over costs for period of project. analysis of this kind generally does not create a problem if costs and benefits series easy to quantify andclearly identifiable. almost all projects linked with environment clear exceptions to this category. water development projects in India facing a difficulty of evaluating success based on economic efficiency due to two reasons: (a) environmental benefits are difficult to quantify and (b) environmental interactions that will cause severe externalities are difficult to predict. main objective of this paper is to suggest a practical method that be used to overcome such difficulties in water development projects. results of paper demonstrate a practical approach to evaluate environmental projects in general.

Analysis/Results and Implications for Policy and/or Research

net development benefit (NDBt) is difference between benefits (Bdt) and costs (Cdt) of development over time. where a project involves environmental impacts that are not valued in markets,a proper CBA have some ways to capture such environmental effects. The impact includes the value of environmental improvement (ENBt) and of environmental deterioration consequent upon going ahead with the project. On other hand, a project of this nature creates externalities due to the complexity of operation in the field. assessment of the total impact of SRP at the sub-project level is problematic in both conceptual and methodological terms. Its incorrect to use approach adopted in the original feasibility studies, because it measured only changes to agriculture, assumed that all measurable changes are due to the project and also assumed that these changes had no associated non-project costs. modified study, evaluation has been approached in three different ways: two structured sample surveys were carried out in seven selected sub-projects at two different time intervals. gives a number of useful insights of the work done in investment terms, including the people's perception and own valuation of the rehabilitation work done. evaluation of the economic internal rate of return (EIRR) for both the Scenarios II and III of this analysis were used to estimate the efficiency of water projects including the externality effect and also the non-market benefits of water sample sub-projects and, based on these results, 10 of the remaining subprojects (total of 16) for which adequate base data were available index of DBP was based on this information Contingent valuation was carried out as a part of the sample survey to evaluate non quantified environmental benefits.

This gives insight into benefits such as flood protection, bio-diversity, etc. and costs such as declining environmental utility. A simple spreadsheet model was developed to estimate the economic viability of the different sub-projects at the individual sub-project level. In estimating the economic value of each project, EIRR and the NPV has been calculated for each sub-project at the base cost level. Once financial prices for costs and benefits have been determined, then estimates of the economic value of a sub-project to nation as a whole were made. Financial prices are adjusted as needed to reflect the value to the society as a whole of both the inputs and outputs of the project. the market price of any good or service is changed to make it more closely represents the opportunity cost to the society (shadow price).

Modified CBA approach applied to evaluate Andhra Pradesh water development projects under several scenarios. idea of scenario analysis was to compare the criteria of original project evaluation with the sustainable water development concepts.

In case of scenario one, which is a pre budget calculation net benefits are divided by discount factor has showed the results of all the projects Economic internal rate of return and NPV. first is that the NPV for several subprojects is negative although they have been approved as viable using the same methodology, at the time of project planning. These results suggest that the SRP investments were far less attractive than originally assumed, and that in several cases should not have been made. There strong, though not explicit, pressures on the consultants to ensure a positive rate of return for all projects, many of which were chosen for political expediency rather than objective worth within the narrow criteria used. In case of second model, second spreadsheet model (Scenario II) has been modified to incorporate cost and benefits Investment cost has been adjusted to actual figures of each project.

Similarly, the changes were being made to the O&M costs to capture the expenses incurred as a result of the figures based on the pre SRP project activities DBP is the dis-benefits (externalities) as a result of the project; NDB is net development benefits; are considered. The index DBP captures negative impact created by the project activities. The index was effective when used to adjust the cost stream of each project to capture the negative effect.

Third revealed non-use or un-quantified component of benefits (environmental benefits) and costs which incorporates of unquantified environmental benefits. present-value Equation for the total value calculation which is written the CV approach used in this study has facilitated an estimation of the environmental benefits of SRP.

The study also has compared results of three scenarios's NPV and Economic internal rate of return, As a policy decision criterion, the results indicate unsatisfactory performances of many SRP sub-projects and call into question the overall viability of the project. These results also raise fundamental questions about the feasibility assessment development. The total value in general comprises direct use values and passive use values for arriving at clear picture of the projects.

Valuing Water Infrastructures Expansion Using Real Options the Case of the City of Agadir

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Keywords: real options, water infrastructure, Monte Carlo simulation, flexibility, uncertainty

Introduction/Problem Identification

This paper presents a flexible method that is real options to increase the value of the water infrastructure systems. In particular, it analyses: Net Present Value (NPV), Decision Analysis (DA) and Real Options Analysis (ROA), and compares these approaches in terms of their handling of uncertainty, their acknowledgement of flexibility, and their usefulness for strategic decision making. The study is illustrated by a system design for the expansion of the water supply to the city of Agadir in southern Morocco. This study illustrates the application of each methodology and identifies the policy challenges relevant to infrastructure investment evaluation in Agadir and other evolving economies. Real options make a flexible ability to respond the systems more effective to good opportunity and withdrawn unproductive situations from loss of investments in the future.

Analysis/Results and Implications for Policy and/or Research

The results of this approach are compared with traditional net present value, Decision Analysis in cases of with and without uncertainty to show expected values of investment of water demand and supply schemes. It shows that real options in water system design can increase expected value of water infrastructure investment by reducing negative risks and increasing opportunities. The methodology is applied for valuing the water system expansion of the water infrastructure in the city of Agadir and shows that the option to differ the investment is very conclusive than to invest now in very expensive desalination plants.

The Public Private Partnership Project on Sanitation Marketing in the Slum of Bwaise I and II, Kampala

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Keywords: latrines, marketing, public-private partnerships, sanitation, slums

Introduction/Problem Identification

About 2.6 billion people in the world lack access to improved sanitation (WHO, 2006; EcoSanRes, 2008). To meet the Millennium Development Goal (MDG) for sanitation in the developing countries requires about US$142 billion, and to maintain the existing sanitation services requires about US$216 billion (Hutton and Bartram, 2008). The capital and maintenance costs for sanitation may be decreased by investing in decentralised systems, which also offer jobs for small scale independent providers, e.g. in latrine construction, emptying and nutrient recycling activities. The lack of access to improved sanitation contributes to increased mortality and morbidity, which is much higher in children under 5 years old. On average, each slum dweller in Kampala spends about UGShs. 25,000/= (US$ 14) per month on sanitation related diseases (Pers. Comm. H. Plumm, 2008). Available evidence suggests that improving sanitation can reduce diarrhoeal diseases by 35-40% and child mortality by half (WSP, 2000).

Analysis/Results and Implications for Policy and/or Research

The GTZ and a Ugandan private company (Crestanks Ltd) as well as Polyfibre (to a limited extent) in collaboration with SSWARS local NGO and the local authority (Kawempe Division) implemented the Private Partnership (PPP) project in the slum of Bwaise I, Kampala between December 2008 and June 2010 using a sanitation marketing (sanimark) approach. The partnership was expanded when JICA joined to support the sanimark interventions. In December 2010, another slum, Bwaise II was included in the project. An estimation of the latrine coverage was carried out initially, which was found to be 50% in each of the two parishes Bwaise I and II. The sanitation marketing was carried out using house-to-house visits by use of foot-soldiers, road drive shows, drama, story tale booklets for school children, various Information Education and Communications (IEC) materials including posters, fliers, stickers, branded items (pens, pencils, rulers, t-shirts). Forms of credit acquisition through banks and microfinance institutions were explored, as well as sanitation acquisition through installment purchase. The possibility to run sanitation as a business was also explored. The total number of sanitation (including water) facilities constructed in Bwaise I and II comprised of 42 slabs, 18 latrines comprising of 39 stances, 10 water storage tanks, 10 hand-washing basins, three wonderloos and one Ecopan. The above installations were built at household level, at religious institutions (two churches and one mosque), in four primary schools and in one business establishment. The project directly benefited 2000 people with an additional 3000 indirectly. The latrine coverage in Bwaise I increased from 50% to 63% between December 2008 and June 2010. The increase in the coverage in Bwaise II is not yet estimated since the project was just extended there recently. The total numbers of latrines built in Bwaise I did not alone contribute to the difference in latrine coverage of 13%, but rather, households who were unable to purchase the factory produced latrine superstructures that were marketed in the first phase, built latrines using locally produced materials and these were also included in the census at the end of phase I of the project in Bwaise I. The possibility to run sanitation as a business was found promising in one public latrine visited daily by 100 people (including about 10% that use it for bathing). Latrine use for pooing and peeing for both women and men costs UgShs. 200/= per visit and UgShs. 300/= per bathing per person. The total collection per month is UgShs. 630,000/=. Emptying is done per month costing UgShs. 150,000/=; water costs UgShs. 150,000/= monthly and operator costs is UgShs. 390,000/= monthly. A monthly profit of UgShs. 240,000/= is made. The owner could recover the total costs of the latrine within 2.5 years, and thus the rest of the time is for the profits. For most households, it was found that one of the problems for not investing in latrines was the lack of the entire amount of money to purchase the materials and to pay masons to construct it in a short period of time. This became even more problematic at the time when we vigorously marketed the factory produced latrines from Crestanks and Polyfibre. Banks and microfinance institutions did not show interest in supporting communities to acquire latrines due to the lack of collateral by the applicants. The latrine acquisition was very slow, as people could not afford UgShs 600,000/= to purchase the full product (latrine superstructure) from Polyfibre and UgShs 780,000/= for the Crestanks model. Therefore, we allowed for the use of locally produced materials, basically fire clay bricks, building sand and cement. With this, the strategy was for householders; mainly the landlords to purchase the materials and then SSWARS masons would build the latrine at no cost to the owner. The money for paying the masons was a project contribution by GTZ (now GIZ), which was an incentive to the landlords to own their latrines. Additionally, for the landlords who demonstrated capacity to pay in installments, SSWARS entered into an agreement with them and topped up the materials, mostly the cement, which was not produced locally within the community, and therefore had to be bogut from the shops. The payment was agreed upon to range from three months to twelve months, as determined mutually through negotiation, and no interest was charged. The promotion of sanitation product purchase through installment payments by beneficiaries seems to be beneficial. However, it requires constant interface between the marketing/sales team with the communities to achieve payback. Additional funding agencies should be identified to continue the promotion of sanitation marketing activities in Bwaise I and II and beyond to reach 100% sanitation coverage in the area.

Improving Parastatal Water Utility Regulation

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Keywords: regulation, inventives, tariffs, sustainability, cost of service

Introduction/Problem Identification

Tariff regulation as practiced in many developing countries does not provide sufficient incentives to change management behaviour in public-sector utilities. Regulators often respond to poor technical or commercial management by limiting tariff increases even when operating costs, e.g., energy, have obviously increased or even when government-approved financial or other contractual obligations require adjustments.

The problem is that the tariff (i.e. the price charged to the customer) is not a precise enough regulatory tool to influence management behaviour in public sector entities. Management salaries and benefits are usually not at risk, i.e., not impacted by the regulatory action. And, the regulator's decision not to raise tariffs doesn't pressure the public-sector owner – and thus management – in the same way that it would in the private sector.

The regulator's tariff decisions, however, can negatively impact service provision, financial sustainability and contract compliance.

Analysis/Results and Implications for Policy and/or Research

Case Study

In 2003, the Dar es Salaam Water and Sewerage Authority (DAWASA) entered into a lease agreement with an international water utility company. DAWASA became the owner of the water supply and sewerage systems and the private entity took over system operations. The private sector operator departed in 2005 and was replaced by a parastatal entity, the Dar es Salaam Water Supply and Sewerage Company (DAWASCO) under a similar lease agreement.

Under both lease agreements the owner and operator had separate tariffs. There was also a special fee, or tariff, to accumulate funds for first-time domestic water connections. The three component tariffs made up the customer tariff which was subject to review and approval by the Electricity and Water Regulatory Authority (EWURA). International financial institutions had provided loans to rehabilitate and to extend the water supply and sanitation systems based on the tariffs terms and conditions of the lease agreements.

Beginning in 2006, and for two years, seeking to influence management behaviour of DAWASCO, EWURA disallowed any changes to the customer tariff; although required by the DAWASCO lease agreement which had been approved by the Government.

The two year disallowance of customer tariff changes negatively impacted the financial sustainability and contractual obligations of the entities; but had little impact on management performance.

Proposed Change in Regulatory Apporach for Parastatal Entities

A deconstructed tariff approach that separates the customer water tariff, or tariffs, into separate component tariffs for regulatory review and approval would significantly improve the regulator's incentive control tools and encourage more regulatory focus on separate cost of service requirements., e.g. management-related costs, operations and maintenance, rehabilitation, service extension, debt service and possibly subsidies for the poor.

This approach would strengthen behavioural incentives for management and of improve regulatory analysis of O&M, rehabilitation, service extension, debt service and subsidies for the poor.

Creating restricted tariff pools, or funds, to accumulate associated component tariff collections would escrow revenues; putting management-related costs under a hard budget constraint and reserving funds for O&M, for improving service provision, for repaying debt service or for providing targeted subsidies for the poor. Regulatory restrictions on the use of the component tariff funds, including internal controls like separate bank accounts would facilitate regulatory monitoring, especially as the fund usage could easily be audited.

Using a deconstructed tariff approach should also speed up the regulatory review and approval process as the utility could submit single component tariff adjustment proposals; limiting the scope of the regulator's review.

Can Payments for Ecosystem Service Programmes Help Finance Urban Infrastructure?

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Keywords: watershed services, financing mechanisms, infrastructure finance, financing green infrastructure, urban ecosystem services

Introduction/Problem Identification

Driven by concerns over unsustainable rates of freshwater consumption and recharge, loss of biodiversity and general degradation of ecosystem service, economists, policy makers and environmental leaders have been experimenting with innovative solutions to value and manage water resources by working to capture a willingness to pay for watershed improvements, hoping to help maintain high-impact ecosystem services with a diverse set of payment mechanisms. For the past 12 years, Forest Trends, and its Ecosystem Marketplace, have been reporting on the emerging water markets and market-like payment schemes around the world. Tracking the project-level activity of this emerging marketplace led to a report, released in 2010, focused on the current 'State of Watershed Payments' intended to establish a baseline to inform a diverse group of stakeholders about where these programmes are being developed, in what context, and with what level of investment.

Analysis/Results and Implications for Policy and/or Research

Using 2008 as the baseline year, research unveiled 288 Payments for Watershed Services (PWS) and nutrient trading schemes in varying stages of activity. Far fewer programmes recorded actual transactions in 2008, numbering just under 100. The transaction value from those active programmes in 2008 is estimated at US$9.3 billion, which may be conservative considering the number of programmes where transaction activity could not be determined. Activity was found in most regions, although there are clear leaders in terms of sophistication of programme design, regulatory drivers, defined property rights, market structure, and monitoring and verification methodologies. Each programme is unique to the local watershed conditions and shaped by the various political, cultural, and institutional arrangements that affect civil society.

Trading Schemes were found in the United States, Australia, New Zealand and Canada, spawning a total of 72 programmes, with 14 identified as active in 2008, generating US$10.8 million in transactions. The U.S. accounts for more than 85% of the total programmes and while this may make the U.S. appear as an early trend setter, many programmes are currently stuck in neutral, awaiting implementation of regulatory-based water quality standards that set much needed limits on nutrient loads. Absent this key driver of demand for water quality credits, transaction activity has tapered off since a peak in 2006.

From the global investigation of all other PWS schemes, Latin America has emerged as a leader with a total of 101 payment schemes, 36 of which actively recorded transactions in 2008, contributing some US$31 million to watershed-conservation measures. Anchored by the development of Water Funds, the use of this tool to fund upstream conservation by downstream users is poised to serve as a model for replication in other regions, and as an example for other ecosystem markets around the world. Similar stories abound in China and other part of Asia, Africa, Oceania, North America and Europe.

The global trends point to continued expansion of the use of market-based tools to aid in the improvement of overall ecosystem health. The question remains, how are these conservation finance tools being adapted to help finance infrastructure in the world's rapidly expanding urban areas? The Water Fund in Quito, Ecuador and the PES programme in Dar Es Salam, Tanzania show how these mechanism are already helping to manage green infrastructure upstream for the benefit of downstream, urban consumers. A preliminary look suggests that other existing PES/PWS models can be adapted for funding urban infrastructure needs. This presentation will cherry pick the most promising PES/PWS models for application in financing urban infrastructure, especially critical "green" infrastructure projects. With a growing constituency calling for valuing ecosystem services as part of overall community (including economic) health, the expanded lens of PES application in urban settings will further increase the opportunities for these tools to work for improvements in urban water infrastructure, leading ultimately to improvement in communities along with increased benefits for people.

Cost Recovery and Mismanagement Costs at Water and Wastewater Utilities in the Developing World

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Keywords: irrelevant costs, inefficiency, affordable prices, corruption, accountability

Introduction/Problem Identification

On one hand municipalities, water utilities and water service providers insist that people should pay the full economic cost of the water they consume to be able to provide and sustain good services. On the other hand people demand that water sector should be properly managed on an economic basis with reliable services and affordable prices to cover the real costs without adding irrelevant costs due to mismanagement and inefficiency, only then they will be willing to pay the real costs of consuming this precious commodity. To create livable cities for the unstable future, considerable efforts are required to improve institutional performance in the water sector. The first dimension to be considered is directly related to management performance (well functioning service providers). The water crisis in the developing world is a mismanagement crisis, and without dealing immediately with mismanagement we will never achieve full cost recovery, sustainability, and affordable water prices.

Analysis/Results and Implications for Policy and/or Research

Water is rapidly becoming a scarce resource in almost all countries and cities with growing population on the one hand, and fast growing economies, commercial and developmental activities on the other; this scarcity makes water both a social and an economic good. Water service providers face huge challenges in delivering clean, reliable and affordable water to the public, one of these main challenges is the inefficient management of water utilities which leads to increasing costs of delivering the service and wasting of precious and scarce water resources highly needed.

Water is an economic and commercial commodity which means to buy it you should pay its cost but here we need to define which costs you must pay for consuming water as an economic commodity. It is, therefore, essential to carry out an economic analysis so that planners, policy makers, water enterprises and consumers are aware of the actual economic cost of the scarce water resources and the appropriate levels of tariff and cost recovery needed to financially sustain it.

This paper is an attempt to translate the concerns of water users about irrelevant costs associated with providing water services in the developing world. A high concentration (focus) should be given to highlight mismanagement practices in the water sector in the developing world which add considerable costs in providing water services to the people. The writer will focus on the side of water users who have a good question "Why to ask us to pay the costs of mismanagement, the costs of inefficiency, and the costs of corruption". This paper will highlight some of the major mismanagement practices and explain their effects on the overall costs in the water sector, emphasising that these inefficiency costs are one of the main reasons behind the high costs of delivering water services in the developing world and discus the issue of cost recovery from the perspective of water users as well as from an economic and commercial perspective emphasising on the practices that should be adapted to overcome this serious, deep-rooted problem that hinders almost all the efforts to improve the water situation in the developing world and causes a huge loss of available funds and precious resources. Recent evidence indicates that without taking the right actions now – with no postponing – dealing with the mismanagement issue, the water sector in the urban developing world will continue suffering from high costs of the service and loss of precious available water resources no matter how much funds will be spent to improve the infrastructure "It's a mismanagement problem in the first place". It is impossible to achieve the urban water and sanitation Millennium Development Goals without fighting strongly and courageously mismanagement.

Apart from the need to considerable investments in the urban water sector in the developing world, mismanagement and low or bad performance will harm any opportunity to fully benefit from these infrastructure improvements. It's important that institutional arrangements in the water sector allow for efficient and flexible management to wisely and professionally use the available funds, resources and infrastructure.

It's not only challenging but it's almost impossible to overcome the serious water and sanitation situation in the developing world if neglecting mismanagement and avoiding standing in front of its practices. Frequent occurrence of mismanagement practices means a continuous disaster striking the urban water sector in the developing world, because lack of or poorly functioning water and sanitation systems carry heavy social and human costs especially for the poor. History and present tells us that a water crisis in the developing world is a mismanagement crisis. It's socially wise and often economically rational to fight mismanagement in the water sector to be able to achieve full cost recovery and sustain the good service using affordable water tariffs and shaping a better future through involving all the available potentials in the developing nations and the whole world to deal with this issue now. It's highly relevant to highlight mismanagement causes, practices and costs that hinder the success of any attempt to improve the water and sanitation situation in the developing world, and unify all the honest efforts to end this tragedy once and for ever. Only then we can achieve full cost recovery, sustainability, and affordable water prices.

Mismanagement should be given more attention, and should be perceived as an important issue for sustainable water services in the developing countries, it is my sincere hope that this Paper will contribute to the body of work that exists to enable (highlight) more appropriate management of scarce water resources in the developing countries.

Regional Implementation of Decentralised Wastewater Concepts in Jordan

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Keywords: wastewater, decentralised infrastructure, central operation, financing, Jordan

Introduction/Problem Identification

Currently, the water supply in the Jordan is over allocated, which has resulted in negative environmental and economic impacts. The research project "Sustainable Management of Available Water Resources with Innovative Technologies" (SMART) has set out to assist in addressing these issues. One key to this approach is the effective treatment and reuse of wastewater.

Decentralized Wastewater Treatment and Reuse Systems (DWWTS&R) can play a significant role in the alleviation of water scarcity and pollution. This SMART-concept is also reflected in Jordan's Water Strategy 2009-2022. In addition to setting the aim of adequate wastewater collection and treatment from major cities, the strategy specifies that DWWTS&R shall be built to serve semi-urban and rural communities and that DWWTS&R approaches shall also be explored for new urban settlements. The SMART-investigation focuses on: How to finance the infrastructure, and how to implement a sustainable operation and maintenance (O&M) system?

Analysis/Results and Implications for Policy and/or Research

The main financing instruments for wastewater infrastructure in Jordan are loans or funds provided by development banks or donor organisations. Due to the size of individual DWWTS&R such projects are generally of low priority for these organisations. Other barriers for implementing DWWTS&R are the uncertainty around responsibilities and cost recovery for the O&M of such systems.

The project has focused on providing a regional implementation approach in order to overcome some of these concerns. This approach can also be described as the centralised management of clustered decentralised systems.

In order to define the critical mass, both for international investments and economically feasible operation and maintenance services for decentralised infrastructures, a GIS based tool was developed that aims at defining the most suitable regions, locations and sizes of clusters of DWWTS&R. The tool is considering the following criteria:

Region, Population

Based on data of the Jordanian 2004 census, the implementation of sewer systems was calculated as 5% in the rural sector and 75% in the urban sector for the study area. The annual wastewater production available for DWWT&R was calculated to be nearly 3.8 million m^3 for the rural sector and 25 million m^3 for the urban sector at the end of 2007. The future need of new treatment capacities was estimated to be in the range of 15,500 population equivalents (pe) per year for the rural and 120,000 pe per year for the urban sector. Considering existing and already planned central wastewater infrastructure several regions with the highest implementation potential for DWWT&R were defined together with the responsible ministry.

Topography, Sewer Network

The topography of the selected region was developed using the Digital Elevation Model. Based on satellite image analysis, a collection system was designed in the direction of the slope avoiding pumping stations and favouring the natural drainage of the area. The use of pipes and manholes were considered for the construction of the gravity sewer according to the recommendations of the Jordanian Ministry of Water and Irrigation.

Technologies, Site Selection

The Jordanian Water Strategy implies to establish innovative approaches for decentralised wastewater treatment systems with standardised design and performance specifications.

For the selected region a multi-criteria analysis was performed for three treatment capacities of 50, 500 and 5000 pe to select the core technologies that have a greatest potential for the sustainable implementation of DWWT&R. Based on the ranking of practical results of pilot plants and a multi-criteria analysis two core technologies were selected: sand filters and a SBR treatment system.

Potential construction sites for the decentralised treatment technologies were preselected considering the predefined collection networks without pumping station and the available plot of land for construction and reuse areas.

Central operation

The Water Authority of Jordan is responsible for water services delivery but principally can assign this duty to publicly owned organisations that operate under company law. Several new corporatised water service companies have been created that operate, maintain and monitor both water supply, wastewater treatment and collection systems.

However, no decentralised systems have been included so far in these contracts.

Discussions with private companies and stakeholders on contracting the O&M of whole clusters of DWWT&R are suggested as a sustainable solution in the Jordanian context.

Costs

Representative scenarios with different clusters of decentralised technologies (SBR or sand filters) were defined in order to present a preliminary view for future investors and decision makers in Jordan. A net present value analysis (NPV) was performed over a 25-year period considering 3% discount rate. The NPV calculation includes investment costs of the sewer and wastewater infrastructure as well as O&M costs. Additionally the NPV considered other costs represented by land acquisitions and contingency costs. Finally, specific treatment costs (STC)were derivate from the total flow rate treated. The results indicate that the STC increase with the number of clustered technologies and that the O&M costs can represent more than 50% of the total STC.

Conclusions

The developed tool allows the comparison of costs for the connection of un-serviced populations to existing central WWTPs and to optimise the network for different clusters of DWWT&R. The use of a GIS based tool is a promising development in the attempt to identify clusters and associated costs and as well operation and maintenance considerations for new systems. First analysis of the limiting criteria suggested that one of the most significant barriers of such an approach might be the acquisition of land needed for treatment plants and the availability of areas for water reuse, especially within suburban conglomerations.

Workshop 4: Adapting Cities to Climate Variability and Change

Adapting to Climate Induced Changes in Hydropower Generation and City Water and Energy Supplies: A Delhi Case Study

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Keywords: adaptation, climate change, hydropower, water supply, energy supply

Introduction/Problem Identification

Climate change is affecting the hydrological system of Northern India, which is based on two main phenomena: the monsoon precipitation in summer and the growth and melt of the snow and ice cover in the Himalaya, also called the "Water Tower of Asia". Increasing greenhouse gases are expected to change these phenomena and, in particular, will have a profound impact on snow cover, glaciers and its related hydrology and water resources availability.

The city of Delhi relies highly on climate sensitive sources for water and energy (Hydro electricity). Falling water supply and increasing demand for water and energy could have serious implications on the city; with inter-linkages between different sectors having a ripple effect on the entire economy. The study intends to arrive at measures to strengthen city resilience to climate change based on a participative vulnerability assessment and identification of adaptation measures.

Analysis/Results and Implications for Policy and/or Research

Water is at the epicenter of all socio economic activities in Delhi, like any other city. The impacts of climate change on the rainfall and glaciers could serious implications on the city owing to its dependence on climate sensitive sources for water and energy. Delhi obtains its drinking water from glacier fed rivers of the Ganga basin. Substantial part of drinking water and electricity of the city is sourced from Tehri hydro project, a multipurpose dam built across the river Ganga. Changes in both water supply and demand act and interact with each other to influence the vulnerability of the city to the impacts of climate change on the Ganga basin. While the amount of drinking water from the current sources could decrease because of climate change, the supply of energy is altered due to the changes in runoff affecting the storage of dams like the Tehri dam from which hydro electricity is produced. Water and energy consumption also has a direct functional relationship with standard of living. Delhi has seen a consistent decrease in poverty rates since 1951, which is further expected to go down in the next few decades. A substantial percentage of people are homeless and considerable populations do not have access to electricity and safe drinking water. One of the key objectives of the Delhi Master Plan 2021 is to extend these basic amenities to all populations of the city. This would require very high magnitude of resources to achieve which would alter the demand significantly. Rising population density (growing at a startling rate of 3.8), growing urbanisation, improvements in living standards, falling groundwater level, industrialisation and migration amongst other things could exacerbate already stressed water and energy resources of the city.

The study intends to arrive at measures to strengthen city resilience to climate change based on a participative vulnerability assessment and identification of adaptation measures. From the adaptation perspective behavioural changes as well as technological and policy changes could bring down the demand for water and energy drastically. Impact of climate change is studied through simulations using the hydrological modeling and the scenarios generated by the regional climate modeling. A multi-sector adaptation measures will be identified and tested in a participative approach, involving identified stakeholders. The presentation would focus on the idea of urban systems through the case study of Delhi, determinants of vulnerability in urban systems, specific lessons from the participative vulnerability assessments, measures to enhance resilience and adaptive capacity of the city. As having the main focus on possible adaptation measures, the presentation would also focus on the on the necessary methods and information for a truly stakeholder driven participative approach. The presentation could provide valuable insights to urban planners, local governmental organisation

Rainwater Harvesting: Need for Synchronism of Technology and Policy

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Keywords: rainwater harvesting and rechar, groundwater augmentation and qua, technical approach, area specific recharge models, RWH legislation and regulatory

Introduction/Problem Identification

Today we are witnessing a world of developments, developments in all directions. Since, the process of development is unstoppable and irreversible, it may be wise to focus on the rehabilitating measures complimentary to the growth cycle making it more sustaining. Moreover, with the impact of climate change becoming evident day by day in terms of harsh weather scenarios world over, management of the resources to tackle the seasonal extremities is one of the solutions. Water is one such resource, which owing to its widespread utilisation and common application grounds, needs to be managed and conserved for supporting lifestyle in the changing environment. One way of managing and conserving the water is rainwater harvesting. However, the techniques of rainwater harvesting (RWH) or the management plan should be strongly footed on the technical and scientific investigations, database and policy unlike prevalent practices of implementing plans for the records sake.

Analysis/Results and Implications for Policy and/or Research

In view of above, the current paper attempts to highlight first the need for ensuring the effective implementation of the water harvesting policy in cities making it compulsory for all new/ upcoming constructions and buildings as well as those being built after demolishing the old structures to install a rainwater harvesting structure. Subsequently, the paper underlines the importance of adoption of scientific approach and technical investigations before implementation of RWH structure and thirdly showcases the benefits of RWH using the special, site specific water harvesting models with exceptionally high filtration rate and intake/ recharging capacity as it is believed that with the impending climatic changes, the monsoon pattern too has changed with high intensity and short duration torrential rains flooding the cities/ towns.

A city survey carried out covering both domestic and industrial sectors has revealed that though city municipal corporation provides drinking water daily for fixed hours, more than 50% of the population still rely on their own water (groundwater) supply sources viz. bore wells to cope up with the demand. The survey has also indicated declining groundwater tables coupled with the deteriorating water quality. Only 53% of the population has knowledge about RWH and out that only 4% of population has implemented the RWH technology. Soon after introduction of the RWH policy in September 2009, almost all the residential schemes (apartments, societies, townships)have been provided with the RWH schemes but unfortunately close to 95% of these RWH schemes have failed to function since the building contractors/ builders have either installed the schemes just for the namesake or installed with limited technicality.

This points at compelling need for regulatory measures to ensure the effective implementation of the RWH policy so that the anticipated benefits in terms of water saving can be visualised and also the residents get their due after paying for creation of the facility.

For the second and third aspects of RWH, a case study demonstrating the efficiency of different RWH models for the management of water logging and flooding challenges in an industry with the augmentation of groundwater table and water quality improvement has been detailed.

An industrial house in the city of Vadodara, Gujarat, spread over 350 hectares was facing the challenge of management of the storm water run off and disposal of the same collected from within the premises as well as flowed in from the surrounding areas. City of Vadodara receives average annual rainfall of about 990 mm and is characterised by alluvial aquifer system. However, in last 5 to 6 years, as a result of short duration and high intensity spells of rain, the factory premises used to get flooded with 2 to 3 ft of water column and remained waterlogged for 2 to 3 days leading at times to shutting down of the industry plants. A gamut of thirteen (13) area specific water harvesting structures viz. screen filter type and furaat type, were installed identifying the critical areas. These structures with the capacity to recharge rainwater at the rate of 1000 to 2000 litres/ minute could recharge about 2.0 million cubic meter of rainwater underground in one season. The impact was evident by overall shallowing of groundwater by about 10 m and improvement in the quality of water and most importantly, even on the days when the city received about 170 to 180 mm of rain in just couple of hours, there was no report of flooding/ water logging.

Is Development Aid in Water and Cities Integrating Climate Change?

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Keywords: ODA, development cooperation, adaptation, integration, developing countries

Introduction/Problem Identification

Based on the DAC-OECD methodology for counting Official Development Assistance, this paper proposes ways of knowing how much ODA in water and in cities is integrating climate change issues. Moreover, the contributions of the main OECD donors are analysed, both multilateral and bilateral ones.

Analysis/Results and Implications for Policy and/or Research

The main financial source that contributes to the compliance to the Millennium Development Goals (MDGs) is the Official Development Aid (ODA). It is defined, monitored and evaluated by the Development Aid Committee (DAC) which is part of the OECD Directorates. The DAC also establishes the base for counting ODA, through the Creditor Reporting System (CRS).

Donors have to report annually to the CAD every single contribution to developing countries eligible as ODA. According to the CRS, each contribution has to be qualified with a code and a sector. The DAC database is the major resource to know which initiatives are been promoted in developing countries, which donors are important in certain sectors, the quantity of financial flows and to make estimations about the road to the MDGs consecution.

This work analyses the CRS related to water and to cities development, from the one hundred and twenty CRS last list made by DAC. Secondly, it is studied the Official Development Aid in this sectors for main OECD donors, from 2006 to 2009. This analysis has been made by regions and by the type of ODA. In that sense, contributions to international organisations that work on that have been especially studied. Furthermore, a detailed quantitative and qualitative analysis has been made for the Spanish ODA.

Based on these data, the integration of climate change issues has been studied, both from the mitigation and the adaptation side. OECD reporting system contains a specific marker that gives information on how mitigation has been taken into account in the project. Nonetheless, there is no specific marker for adaptation, so the information about how many projects have taken into account this variable is not easily reachable.

Evaluating Management Solutions to Reduce Vulnerability to Environmental Change for Urban Conditions in the Inner Niger Delta, Mali

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Keywords: vulnerability assessment, adaptation, storylines, urban water management, Mali

Introduction/Problem Identification

Urban vulnerability in the Inner Niger Delta of Mali is strongly linked to water management. Being located within a 20.000 km² wetland, water quantity and quality are driving forces for the resilience and well-being of urban communities. Seasonal floods are part of life and many urban community livelihoods depend on wetland ecosystem services a.o. food production, waste water treatment, flood control, minimum flow regulation and disease control. The flood intensity however appears to be reducing and thereby endangering the sustainability of urban livelihood in the Inner Niger Delta. Besides, climate change, also demographic growth and economic development (hydropower and irrigation) are important explanatory factors of the increasing variability of the flow regime. A combination of both regional (river basin management) and local (sanitation, hygiene and water supply) solutions are identified to adapt the cities of Mopti and Macina, Mali to environmental change.

Analysis/Results and Implications for Policy and/or Research

This paper is developed under the European 7FP project WETwin which works on the role of wetlands in integrated water resources management for twinned river basins in EU, Africa and South America. WETwin follows the assumption that adequate and integrated river basin management maintains/improves the ecosystem services that wetlands contribute to human well-being. Cities, wetlands and river basins are mutually depending on each other, but many lack sustainable management. Both cities and wetlands are currently being threatened by human activities within and upstream of the wetlands. As a result, the ecosystem services which they are providing to maintain or improve urban livelihoods are challenged. Evidence furthermore exists that urban communities and related ecosystems are sensitive towards future pressures such as climate change, demographic growth, land use change and economic developments. This paper focuses on the relationships and trade-offs that exist between the urban environment, wetland and river basin, specifically for the city of Mopti and Macina, centrally located in the Inner Niger Delta wetland in Mali. For this purpose, a methodology is developed to firstly assess vulnerability and secondly to evaluate management solutions in terms of their potential for the reduction of vulnerability to global change.

We will present at the one hand side, the impact of the variable flow regimes and flood intensity on the urban environment and on the other hand a spatially distributed system analysis of the sanitation systems, critical pathways for diseases transmission and water cycles of the region of Mopti, within the Inner Niger Delta of Mali. In a next step, we will present the observed relationships between water quantity (floods), water quality (lack of sanitation) and human health. We will do so by estimating and visualising (in GIS), firstly the urban waste water load, flood extent and frequency, presences of stagnant water (puddles, reservoirs, pools, …), facilities for drainage and the status of sanitation and drinking water supply. The latter GIS maps are then combined into a map showing the vulnerabilities (incl. hot spots and critical infrastructures) of communities for changing flood intensities, pollution and water-related diseases. Next, promising management options are proposed. Beside classical community-based approaches (sanitation, hygiene and water supply) evidence is provided for integrated river basin and wetland management as a promising and cost-effective solution to reduce urban vulnerability and thus adapt cities to global change.

An important element will also be methodology to evaluate the effectiveness – and related trade-offs of potential management solutions to enhance wetland ecosystem services, reduce vulnerability and thus facilitate adaptation. It builds on a multi-criteria analysis including the biophysical effectiveness (impact on ecosystem services), economic costs and benefits, potential and risk for adoption of the measure and stakeholder acceptance. Based on a institutional analysis, and input from local stakeholders, opportunities and hampering factors to effectively manage cities and wetlands in a sustainable way.

In addition, the impact of global change scenarios on the water quality, quantity and disease prevalence is assessed as well. City-scale storylines have been developed based on 1) downscaled regional scenarios for climate change, demographic growth, economic development (dams and irrigation) in line with the IPCC-SRES scenarios (Nakicenovic & Swart, 2000) and 2) insights of local field experts, stakeholders and local development plans and statistics.

The presented results can help both local practitioners and communities and the international community. Maps are proven instruments to facilitate a stakeholder dialogue, to discuss conflicting issues and to inform decision-makers. The presented results can furthermore help to set-up local urban development plans to focus on certain priorities for integrated urban-environmental management.

An Economic-Engineering Analysis of Climate Change, Urbanisation and Long Term Flood Protection: The Case Study of Ho Chi Minh City

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Keywords: climate change, urbanisation, flood protection, risk-based optimisation, cost-benefit analysis

Introduction/Problem Identification

A recent study by the Asian Development Bank has emphasised the vulnerability of Ho Chi Minh City (HCMC) to risks related to climate change and variability. The city is heavily populated and represents a regional driver of economic growth in Vietnam. HCMC is situated in a low-lying delta which is currently subject to flooding due to heavy monsoon rainfall and storm surges. Climate change can worsen flooding problems in Ho Chi Minh City through potential sea level rise and increased frequency and intensity of extreme rainfall. Continued growth in the area will also increase potential flooding damages and vulnerability. Thus, as the city develops over the next decades it will need to balance the potential increase in flood damages with the economic benefits from human uses of urban land. An economic-engineering analysis of investments in flood protection infrastructure has been developed as a framework to analyse structural adaptation to changing flood frequencies and urbanisation.

Analysis/Results and Implications for Policy and/or Research

This study examines some of the effects of urbanisation and climate change on levee system adaptation for long-term flood management using a simplified representation of urban flood management for HCMC to explore economic, engineering, and hydrologic interactions. Although the HCMC region has a wide array of structural and nonstructural options to consider for managing flood risks, we focus this analysis on levee decisions for long-term protection. Options to reduce flood damage potential such as building codes, land use zoning, and flood warning and evacuation systems are not included in the assessment. Our analysis focuses on how flood infrastructure investment plans can be adapted to changing flood frequencies and urbanisation.

Risk-based optimisation is used to preliminarily evaluate the economic desirability of levee height and setback changes for some areas of HCMC over a long period of climate change and urbanisation. Our model seeks to maximise the difference between the annualised economic value of land use (benefits) and the expected annual flood damage and mitigation costs by choosing alternative flood infrastructure investment configurations. The long-term floodplain management problem is formulated as an optimisation problem solved by dynamic programming. The model is a simplification of the Ho Chi Minh City area's true situation and is constructed using the following steps and assumptions.

The first step of the analysis comprises the hydrological modeling scenarios for flood risk analysis. Scenarios of future changes in climate variables such as temperature, precipitation, sea level rise are introduced into hydrodynamic models that contain area specific information such as existing soil characteristics, river flow, canals, dams, existing flood protection infrastructure to estimate future flooding under different scenarios. A flood damage function was constructed by combining a hydraulic model that simulates water levels with GIS maps of land use, population, infrastructure assets and economic activity, which produced geo-referenced stage damage functions of alternative flooding scenarios. Changes in flood frequency are estimated for different flood return periods with their corresponding flood extent estimation. Current land use maps and projected land use maps for the future based on economic growth assumptions are used in the analysis. Results from hydrodynamic modeling undertaken by the Southern Institute of Water Resource Planning (SIWRP) and the Asian Development Bank (ADB) are used in our analysis. Finally, flood occurrence is estimated for different assumptions of flood protection infrastructure in place (i.e., different combinations of levee heights and setbacks), which allows us to derive a relationship between levee configuration, flood flows and flood extent.

The second step of our study involves cost-benefit analysis to allow comparison of different flood infrastructure design alternatives. Expected flood damage functions were estimated from recent flood damage studies by SIWRP and ADB in which a relationship between flood extent and land value is derived. The costs of building or upgrading flood protection infrastructure are modeled as the costs of changing levee heights and setbacks which are estimated from the literature and discussions with local flood engineers.

Using the data obtained from the previous steps the model can simulate economically optimal levee infrastructure design for a long term planning period derived for a set of climate change and urbanisation scenarios. Illustrative results and conclusions will be presented. A preliminary application of this model suggests that there might be economic value to expanding some of HCMC levee heights and setbacks over long periods of time, and making present-day zoning decisions to preserve such options.

This study demonstrates the economic-engineering interaction of flood control decisions over long planning periods with changing economic and climatic conditions. For long-term planning these interactions can be examined by optimisation methods providing some insights into this flood infrastructure investment planning problem. The model constructed integrates climate change risk analysis and can be a useful tool for regional planners that need to integrate climate change considerations into their planning process.

Rapid Urbanisation and Associated Sociological Impact Due to Flooding in an Urban Regime

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Keywords: urbanisation, flooding, HEC-HMS, HEC-RAS, sociological impact

Introduction/Problem Identification

The exploding urban growth and poor urban planning creates unprecedented challenges, among which shrinkage of water bodies and its surplus channels is the major issue. Continuous shrinkage in width of the flow carrying channel due to urban settlement and the man-made changes to hydrological cycle has induced a flooding scenario in the urban area even for a precipitation which has two year return period frequency. Many studies have been made to simulate the scenario and to suggest management measures. Very few have made attempt to quantify the sociological damages and its associated economic cost due to flooding.

Analysis/Results and Implications for Policy and/or Research

From the hydrological analysis, it is inferred that change in land use has a major impact on flooding scenario. The hydrological analysis for 1985 and 2005 year precipitation is done and the result explicitly shows that even though the precipitation has reduced from 1985 compared to 2005, the urban area under inundation has increased in 2005. The interpretation made from analysis and field observation is that imperviousness in the watershed has increased and the carrying capacity has been reduced due to urban activity.

From the sociological survey and stakeholder's discussion it is inferred that the cause for flooding might be change in land use and variability in micro climate due to influences, but during flooding/ inundation the exposed population is the people whoever settled in the urban slum located along the channel banks. It is also observed that, many management measures have been implemented. The implemented measures when simulated it is observed that, it reduces the flood in one vulnerable area and increased the risk at the downstream.

From the above analysis and interpretation, through the study few management measures has been identified which can really reduce the risk of flooding/inundation on the exposed population.

Building Institutional Capacity at Seattle Public Utilities

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Keywords: climate adaptation, institutional capacity, water supply, urban drainage, sea level rise

Introduction/Problem Identification

Seattle Public Utilities (SPU) provides a reliable drinking water supply to 1.3 million people in the Seattle area and provides essential sewer, drainage and solid waste services to City of Seattle customers. SPU's water supply is derived from two mountain-based river systems that are fed by a combination of snowmelt runoff and precipitation, while its drainage and wastewater systems are driven by precipitation patterns. SPU also operates and maintains infrastructure in an urban environment with an extensive amount of marine shoreline. Given that climate change is projected to alter the hydrologic cycle and cause sea level rise, it is imperative that SPU understand the projected impacts on the systems it manages and to develop appropriate adaptation strategies. This imperative has led to institutional adaptation on the part of SPU and sustained and focused effort on exploring the scientific, technical, policy and management implications of climate change and utility management.

Analysis/Results and Implications for Policy and/or Research

SPU's climate programme consists of two primary areas: GHG mitigation and climate adaptation. The focus of this abstract is on the former.

SPU's climate adaptation work has three focal areas: water supply, urban drainage and sea level rise. SPU's approach to adaptation consists of assessing the impacts, pursuing no-regrets strategies, enhancing our knowledge, building our capacity, collaborating and establishing strategic partnerships.

SPU has had the most experience on adaptation with its water supply line of business. SPU initiated its first climate impacts assessment approximately eight years ago and is in the process of starting its third climate impacts assessment. We have used our previous two studies to use downscaled Global Climate Model (GCM) data to assess impacts on water supply, as well as on demand, and to test the effectiveness of adaptation options. Over the course of the two previous studies we have built up inhouse knowledge of GCMs and downscaling techniques such that we are intelligent consumers of climate information. We our next downscaling study we intend to generate climate-altered hydrology in-house, furthering our evolution and expanding our skill set.

For urban drainage, we have also pursued downscaling as a means to assess impacts, but with the understanding about the limitations of using this assessment technique for urban drainage due to the challenges of modeling precipitation as well as the highly resolved spatial and temporal needs of urban drainage. Given the uncertainty of how climate change may affect precipitation in the Seattle area, we have pursued no-regrets strategies aimed at enhancing our operational capacity. We have developed a nowcasting tool called RainWatch that improves upon National Weather Service forecasts and radar imagery and leverages SPU's rain gage network to generate 60-90 minute forecasts at a neighborhood scale. We have also brought in new skills, including a staff person who is a meteorologist, which is an unusual skill set within a water utility.

For sea level rise (SLR), we have used local projections for sea level rise developed by an university-based research group, as well as observed data for the highest tide on record in the Seattle area, and have created layers in our Geographic Information System database for 2050 and 2100. We have used this information to project areas of inundation as well as to assess the extent to which seawater would enter aspects of our piped network. We are now developing a framework for how to reflect SLR projections into our investment decision-making framework with a goal of developing an adaptive framework.

In addition to the ongoing assessment work, SPU has engaged extensively in initiatives to enhance the water sector's adaptive capacity as well as to influence SPU's and the water sector's operating environment. SPU was a founding member of the Water Utility Climate Alliance (WUCA), an alliance of ten US water utilities focused on climate adaptation. WUCA has published two white papers on climate modeling and decision support systems and has played a leadership role in the water sector. SPU has also contributed to the development of adaptation principles for the water sector which were adopted at an international adaptation workshop in Washington DC in 2010. SPU has also reached out internationally to learn from other parts of the world. SPU is participating on two EU-funded research projects focused on adaptation, and is the only US utility involved. SPU has emphasised engagement and collaboration as a means to learn and share our experience. Over the past three years SPU staff has presented at or attended more than 25 water and climate change events as a means to share our experience and to learn from others. Recognising the important role that the US federal government can play in hastening or hindering adaptive capacity, SPU has been active in attempting to inform US federal climate adaptation initiatives. SPU has testified before the US House of Representatives on legislation that would create a national climate service, and co-chaired the US EPA's Climate Ready Water Utilities Working Group, which developed recommendations for the EPA on how it could support the development of a "climate ready water sector".

The adaptation component of SPU's climate programme is still very much a work in progress, but we have made great strides since the programme's inception. We have leveraged limited staff and a relatively small budget to further our understanding of the climate impacts relevant to our department, created and utilised an extensive network of organisations focused on adaptation and are continually building our capacity to engage the scientific, technical, policy and management implications of climate change adaptation.

Epydemics Threat in Urban Areas of Central Asia Due Global Warming

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Keywords: epidemy, water-related, malaria, typhus, prognosis

Introduction/Problem Identification

An irrigating-agricultures (rise, cotton) is the life-pivotal for whole Central Asia (CA). But reservoirs and canal in urbanising areas are source of danger epidemic illnesses: abdominal typhus, helminthes, cholera, malaria (mosquito carrier), viruses (ticks of birds carrier), etc. There was a high level of the mentioned water-spreading illness in CA during last century (30s-40s, and begin 50s); for example malaria illness reach 25% of population in some areas. Bogs dry campaign led to the diseases disappearance in 60s. But it appeared again in CA states at the end of the 90s due soil and water warming due temperature rise by Global Warming (GW). There are paradox results of GW in CA: desertification of some land on one hand, some part of irrigating land becoming wet due disturbance of water regime and ground waters high up (due soil warming) – on other hand. "New humid areas" are situated in high density of big towns (in neighboring areas with poor population mostly).

Analysis/Results and Implications for Policy and/or Research

New bio-senosis for malaria were creating in intensive agriculture areas (rise, cotton): Fergana valley and in the Lower Syr-Darja and Lower Amu-Darja during last ten years. Even in the North of CA (Kazakhstan) these bio-senosis for malaria have created in the latest 5 years. The latest big epidemic of malaria occurred in CA in 2002, and there were over 3500 sick people in Kyrgyzstan and Uzbekistan. Mosquito spices An hyrcanus, An caspius, C.modestus – live in Fergana valley. The most dangerous spice is An. Hyrcanus, which live and spawn in small water reservoirs in settlements. There were determined many dangerous reservoirs of mosquito spawn in suburb of main towns of CA: 19 reservoirs near Almaty (town population 1,5 mln), 7 in Bishkek (1,3 mln population, capital of Kyrgyzstan), 11 near Toshkent (population 2,3, capital of Uzbekistan), 9 near Andijan (1,3 mln). And even in the North Part of Central Asia 12 reservoirs near Astana (0,9 mln, capital of Kazakhstan). Mosquitoes can carry several viruses in future epidemics (Nile fiver, Hemorrhagic fever, etc), but not only malaria. Number of malaria cases had been stead fasted during latest 5 years in the mentioned towns. A new danger is bird influence. A lot of birds (from Indo-China) migrate via the region and the most of them landing temporarily in lakes. The other water-related epidemic threat is bacterial pollution (due cattle wastage and bad sewage) an abdominal typhus bacteria mostly. The bacteria pollution in Fergana valley (Kyrgyzstan, Uzbekistan, Tojikiston) rise up latest ten years coincidently with temperature rise. For example: KaraDarja river 20-24%, Ak-Buura 30-40%, Kugart 30-40%, Shahimardan-Say 15-20%, Aravan-Say 24-35% (study during 1983 – 2009). Several epidemics of abdominal typhus in the south of Kyrgyzstan and in the east of Tojikiston occurred in 1999-2004 years. Five thousands Tojikistoni citizens died in 1997, over 2 thousands were hospitalised in 2002 with abdominal typhus. Several reservoirs containing cholera vibrio were found during last 5 years in CA. Several experts have suspicion that slight form of cholera cases non redistricted in medicine officers, but occurs really. We have done complex study by maps comparison, maps ranking correlation, and done scenario mathematical methods by Diseases Mapping, 1999. We determine close correlations between – soil humidify on the one hand, and, several mentioned diseases – on the other hand. There is a bad prognosis about epidemics in CA for the nearest 10-20 years. We did some offer for high officials of CA countries: a) to establish warehouses of insecticides and pesticides for emergency situations; b) to ask WHO allow DDT use in CA in epidemics emergency situation (similar India and China), as climate in CA becoming similar as India and China; c) to create 20-30 years comprehensive programme in each CA countries (and inter-governmental regional too) for water-related epidemics avoid; d) to correct old (USSR time) registers of water quality for lakes, water reservoirs, canals – in spite of new conditions.

Mapping of Key Institutions for Building Climate and Water Resilience in Lusaka

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Keywords: institutional arrangements, climate change, peri-urban settlements, supply and sanitation, economic infrastructure

Introduction/Problem Identification

Lusaka, the capital of Zambia, was identified as a hotspot for climate change vulnerability under the Regional Climate Change Programme, funded by DFID. This vulnerability largely stems from Lusaka's significant uncontrolled population growth and urban development over the past twenty years, going from an estimated population of 761,000 in 1990 to 1,385,000 in 2007. Much of this growth has taken the form of unplanned peri-urban settlement areas surrounding the city. During this expansion, Lusaka has not adequately developed water supply and sanitation infrastructure to support the increasing population and increasing per capita demand. Additionally, unplanned development has resulted in poor peri-urban settlements which are vulnerable to frequent and severe floods. Addressing water supply, sanitation, and flooding challenges to build resilient urban centres requires institutional involvement and capacity from government, NGOs, community organisations, and private industry.

Analysis/Results and Implications for Policy and/or Research

A case study through a series of interviews was performed to understand the main climate variability and water-related challenges in Lusaka, and to identify the institutional arrangements for addressing those challenges. Relationships between institutions, institutional capacities, and funding sources were also ascertained. The purpose of this analysis was to understand institutional arrangements in this developing urban context, identify effective institutions and therefore opportunities to support building of resilience in Lusaka, and identify gaps in institutional arrangements.

The most important climate and water-related challenges include supply and sanitation, with particular complexities in the poor peri-urban settlements, and urban economic infrastructure vulnerability to flooding events. Water demand currently exceeds maximum yield for Lusaka's developed water sources, which should be resolvable through further development of adequately available groundwater sources. Unplanned and uncontrolled development, however, has left Lusaka facing considerable pressures to approve septic tanks and unable to stop human developments near groundwater sources, resulting in contaminated groundwater which will require expensive treatment if developed. Peri-urban settlements face further difficulties as they rely heavily on pit latrines, have poor drainage, and depend on standpipes and shallow water wells for potable water. This leads to health problems, particularly disease endemics such as cholera. Finally, economic infrastructure including, roads and telecommunications, are susceptible to damage from flooding.

Institutions considered included national and local government, non-governmental organisations, private companies, community-based organisations, and traditional authorities. The key institutions involved in the city-wide water and sanitation challenges were at the national and city level, including the National Water and Sanitation Council (NWASCO), Lusaka Water & Sewage Company (WSC), and the Lusaka City Council. For the peri-urban settlements, these same institutions, along with the Disaster Management and Mitigation Unit (DMMU), the Ministry of Local Government and Housing and local community representatives, and NGOs contributing to supply and sanitation efforts were key. Urban economic infrastructure participants are largely at the national level, including the DMMU, Road Development Agency, Ministry of Finance and National Planning, and Ministry of Works and Supply.

Examining the institutional capacities and relationships revealed lessons regarding requirements for effective participation, as well as gaps in institutional arrangements. The DMMU plays a large role related to building resilience and responding to floods by leading the coordination of responses from the line ministries, including health, education, and environment. The DMMU is well-positioned to be effective in this coordination role because of its placement under the Vice President's office, which gives it authority to direct actions and therefore resources of other ministries, and recourse in the case of noncompliance at a high enough level so it is enforceable. In contrast, the Lusaka City Council plays a central role in the planning and enforcement of new city developments, but lacks capacity to be effective in this role. As a result of either insufficient planning or inability to enforce plans, settlements developed in unapproved locations, leading to the contamination of groundwater supplies and unhealthy living conditions in the peri-urban settlements. The situation has been exacerbated by the approval of septic tank installation near groundwater sources to provide sanitation relief. This reveals a critical lack in institutional planning and enforcement capacity at a local level which must improved in order to build climate resilience and sustainable water use as Lusaka continues to develop.

This analysis illustrates key climate and water-related challenges, and provides an institutional framework around which to think and engage with building climate resilience and sustainable water use in Lusaka. Additionally, it serves as an example of an institutional mapping in a developing and particularly climate-vulnerable urban centre in southern Africa, and therefore may inform other analyses to understand key institutional requirements and gaps in similar urban areas.

Challenges for Supplying Pipe Borne Drinking Water for the Urban Areas in Developing Countries

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Keywords: urbanisation, water sources, water demand, water quality, water sharing

Introduction/Problem Identification

Demand for urban drinking water is rapidly increasing due to population growth and urbanisation. By 2025 water stress will affect three billion of the world population. Since the fresh water resource is limited it is important to develop integrated and proactive plan for supplying future demands. However, difference between increasing demand and shrinking supply in many water supply schemes implies that the progress towards sustainable management of this vital resource has been less than adequate. In order to cater the future demands it is important to understand challenges that may have to face in future. National Water Supply & Drainage Board is the main organisation involved in supply of drinking water in Sri Lanka and it serve all the cities in the country. There are 33 water supply schemes in Uva province of Sri lanka. Particular challenges which have already arisen and challenges that may have to face in supplying future demands in those schemes are discussed in this paper.

Analysis/Results and Implications for Policy and/or Research

Both quantity and quality issues have to be addressed in development of a long-term approach to sustainable water use. The main issue related to the quantity of water is the lack of reliable water sources. Water sharing in the available water sources is another main challenge for drinking water supply. Since the majority of the population in the Uva province depends on farming, water demand for agricultural purposes is dominant. Since water has been used for agriculture from ancient time farmers never allow to abstract water for drinking water purposes upstream of their intakes. In fact farmers reside in rural areas and they don't allow transmitting water to the urban areas. Due to the protest from farmer organisations several proposed water supply projects have been abandoned and the scope of some projects has been changed though the cost is much higher compared to the original proposal.

Every year there are two dry spells (February to March and July to October) and abstracting adequate raw water from sources is a sever challenge for the water supply officers. Runoff pattern of the rivers has been changed due to the climate change, urbanisation and deforestation, and this will drastically affect in future due to reduced flow of rivers and streams during dry spells. In order to supply the demand especially during dry spells it will be necessary to construct impounding reservoirs to store the demand needed for the dry spells. In addition catchment protection programmes have to be implemented to maintain the base flow of rivers through out the year. Plantation of local plants will be a better solution to improve hydrological characteristics of the catchment.

Lack of flow data in the rivers and streams affect the assessment of changes of runoff pattern. There are no funds allocated for investigation purposes and this will affect the future planning activities. One of the most important ways to increase the supply is to reduce the non revenue water. In the Uva province non revenue water is higher than 30%.

Among the 33 water supply schemes in the Uva province majority is operated with partial treatment facilities. However, raw water quality has been changed severely during last few years and partial treatment facilities are inadequate to treat raw water. Since vast amount of pesticide and weedicide are used in the agricultural areas, facilities should be available to check the presence of those in raw water at the regional laboratories.

It has been estimated that waterborne diseases kill more than 5 million people in the world annually. The microbial pathogens responsible for most of these deaths originate from human and animal feces. In the Uva provincial cities there is no proper sewerage system to treat waste water except for the septic tanks used by the individuals. Hence more attention should be made to prevent the spread of water borne diseases through the water supply schemes. However it should be noted that the reported patients due to water borne diseases in the urban areas where water supplied by the National Water Supply and Drainage Board are less compared to the other areas.

Reduced raw water quality might lead the planners to use best available technologies. However due to lack of suitable lands effective drinking water treatment processes has to be used. In addition more researches have to be carried out to investigate the possible pollution threats. Pollution threats due to new settlers in the catchments should have to be avoided even with the implementation of new laws, education programs, providing hygiene facilities etc.

Proper training should be given to the staff such as pump operators, plant operators, pipe fitters etc as these positions are occupied by non technical persons that lead to poor performance in treatment plants and distribution systems. Therefore it is vital important to employ suitable people to particular positions and improve the effectiveness of the water supply schemes.

Most part of the Uva province consists of hilly terrains and due to lack of suitable lands people has settled in higher elevations too. Supply of drinking water to these higher elevations needs second or third stage pumping of treated water. The tariff applied in the whole country is unique. With the raw water pumping and the treated water pumping, unit cost of the water is much higher and is not feasible for the operation and maintenance of the scheme. Hence it is important to declare the maximum elevation from the mean sea level that drinking water will be supplied by the National Water Supply and drainage Board.

The development of a long-term approach to sustainable water use requires collaboration of politicians, local authorities, other users, community based organisations, nongovernmental organisations and the consumers.

Urbanisation and Climate Change Impacts on the Urban Core Aquatic Ecosystem: Problem and Prospect

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Keywords: urbanisation, sedimentation, climate change, sea level rise, Bangladesh

Introduction/Problem Identification

The aquatic resources of the urban core coastal area are being depleted day by day due to unplanned and unabated practice of urbanisation while global climate change poses threats to overall ecosystem in Bangladesh.

Analysis/Results and Implications for Policy and/or Research

The urbanisation and climate change activities are adversely affecting on the environment, natural resources, water and soil qualities of urban core riverine environment as well as increases of siltation rate in water. The sedimentation rate was found 4.37-14.23 mg/cm^2/day throughout the year in urban core coastal water which eventually effects on the estuarine and river ecosystem including water quality, fishes, benthic organisms, seagrass, salt marsh and mangroves. Besides, the global climate change and sea level rise is the greatest threat and challenge for sustainable urban core coastal adaptation in Bangladesh. The consequences in terms of flooding of low-lying urban areas, retreat of shorelines in urban area, salinity intrusion, drought, flood and changes in the water table have raised serious concerns for the well-being of urban resident and the resources they depend upon. The changes of tidal zones due to the changing of eco-biological processes via sea level rise could extend further toward inland resulting in the alteration of existing vegetations and water profile in the urban core coastal area. The limitation of landward margin together with the vertical rise of water due to sea level rise may cause water logging resulting the stressing and sometimes killing of inter-tidal plants and their dependent organisms within the same ecosystem. However, by this study we assess the impacts of urbanisation and global climate change on the urban core aquatic ecosystem in some of the coastal area of Bangladesh.

Assessing Urban Capacity and Resilience to Climate Change: A Case Study of Peshawar City District

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Keywords: climate change, adaptation, capacity building, indicators, resilience

Introduction/Problem Identification

Pakistan is highly vulnerable to adverse impacts of climate change. Adaptation to climate change is the key priority issue for the country particularly for urban areas as the cities are more vulnerable due to a high concentration of population and economic activities in a relatively small space. This demands capacity building of cities to develop and implement adaptation measures. The first step for which is to assess the capacity of city's infrastructure and services to cope with climate change and climate related disasters. This study has assessed the capacity/resilience of Peshawar City District in Pakistan, with a population of 3 million to adapt to climatic change particularly to extreme climatic events. The City District is the capital and historic city of Pakistan, which has seen massive expansion in the last three decades in both administrative area and population. Located in a valley at the mouth of Khyber Pass, it has been prone to floods, droughts and heat waves.

Analysis/Results and Implications for Policy and/or Research

The paper analyses capacity/resilience of Peshawar City District to climate change and climate related disasters along five major dimensions – physical, social, economic, institutional and natural, which provide a snapshot of conditions as they exist today. The analysis is based on a survey conducted in all four towns and the cantonment, which constitute Peshawar City District covering above five dimensions. Assessment in each dimension is based on five indicators. For example in physical dimension, the indicators included (i) electricity, (ii) water, (iii) sanitation and waste disposal, (iv) accessibility through roads and (v) housing and land use. In institutional dimension the indicators include (i) mainstreaming of disasters risk reduction, (ii) effectiveness of city's crisis management framework, (iii) effectiveness of city's institutions to disasters, (iv) institutional collaboration with other organisations and stakeholders, and (v) good governance. Each of the indicators was further assessed based on five variables. For example taking Electricity as an indicator within physical dimensions the variables included (a) access, (b) availability, (c) supply, (d) external dependency on supply and (e) alternative capacity. Thus overall 125 variables have been considered to map or highlight the capacity or resilience of Peshawar City District and its component towns to climate related disasters. During the survey the respondents (city officials) rated the towns performance against each indicators on a scale from 1-5 based on their five variables respectively. The scores are thus aggregated into indices for mapping resilience/capacity of each town and cantonment as well as the City District as a whole, to see how robust is there capability to adapt to climate change and climate related disasters. The study is in progress and the final results will be presented at the workshop, however, it appears that the resilience of the city district needs considerable upgrading. It is particularly weak in economic dimension due to prevalent poverty. It also needs big attention in term of institutional dimension particularly due to lack of effectiveness of city district's institutions to cope with disasters, lack of crisis management frameworks and lack of effective institutional coordination and collaboration. These problems are not insurmountable; nevertheless they require serious attention in terms of upgrading institutional capacities for handling disasters. More importantly, the situation calls for developing mechanisms for cooperation and coordination between various departments of the Government such as civil defense, police, health, transport, information, education, communication, and departments dealing with utilities and services etc. Moreover, there is a need to develop a coping strategy for climate change and disaster management framework for preparedness and management of climate related hazards.

Balance between Community Engagement and Supporting Facilitation Roles of the Local Government to Reduce the Impact of Climate Change

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Keywords: climate change, community empowerment, climate resilience cities, flood management, community action plan

Introduction/Problem Identification

The purpose of this abstract is to give clear understanding of community empowerment in climate change adaptation and utilising the government support. The urban poor are among the most vulnerable group that in the face of climate changes, as they are incapable to adapt the consequences of the impacts. Those who lived in Asian cities such as Jakarta are especially susceptible to unpredictable environmental changes. Much of the problems in these cities are on the incapability of managing the risk on the preventive side in terms of planning, budgeting and implementation from the local authorities as well as the communities.

A proper technical assistance is in need to improve the capacity and capability of both side, the imbalance of knowledge in climate adaptation between local government and communities needs to be addressed. Therefore, a comprehensive action plan should be introduced to the community living in urban poor settlement within disaster prone areas.

Analysis/Results and Implications for Policy and/or Research

Jakarta as the capital city of Indonesia is one of the densest city in Asia. Divided into five municipalities and one administrative regency (Central, North, East, West, South Jakarta and Kepulauan Seribu Regency), total of the area is 661.52 km^2 with around 35 km of coastal area in the north. With various areas under sea-level of 3 up to 7 meters; the north part of Jakarta is practically prone to flood by sea-level rise. The eastern part of the city which consisting of several large rivers, also prone to flooding caused by the upstream flows.

To overcome this, the government of Jakarta had done some significant efforts such as dredging the river floor and dams, constructions of pump house in flood prone areas including mobile pumps, large canal construction on east and west side of the city, and socialising through clean campaign in solid waste management to the people. The effort in constructing particular infrastructure for flood management is actually on going process, the east side canal still facing land clearance problem and most of the infrastructure doesn't play it role as it supposed to be because the planning did not pay great attention towards what the community really need and local geographic condition. Current 'Go-Green' campaign did not followed up by proper law enforcement.

Donor driven climate change adaptation projects in Jakarta such as Jakarta Urban Flood Mitigation Project (JUFMP) is a good chance to adapt the model. JUFMP is a project that mainly focuses on building infrastructure such as dredging works and rehabilitation of river embankments, pump, rack and bridges. Communities in vulnerable area are the end-user of this particular project, so it is important to ensure they are prepared with comprehensive and do-able action plan. Knowledge and understanding of the available infrastructures is important in order to ensure it will be fully utilises. But all of this effort still doesn't answer the challenge of climate change adaptation since it calls for more comprehensive way of tackling the urgency ahead. The current situation doesn't properly represent the best manageable way in institutional building for the issue discussed since the planning process hasn't been able to facilitate bottom up planning, hence the disaster still shows incapability from both the government and community side.

Jakarta still owns a distinct characteristic compare to other Asian countries in terms of willingness of the people to have a working group in the communities, particularly in urban poor area. The complex migrant group from allover Indonesia still carries this common characteristic into their new neighborhood. On the other hand, the limited knowledge of the local authority in climate change context is also worsened by a big gap of climate change adaptation knowledge by the local communities. Constraint in budget from the local government is no longer a reason for lacking of building infrastructure, urban poor still can contributes with their effort on labor and other in-kind material, not to mention the availability of other funding such as PNPM Mandiri or National Program of Independent Community Empowerment, a government subsidy fund for local development, international donor fund, local government development fund, etc.

The community in urban poor context nowadays has the opportunity and capacity to manage themselves to be more self-sufficient. The fact that the local government staff limited knowledge on some urban technical development aspects and management, lack of knowledge from the community in project management presents the need to bridge the gap and to accompany the knowledge transition.

A community approach for climate adaptation is called for. In concept, the programme is addressing the challenge to create a balance between community engagement and government role in supporting the facility. The main concern of the programme is how to educate the community and local government officer in the sub district to be able to self-sustain when it comes to climate change adaptation. The limited knowledge from the local official in climate change adaptation and mitigation will be bridged. The communities will also benefited by understanding the same learning module, so they are more equipped with the tools to prepare plans and actions. A balance between community engagement and supporting facilitation roles of the local government in a community based project will ensure the sustainability of the project being addressed since it can be self-managed afterward. New ideas and innovations will likely be introduced in the programme and the aim is that both the community and local government official could produce and fully utilise the Local Resilience Action Plan (LRAP). The LRAP will provide a framework to establish a pragmatic and comprehensive action plan for the community to better manage DRR in the short term, and climate change adaptation in the long term.

Precipitation Extremes, Flooding and Adaptation in the Greater Toronto Area (GTA), Canada

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Keywords: climate change, extreme precipitation, urban flooding, damages, adaptation

Introduction/Problem Identification

Since 2007, more than half of the world population live in urban areas and within next two decades, more than three quarters of the world population will be living in urban areas and in Canada it would be more than 80%. As urban are expanding, climate of the cities are becoming very important for its growing population. Warming of our climate system is clear and unambiguous as concluded by the Intergovernmental Panel on Climate Change (IPCC) in its 2007 Fourth Assessment Report (AR4). In the last one hundred years (1905-2006), the world has warmed up by three-quarters of a degree Celsius. The IPCC projects widespread increases in extreme precipitation with greater risks of not only flooding from intense precipitation, but also droughts from greater temporal variability in precipitation in North America. Population and infrastructure in the urban areas will be particularly vulnerable to flooding from extreme precipitation.

Analysis/Results and Implications for Policy and/or Research

The Adaptation and Impacts Research Section (AIRS) has recently concluded a study on the climate change in the Greater Toronto Area (GTA). The study considered climatological data for 10 meteorological stations in the GTA for the period 1971-2000. The stations have been classified into urban, sub-urban and rural stations. Analysis shows a consistent increase in annual mean temperature in the stations in these three settings. Annual precipitation in the urban areas shows a decreasing trend while it demonstrates in general an increasing trend in sub-urban and rural areas. Heavy precipitation extremes (e.g.20 mm) have increased in rural stations but decreased overall in urban and sub-urban stations. Short duration extremes did not show any trend.

Although analysis of historical data do not demonstrate any trend in heavy precipitation extremes in urban and sub-urban stations in the GTA, in recent years, it has experienced many extreme weather surprises. The August 2005 storm was one of eight extreme weather events in the period 1985-2005. The City of Toronto rain gauge recorded 153 mm rain over 24 hours. The event exceeded 1 in 100 year storm in northern part of the Toronto City and it washed out a portion of Finch Avenue. The main categories of damage were: erosion in ravines and water courses; sanitary sewer collapse; basement flooding, watermain breaks and flooding of waste water treatment plant. Damage to public and private property was estimated at $400-500 million. The storm flooded more than 4,200 basements and damaged stream banks, trees and parks. The summer of 2007 was the driest summer in 50 years, with 95 consecutive days without significant rain. Droughts harm wetlands, trees, plants and the ecosystem in general. In future, increased precipitation could cause: pressure on the storm water management system; Flooding of basements and low-lying areas; increased wear and pressure on culverts, bridges and other transportation infrastructure; Contamination of streams and lake from runoff; and Erosion of rivers and streams.

In order to tackle extreme events like 2005 flooding in Toronto, following adaptation measures are either already place or underway. They are: (1) A 25-year plan designed to reduce flooding from intense rainfall and impacts on streams and lake water; (2) very low cost downspout disconnection rain barrels reduce storm sewer overload and provide water for lawns and gardens; (3) a subsidised programme to install back-water valves and sump pumps on household sewer connections provides additional protection against flooding from sanitary sewers. Back-water valves reduce the risk of basement flooding; (4) incentives are available for green roofs to be installed on new or renovated Toronto buildings. Green roofs capture and retain storm water and cool the buildings on which they grow; (5) The Toronto and Region Conservation Authority's system helps prepare for flood emergencies and reduce damage to life and property; and (6) There is a potential for tree canopy. Expanding the tree canopy will increase shade, reduce the urban heat island effect and reduce runoff. These measures are not part of any integrated plan.

The adaptation process should create a "flexible adaptation pathways" that would allow policy makers, stakeholders, and experts to develop and implement strategies that evolve as climate change progresses. Market mechanisms such as pricing can be responsive to changing conditions. Adaptation measures should be designed in such a way so that it can absorb a wide range of climate conditions-means the affected system must be able to continue functioning as intended even in extremes of different magnitudes.

To meet the challenges of future climate change, a detailed adaptation plan for the Greater Toronto Area is still absent. The planning process should comprise of the following steps: (1) identify current and future climate changes as much as finer resolution possible; (2) assess the vulnerabilities and risks especially the poor communities; (3) develop an adaptation strategy using risk based prioritisation schemes; (4) identify opportunities for co-benefits and synergies across sectors; and (5) adaptation options to be identified based on past experience and extensive public and expert consultations. Infrastructure questionnaire, risk matrix and strategy framework tools can be employed to identify and analyse adaptation options.

Uncertainty is a big obstacle for the policy makers to make decisions. Climate change is an additional source of uncertainty for the decision makers as well as it will pose additional risks. Climate change is expected to alter the choice between, and the balance of risk associated with, different options for managing risks. Policymakers need to apply appropriate frameworks for decision making under uncertainty. These frameworks are: top-down (scenario based); bottom up (engineering safety margins, anticipatory design, resilience and adaptive management).

Adaptation Strategies to Face Climate Challenges in the Megacities of India

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Keywords: climate change, India, megacities, adaptation, urban policy

Introduction/Problem Identification

Millions of unaccounted population living slums and climate sensitive coastal zones and wetlands make the fast expanding megacities of India highly vulnerable to the impacts of climate change. Providing basic necessities and ensuring safety and quality of life under a changing climate condition have become complicated management issues in these cities. The four megacities – Mumbai, Chennai, Kolcutta and Delhi – are already under tremendous pressure from the rising population and development activities. Existing urban infrastructure is quite inadequate to face these challenges. Safe water and power have become expensive and the supply is often unreliable. Changing climate pattern also causes serious health issues. Storms and floods bring catastrophes to the coastal megacities. The situation leads to social issues such as migration, competition and conflicts. Current strategies for climate change impact mitigation and adaptation are not efficient.

Analysis/Results and Implications for Policy and/or Research

Population as well as the size of the megacities of India are fast expanding, worsening the impact of climate change. Mumbai with a population of more than 16 million is now the world's fourth-largest urban area followed by Kolcutta. By the year 2020, 12 out of the 100 largest cities in the World will be in India, Mumbai ranking second in the list. Even now, more than half of the population in Mumbai is living in slums or informal settlements with high risk from climate extremes. Industrial development associated with globalisation and setbacks in rural agriculture leading to fall in rural employment opportunities promote uncontrolled migration to cities. Changing climate and sea level variations may result in a large inflow of environmental refugees to these cities in the coming decades, including illegal migrants from neighbouring countries. The cities are not well-designed to accommodate such a large population. Decade's old inadequate, not well-maintained drainage system causes floods during monsoon months. Severity of floods increases during climate extremes, resulting in casualties and outburst of epidemics. Area prone to malaria is likely to extend to Mumbai in near future. Changing climate, especially the extremes have already started affecting the urban area. Rainfall is becoming more seasonal and intense. Mumbai experienced the worst flood in year 2005 from the record one-day rainfall. Delhi was under the threat of flood in the Yamuna River during the monsoon of 2010. Conditions of floods and droughts worsen in the northern parts of India with the retreat of the Himalayan glaciers. This will have far-reaching impact in the capital city of Delhi. There is also a considerable fluctuation in urban temperature that leads to heat and cold waves. Cities other than Delhi lack a sincere effort to control the greenhouse gas emission from vehicles. Three of the mega cities – Mumbai, Chennai and Kolcutta – are in the coastal region and they face threat from the sea level rise, increased wave action and increasing frequency and severity of cyclones associated with climate change. Tide gauge data shows nearly 1 mm/year rise in sea level along the Indian coast. Salinity intrusion in coastal aquifers seriously affect the cities Mumbai and Chennai. Perhaps the most serious impact of climate change on cities is the decreasing availability of reliable water and power. The cities experience seasonal water stress. Competition for water is already leading to conflicts among urban inhabitants and also among urban-suburban and urban-rural populations. Urban environments are fast changing, as a result of industrialisation associated with globalisation and development of tourism. Many cities are growing fast to get the status of megacities. Wetlands, paddy fields and green cover in and around the cities have been widely destroyed for economic expansion zones and residential complexes, adding to the impact of climate change. Current strategies for climate change impact mitigation and policy for adaptation to climate change are not efficient. The implementation mechanism often fails because of various administrative, social, political and economic reasons. This paper is a comprehensive assessment of the impact of climate change on different facets of life in the megacities of India. Climate change scenarios adopted by the ministry of environment, data from the India Meteorological Department and reports of various ministries and research institutions have been used for the study. Extremes in hydrometeorological conditions have been analysed and changes in water availability under a predicted change in rainfall and temperature have been assessed using hydrological model. Results point towards acute water shortage in the cities in the coming years. Climate change will make life in the cities more and more miserable, unless measures for adaptation and control of environmental degradation are taken immediately. Providing better facilities in planned suburban centres and relocating urban industries may help control the population inflow and expansion of slums. Strict implementation of the coastal zone regulation act and structural measures to face the rising sea level are utmost important, especially in Mumbai. Protection of urban and suburban water bodies including groundwater resources and improved water conservation programmes starting from the domestic level can help reduce the impact of climate change on urban water sector. A critical review of the current policies and strategies related to climate change shows that they are not efficient in the urban sector, though the Ministry of Urban Development has initiated several institutional, fiscal and financial reforms. India needs an appropriate and frequently updated climate change adaptation policy and an urban policy. Guidelines for this have been provided.

Capacity Building of Community Structures to Reduce Vulnerability of Climate Change in Urban Areas

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Keywords: capacity building, community structures, reduction, vulnerability, climate change

Introduction/Problem Identification

Climate change is no longer an issue for the future. It is already taking place, and the developing countries like Uganda are most at risk. In this effort of combating climate variability change, Voluntary Action for Development a non governmental organisation operating in Wakiso and Mpigi urban centres focuses on building capacity of community structures in promotion of Water and sanitation improvement as an approach to combat climate variability change. Voluntary Action for Development trains Water User Committees, Community Monitoring Teams, Sanitation Clubs and local leaders in operation and maintenance for sustainable water supply, proper management of garbage and sanitation in the urban cities; and to demand for better services. VAD has trained 30 Community structures of 20 members each making a total of 600 members in Nansana, Kawempe, Matugga, Kawanda, Ganda, and Kyebando trading centres. This has contributed to reduction in vulnerability of climate change in urban cities.

Analysis/Results and Implications for Policy and/or Research

There is improved hygiene and sanitation due observed proper management of garbage disposal, proper handling of drainages, proper waste disposal and good hygiene behaviours. All this reduce on climate vulnerability change.

Through community structures, urban communities are aware of the existence of the National water, sanitation and environmental policies and they have begun to take part in implementing such policies.

There are reduced incidences of water and sanitation diseases caused by climate change like malaria, skin rushes, diarrhea and typhoid among others.

There is community empowerment in that the communities are part and partial of solving the problem of climate change. They are in better position of rising their voices on climate change, discuss issues on combating climate change and taking such message to the people they represent.

The Uganda Water statute provides the formation community structures for the purposes to ensure sustainability of the water and sanitation facilities through proper management, operation and maintenance and monitoring of hygiene and sanitation. However, the policy does not stipulate community structures to engage in combating climate change. Therefore there is need for government to formulate a clear policy on climate change in greater involvement and consultations of the communities and the local leaders

Reviving the Tanks and Their Channel Net Works for Mitigating the Flood Risks During the Monsoon Season at Madurai City, Tamilnadu, India

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Keywords: tanks, encroachment, flood, net work, rehabilitation

Introduction/Problem Identification

Madurai city is the one of the famous and historical place in India.Madurai city area is endowed with 38 more tanks and their channel net works. These tanks and channels are built during the kings period and getting water from the Vaigai river passes through the city. These tanks and channels were maintained and managed by the community in those days with the well established local management and governance system. Because of the city development, population growth,encroachment of the tank and channels and improper management of these water bodies, many tanks have lost their functioning and the channel net works got abandoned. Now out of 38 t anks, 11tanks have been fully abandoned and 10 more partially getting abandoned.Due to the reasons and situation above during each North East monsoon season(October to November every year) city is facing the acute problem of flood and its implication on the city dwellers and their assets.

Analysis/Results and Implications for Policy and/or Research

In the situation above the DHAN Vayalagam (tank) foundation, a Non Government organisation have initiated a project called tank restoration and renovation with the community ownership and participation to revive the defunct tanks and their channel net works as to bring back the original conditions of the tank system to effectively dispose the water to the drainage net work and protect the city people from the ill effects of the flood during the north east monsoon perippod. DHAN Vayalagam (tank) foundation has created a concept called CURE (Conservation of Urban water Resources) for entire protection of the water bodies existing in the Madurai city.One exclusive professional staff has been appointed for the initiative and the CURE focused mainly on three purposes namely reviving the urban water bodies to protect the community and their assets from the floods during the rainy season and there by augmenting the ground water through stored surface water in the tanks. Secondly, to evolve the model for Decentralized Waste water Treatment plant and implementing at one or two places and thirdly creating demonstrations of house hold water treatment through different filter technologies.

The Dhan foundation, Parent organisation of DHAN Vayalagam (tank) foundation, is conducting the Mdurai Marathon every year in Madurai City with the focus of the particular theme to create the mass awareness among the community in the city. First three such Marathons have adapted the theme called Urban Water Bodies conservation to create the awareness among the city people to protect the tanks and water bodies against the present climate change and global warming implications. During the Madurai Marathon 2007, 2008 and subsequent years the CURE, created for Urban water resources development, has contributed much to position the theme on conserving the urban water bodies. It has collected the details of all the 38 water bodies and their current situations and mapped the encroachment status of these tanks. Then the same has been created as data base and printed a small booklet and circulated the same to all planners and agencies in the city for integrating the same as planing document for developing the water bodies. The CURE also has mobilised some resources through the DHAN Foundation for revival of the water bodies in the city. For that it has approached the corporates, Industrial houses and public trusts and put the appeal for renovating few water bodies through the corporate social responsibilities. With this approaches three water bodies have been rehabilitated with the support from the philanthropic resources. Among the three one is the long channel feeding the tank which was not functioning for the more than 20 years and the entire channel has been surveyed with the help of Public Works Department, Madurai, and then it has been rehabilitated by deepenign the channel with earth moving machine. After 20 more years it has got its life to transfer the water to the tank. During the implementation so much pressure has been realised from the encroachments. During the recent monsoon the channel has carried the water and it functioning properly.

Through this CURE, two more temple tanks also have been rehabilitated. By this model, the CURE has created the approach that the work has been implemented with the public cooperation and created the message that the existing tanks and channels needs to be protected as to cope up with the changing monsoon and its effect on the lives of the people in and around the Madurai city. If these water bodies and channel net works are not cared properly, the entire water during the monsoon would causes the severe inundation of the city and its people and it leads to various problems on the lives of the 15 lakhs people in the city.

In addition CURE also have collaborated with the District administration to create the decentralised waste water treatment plant at Paniyur with the funds from Mainstream and community. This is going to be the pilot plant in Madurai city to treat the toilet waste water and reuse the same for vegetable cultivation. During the last three years the CURE also has done tremendous work on creating the awareness on safe drinking water, revival of tanks and temple tanks and sanitation related as against the implications of climate change and adaptation.

Using Climate Information to Prepare for Health Effects of Extreme Events – The Red Cross Bridges the Gap from Meteorology Services to Community Level

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Keywords: climate information, early warning, water-borne disease, climate change, community based

Introduction/Problem Identification

A key focus of the Red Cross Red Crescent strategy to tackle the health effects of climate change is to make better use of climate information to prepare for extreme events and the related health effects. Health managers are often not making the best use of such information for a variety of reasons. Meteorology services are not used to tailoring their services to the operational decision making needs of health or disaster managers. Available climate services are often communicated in very technical language which might be hard for operational decision makers to understand and to translate in a way which allows them to communicate the information to local communities. Urban areas pose a particular challenge due to different vulnerabilities than those present in rural areas where many community based organisations have more experience of working.

Analysis/Results and Implications for Policy and/or Research

To address some of these challenges, the Kenya and Tanzania Red Cross National Societies are implementing a 2.5 year operational research project supported by a grant from the Rockefeller Foundation. The project is coordinated by the Red Cross Red Crescent Climate Centre with technical input from the Columbia University Centre for Research on Environmental Decisions. The aim of the project is to establish community based early warning systems for extreme rainfall in peri-urban and rural communities in Kenya and Tanzania. This would allow for actions such as prepositioning of water purification equipment and the mobilisation of volunteers to prepare the community. In the process of developing this early warning system the aim is to extract lessons learned in order to facilitate this process for other Red Cross and Red Crescent National Societies.

As part of this project the Kenya and Tanzania Red Cross National Societies have each carried out a 'table top exercise'. This is a process where key staff sit together and reconstruct a flood response, either based on a hypothetical scenario or a past event. In the case of Tanzania, the focus of exercise was the El Nino season of 2009/2010 which resulted in flooding in some parts of the country. A seasonal forecast was given in August 2009, and certain actions were taken such as constructing different possible scenarios, looking over contingency plans and taking stock of volunteers at branch level. A constraint in being able to take pre-emptive action was available resources. A key lesson learned was that it is important to keep track of short term forecasts throughout the season to enable more detailed planning.

In Kenya the table top exercise was used to deconstruct a hypothetical flood scenario in Nyanza. Key actions that the National Society normally takes in preparation for a flood season and in response to a flood were identified and the next step was to look at which of these actions could be taken earlier with better climate information at different time scales such as seasonal or with a lead time such as 10 days or 2-3 days.

An important part of the project is also to engage at community level through interviews and baseline surveys to understand how the community prepares and responds to floods at the moment, including us of traditional early warning information such as the croaking of frogs in the case of Nyanza. This allows for the identification of entry points for disseminating and acting on climate information.

The information from the community level, taken together with the results from the table top exercise is helping the Kenya and Tanzania Red Cross to engage in dialogue with their respective meteorology services. The objective is to produce more demand driven and user friendly climate services.

In Tanzania, the IRI is building the technical capacity of the Tanzania Meteorological Agency to enable them to provide climate information on extreme events within a season. The Tanzania Red Cross is also part of this dialogue to provide an operational perspective to the development of these forecasts.

Detailed results from these exercises will be presented during the workshop.

Regional Climate Model Projections for Urban Hydrological Planning and Adaptation: The SUDPLAN Project

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Keywords: climate change, urban hydrology, precipitation, downscaling, bias correction

Introduction/Problem Identification

Changes in the climate can potentially greatly impact urban hydrological processes and thus the functionality of e.g. sewer networks and waste-water treatment plants as well as the status of surrounding recipients. In a general qualitative sense, main impacts may often be roughly inferred directly from the estimated future climate changes on a regional scale. More in-depth quantitative assessment however always requires local hydrologic and hydraulic modeling, taking into account the specific design and status of the urban environment. Such modeling is however difficult to perform, mainly because (1) relevant climate model results are difficult to access, (2) the spatial resolution of climate models is too coarse and (3) climate model results have systematical errors (biases). There is thus a need for services providing downscaled and bias-corrected climate model results suitable in local urban-hydrological climate change impact assessment.

Analysis/Results and Implications for Policy and/or Research

The EU-project SUDPLAN (Sustainable Urban Development Planner for Climate Change Adaptation) aims at developing a web-based planning, prediction and training tool to support decisions in long term urban planning. This will help to assure population´s health, comfort, safety and life quality as well as sustainability of investments in utilities and infrastructures within a changing climate. With its open nature and architectural design, SUDPLAN will contribute to a shared information space in Europe.

The functionality of the SUDPLAN tool is centered around three so-called "common services" related to (1) rainfall for urban hydrology, (2) river runoff and (3) air quality. In the tool, results from Regional Climate Model (RCM) scenarios will be made available with possibilities of further processing and downscaling to allow for local climate change impact assessment. A key feature in SUDPLAN is the acquisition and processing of local observations uploaded by the user. Such local data are important, often necessary, for downscaling and bias correction, and the use of local data further brings the application closer to the stakeholders and their local knowledge. The SUDPLAN tool will provide state-of-the-art technique for visualisation and characterisation of the data.

The urban hydrological common service is in turn intended to have two main functionalities, both based on analyses of local RCM precipitation with a 30-min time step. The first focuses on single events and is particularly relevant for flood risk assessment. By extreme value analysis, the RCM data will be used to estimate future changes in short-term precipitation extremes and in particular the Intensity-Duration-Frequency (IDF) curve which is widely used in urban hydrological design. By this function, the future change in the short-term rainfall intensity for a certain duration and a certain return period may be estimated. Further, a design storm may be generated for subsequent direct input in e.g. hydraulic sewer models. Both a static and dynamic version of the design storm is intended, where the latter takes into account storm movement in a user-specified direction.

The second urban hydrological functionality focuses on continuous rainfall time series with particular relevance for e.g. treatment plant loads and sewer overflow. By analyses of continuous RCM precipitation time series, future changes in the frequency distribution of short-term intensities as well as precipitation occurrence will be estimated. These changes may be projected onto a historical time series, generating a realisation of a future time series for subsequent model input.

The river runoff service is intended to provide boundary conditions in the form of discharge in rivers flowing through the city or in some other way interacting with the urban hydrological system. For this purpose, the user may extract a local version of the pan-European E-HYPE model, which includes all sub-basins upstream of the point-of-interest (for example at a stretch of river within the city that is sensitive to flooding). This local version of the model is then automatically recalibrated to the nearest gauging data (measured river discharge data). Users may add their own measured river discharge data within the local model domain for improved calibration. The recalibrated local model can then be used to simulate local hydrological scenarios using bias-corrected RCM projections as inputs.

The services are developed in close cooperation with end users through a number of pilot applications, notably in the cities of Wuppertal (focusing on flood risk) and Linz (sewer overflow).

In this presentation, an overview of the SUDPLAN project will be given with particular focus on the urban hydrological common service. Results from tests and applications of the various functionalities will be shown and discussed with focus on the uncertainties involved and the implications for practical adaptation.

Views from the Frontline [VFL]

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Keywords: [DRR]Disaster Risk Reduction, [HFA]Hyogo Framework for Action, local governance, partnerships, cultural sensitivity

Introduction/Problem Identification

Uyo the capital city of Akwa Ibom State has never witnessed any scientific disaster risk reduction programme which instigated this study. Views from the Frontline is a participatory multi-stakeholder engagement process which uses a survey questionnaire based on a series of core indictors as articulated in the HFA. Through guided face-to-face interviews and focus group discussions with two key informant groups (local government officials and community representatives) we were able to assess the level of progress achieved. Following an initial analysis of 3000 respondents, a programme of local consultations was held to better understand the contextual reasons for the specific indicator ranking and different perceptions of progress. These discussions highlighted key challenges and constraints encountered by the local authorities, identified drivers of success and agreed recommendations to accelerate progress at the local level.

Analysis/Results and Implications for Policy and/or Research

The VFL methodology is modelled on the Hyogo Framework for Action based on five main PFAs or 'strategic areas' in addition to a set of cross cutting issues namely:

1. Governance
    - Frameworks and structures
    - Planning
    - Financial resources
    - Financial resources (for partnerships)
    - Human resources

2. Risk assessment, monitoring and warning
    - Disaster risk assessments
    - Early warning systems
    - Risk management systems

3. Knowledge and education
    - Information management and exchange
    - Formal education (curriculum)
    - Formal education (training of teachers and materials)
    - Community training
    - Public awareness

4. Underlying risk factors
    - Environmental and natural resource management
    - Adaptation to climate change

- Food security
- Social protection
- Economic protection
- Poverty alleviation
- Land use
- Urban planning
- Overall planning
- Building codes and standards
- Building codes and standards (enforcement)
- Protection of critical public facilities
- Public-Private Partnerships

5. Disaster preparedness and response
    - Disaster preparedness capacities (future risks)
    - Disaster response
    - Disaster preparedness and response planning
    - Disaster response and recovery
    - Evacuation
    - Training drills and rehearsals
    - Financial reserves and aid
    - Coordination and information exchange

6. Cross cutting issues
    - Community participation and information
    - Actual and fair participation
    - Encouraging volunteers
    - Training activities
    - Gender
    - Gender (resources)
    - Cultural sensitivity (diversity)
    - Cultural sensitivity (traditional knowledge)
    - Cultural sensitivity (languages)

The higher scores reported in the survey suggest that while awareness and establishment of policy may be moving ahead at the state level, there is an urgent need to now focus on action at the local level. The VFL country report from Nigeria highlights this challenge butressing the fact that within the governance theme, a reasonable degree of awareness exist particularly cultural knowledge on dealing with disasters. For instance, a local government leader in the riverine Onna Local Government Area took the VFL team to see a bridge, which had collapsed due to erosion and flooding, cutting communications to several villages in the region. She has been trying unsuccessfully for several years to secure resources from central government to rebuild the bridge – essential for local communities. In the meantime, local villagers have managed to create limited pedestrian access, using their own resources. From our survey, we can reach the conclusion that though there is a national DRR strategy, which is based on the HFA, but bridging the gap between policy and practice is the challenge.

Promotion of Rainwater in Coastal Urban in Bangladesh for Safe Water Solution in Light of Climate Change and Adaptation – A Success Story of SPACE

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Keywords: climate refugee, migration, coastal urban, rainwater tanks, capacity development

Introduction/Problem Identification

Bangladesh, like other developing countries, experiences rapid growth of urban areas caused by huge migration of its rural poor people, mostly the climate refugee. They take shelters in existing slums or develop new squatters. Apart from socio-economic problems, severe crisis of safe water, sanitation and hygiene facilities impose them into frequent health hazards, extreme poverty and gross inequalities. These problems are more acute in coastal urban.

Morelgonj Municipality locates in southern coastal zone of Bagerhat district, goes under brackish water at least once in a day due to high tides. Its population density is very high due to due to regular migration of disaster-victims from rural areas that have taken shelters in existing slums and developed new squatters where they do not get access to safe water and sanitation facilities. These unwanted situations compel them to use brackish water and impose them into high prevalence of diarrheal diseases and extreme poverty.

Analysis/Results and Implications for Policy and/or Research

Rapid growth of population in both small and big cities have worsen the situations as urban development strain the existing water resources. The existing water sources are over-exploited and frequently polluted due to over used by the increasing populations. Bangladesh is a tropical country and receives heavy rainfall due to northeasterly winds during the rainy season influenced by monsoon. The average annual rainfall in Bangladesh varies from 2000 to 2800 mm, 75% of which occurs between May and September although effects of climate change have turned the situation into uncertainty. The low rainfall, less than 1,500 mm, occurs in the western part of Bangladesh. The high rainfall occurs in the eastern part and coastal zones of Bangladesh, which provide good opportunity for rainwater storage and safe water solution.

Realising the contexts of coastal urban and miserable conditions of the inhabitants, people, SPACE a specialised NGO in Water, Sanitation and Hygiene (WASH) in Bangladesh has installed household based 50 concreted Rainwater Tanks in the early of 2008 at a selected area of Morelgonj Municipality. Water storage capacities of rainwater Tanks were 2500 to 4000 litres and those were made of bigger size concreted rings with 52"-60" diameters as the alternative solutions. It is to be noted that these rings are usually used in constructing manholes for sewerage and constructing pit-latrines. SPACE demonstrated an alternative use of those rings for the rainwater harvesting and storage purposes as those are locally available and affordable as well. Unit cost of ach Rainwater Tank was Tk. 9000 to 12000 (Equivalent Euro 95 to 125). These were mainly attached with Tin-shade house for catching rainwater after flashing the catchments. Few of the users, who did not have tin-shade roof use polyphonic paper and clean cloths as catchments for collecting rainwater. These tank could ensure access to drinking for a single family consisting of 5-6 members round the year if they use abandoned rainwater directly during rainy seasons, store and ensure improved management. The owner shared about 30% of the total construction costs through cash and manual labor. At present, 262 people from the rainwater tanks can have drinking water round the year.

In order to enhance use, operation and management capacities of the Tank owners, SPACE conducted various audience-fit awareness raising activities e.g. school sessions. Court yard sessions, child to adult approach, popular theatre etc along with imparting Mason training on quality construction and user's training on efficient use, operation, maintenance and management. Besides, SPACE also conducted regular monitoring during implementation phase and follow-up at a certain frequency after phasing out.

The recent study conducted by SPACE reveals that reveals that almost 97% of the installaed Rainwater tanks are well-managed by the users and found full functional. All the family members and neighbors are careful for the security, neat and cleanness of the tanks. Taking experience from these rainwater tanks, good number of solvent families in the same areas and neighboring areas has constructed the tanks by their own investment. The field report further revealed that many of the neighboring households collected and reserved rainwater without tanks and using their small jars and utensils.

The trained masons have increasing demands in the areas for the constructing of these types of rainwater tanks. They have also got alternative job opportunities using their technical skills. One of the trained masons was hired by an organisation in abroad for buying his technical skills.

As results of the project, physical burden and mental stress of women and girl children have been reduced since they can collect safe drinking water at their door steps. Field findings again reported that many of the rainwater users have got relieve from many intestinal sufferings and diarrheal diseases.

The field reports also quoted few problems which contained inadequate capacities of the tanks mainly the tanks with less than 3500 litres of capacities, insufficient resources in compare to the huge demands of the rainwater among the poor people. Besides, few of the tank owners gave reserved water during dry seasons due to kinship feelings. They failed in managing water for drinking purpose round the year.

SPACE has gained unique learning from implementing the project. Those include, utilising locally affordable resources are always cost-effective, affordable, sustainable and easy to make people aware and motivated for ensuring their active participation in implementation, monitoring and evaluation process. It is also efficient in easily solving the WASH related problems in urban areas.

The major challenges now have emerged with SPACE to mobilise required resources for responding increasing demands of the poor urban inhabitants of Morelgonj and neighboring urban areas of the coastal zone.

Using Environmental Flow Assessment Results as an Adaptation Approach to Climate Change

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Keywords: environmental flow assessment, water allocation, flow scenarios, climate change adaptation, climate resilience

Introduction/Problem Identification

Environmental flow assessments can be used to support water allocation decisions that are based on development scenarios and multiple criteria. Flows assessments create adaptive capacity to identify and plan for ecosystem-based measures that include recharging of aquifers, refilling of wetlands as wetter areas with lower evaporation, and reconnecting floodplains to buffer against the damage of floods. In essence, implementing environmental flow management builds climate resilience as it provides a mechanism to 'engineer' environmental outcomes that benefit ecosystems and their uses. This type of environmental management can benefit urban areas by buffering against water related shocks (such as flooding and drought).

Analysis/Results and Implications for Policy and/or Research

An environmental flows assessment undertaken in the Pangani Basin in Tanzania is being used to organise ecological, social and economic knowledge of the basin to aid future planning and management of its water resources. In addition, climate change modeling undertaken in the Pangani Basin has predicted that the seasonality of stream flows in the Pangani is likely to be changed due to hotter and drier winters.

Based on these climate predictions and using the information from the integrated flows assessment, scenarios looking to 2025 are being developed to determine how different water allocations under this climate future will impact economic development, environmental health and social well-being in the basin. This paper demonstrates how environmental flows is being used as an adaptation tool in the Pangani Basin and how this approach is guiding decision making at the basin on water allocation as well as influencing at wider scales including the national, regional and international levels.

Assessing Cities Vulnerability to Floods by Using Indicators: An Overview

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Keywords: vulnerability, assessment, indicators, floods, climate change

Introduction/Problem Identification

Heavy precipitation can lead to fluvial floods in cities, possibly resulting in urban drainage flooding. Extreme weather events are nothing new across Europe. However, changes in precipitation patterns and magnitudes due to climate change can contribute to an increased occurrence of potentially damaging fluvial- and urban drainage flooding events by factor 30 (Jacobs *et al.* 2000; Arnbjerg-Nielsen 2008). Vulnerability assessment by indicators can show where the most vulnerable people or building structures are and support decision makers in deciding where adaptation measures are needed. Population groups most likely to be vulnerable to floods are elderly, disabled and sick people, ethnic minorities, and low income groups (Werg *et al.* in preparation).

Analysis/Results and Implications for Policy and/or Research

We reviewed nine different vulnerability indicators for fluvial floods and one for urban drainage flood from the literature. There are two different foci of the existing vulnerability indicators: They contain either social components to identify vulnerable groups or geographical components to identify vulnerable buildings structures. To identify vulnerable groups many different indicator components are used with various levels of detail: from data on population density to very specific data on household types and age classes. Most of the data is probably only available regionally (census data). Only one indicator integrates social hot spots (e.g. schools, hospitals) and only two indicators include components describing ecological values (e.g. existence of vulnerable biotopes). The main reason for selecting a specific component was the data availability. The methods used for aggregation of the components vary considerable; they were using simple arithmetic operations up to sophisticated statistical methods as well as expert opinions. An evaluation or validation of the proposed indices, e.g. in form of a plausibility check or sensitivity analysis of the components, is largely missing. No clear framework or methodology to select and aggregate the indicators could be identified.

There is no firm theoretical background or agreed methodology for the development of vulnerability indicators to climate change impacts. Thus, the development of each new indicator should be transparent and give the rational for the choice of the components and the way of aggregation. The interpretation of the indicator results must be done with great care. Intermediate aggregation levels should always be visualised and communicated together with the final results.

Adaptation of Water System to Climate Variability and Change for Urban Sustainability

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Keywords: climate variability and change, water system, vulnerability, adaptation, urban sustainability

Introduction/Problem Identification

Adaptation of the water system to a changing climate is the primary focus of urban environment and sustainable development. Even with restriction on the worldwide production of greenhouse gasses, the climate will change in the course of the coming century. The approach up until now for the development of adaptations and alternative strategies, was to adapt spontaneously, without caring for end result. The scope and direction of climate change are surrounded by uncertainties. Change in seasonality is leading to the extinction of certain plant species. Human are exposed to climate change directly through the weather patterns and indirectly through changes in water, air, food, ecosystems, agriculture, livelyhoods and infrastructure. Anomalies in rainfall have become more frequent in Jammu region of India. A study was conducted to monitor the extent and impact of climate variability on water regime in urban Jammu and to adapt to changing climate with possible affordable measures.

Analysis/Results and Implications for Policy and/or Research

The impact of minor levels of climate change are already being felt in urban Jammu, with impacts across many economic sectors. Though, it has been difficult to evaluate climate change in short period, however, climate variability is quite apparent in time and space. Rising temperature in Jammu and surrounding areas has led to intensification of the hydrological cycle, resulting in increase in drought years. Changing climate has caused shift in ecosystem and a significant impacts on the quality and quantity of water. The predicted changes in quantity, quality and accessibility has significantly affected the population, through impacts to agriculture and food security, health, economic activity, and conflict over water resources. Poor urban planning has contributed to a reduction of the resilience of ecosystem services on which urban areas depend. Due to its continental dimensions, Jammu city has a complex geographic configuration, with great physical and climatic diversity. Consequently, the availability of water resources occurs in an inconsistent way in space and time. The situation of water scarcity and stress in Jammu has become progressively more evident in recent times. The direct use of rainwater in urban areas may reduce the climatic vulnerability in areas which are sensible to water problems. In the coming decades, climate change is expected to exacerbate the risks of disasters, not only from more frequent and intense hazard events but also through greater vulnerability to the existing hazards. More frequent and long-lasting droughts can erode existing community coping capacity to prepare, respond and rebuild after successive hazard events. Due to economic marginalisation and population migration to Jammu city, more risk prone zones will increase peoples' vulnerability to disasters such as persistent droughts and water pollution. The city is not adequately prepared to deal with such events. The rapid growth of urbanisation and industrialisation in Jammu has led to massive land use changes. The most apparent impact of anthropogenic stress is the modification of the environment by land use activities. Most of the changes due to rapid population growth have occurred during the last about five decades. Due to the large number of people that may be affected, malnutrion and water scarcity are the most important health consequences of climate change.

Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides. Adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of change in conditions. Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. The planning strategies to cope with climate variability need to be in place. The ultimate objective of adapting water management to natural variability and climate change is to decrease the vulnerability of ecosystems and societies. But the concept of vulnerability may be interpreted in different ways that dictate the appropriate types of adaptation strategies.

There is need for systematic sector-based work in the city where climate-related issues typically span disciplines, sectors and administrative regions and, therefore, cannot be dealt with within single sectors or organisations. Special efforts are needed to bridge the gaps between sectoral organisations, in order to share relevant information concerning risks and their management as well as achieve efficiencies and synergies. Adaptation measures to deal with water scarcity may include, water conservation measures, water pricing, reducing linkage from water supply networks, capture rainfall effectively, limit soil erosion, regulate water flow, and effective control on water abstraction and subsequent water use. There is need for integrated water resources and watershed management around Jammu city to safeguard the ecological integrity, riparian forests, range lands and protected areas to ensure sustainable use of water and land resources on which the urban population depends. It will be one of the good adaptation strategy to climate change. The increased vulnerabilities to climate hazards will compound current water governance problems. Therefore, governance structures and water use practices will need to adapt to climate change. New infrastructure will prove to be an appropriate response to climate-induced shifts in hydrological regimes and water demands for sustainable development of Jammu. But it is difficult to plan for and justify expensive new projects when the magnitude, timing, and nature of the changes at the basin and regional levels are unknown. This would require generation of broad data base.

Scenario Generation Using GIS Based Hydrological Modelling for Climate Change Adaptation

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Keywords: climate change, impact assessment, GIS, hydrological modelling, scenario generation

Introduction/Problem Identification

In the present study GIS based hydrological modeling has been used to assess the impacts of climate change on the hydrological regime of Cauvery river basin in India. The hydrological model used for the study is SWAT. SWAT is the acronym for Soil and Water Assessment Tool, a river basin or watershed scale model developed by Dr. Jeff Arnold for the USDA Agricultural Research Services (ARS). SWAT was developed to predict the impact of land management practices on water, sediment and agricultural chemical yields in large complex watershed with varying soils, land use and management conditions over long periods of time. SWAT is a continuous time model, i.e. a long-term yield model having the capability of scenario generation so as to equip the policy makers with a wider range of options, which make it the ideal tool to be used for such a study.

Analysis/Results and Implications for Policy and/or Research

The analysis has been carried out in two stages. In the first stage, the impact of changes in the land management practices on the water availability in the basin under the present conditions has been modelled. In the second stage, the same analysis has been carried out under the future climatic conditions. The future climate change scenarios have been generated using the daily weather series generated by Hadley Centre, UK (HadRM2).

Generation of futuristic scenarios is one of the most important applications of hydrological modelling. Scenario generation helps the decision makers to analyse the potential impacts of their actions. The well known hydrological principle of "Think globally, act locally" can only be applied if sophisticated tools and techniques such as simulation modelling are available. In the present case, a variety of land use changes are simulated and the impact on the hydrological characteristics of the basin are analysed. The aim of the exercise is to generate a series of scenarios or options for the stakeholders, so as to enable them to take sound rational decisions. The stakeholders, if they so desire, can use simulation modelling for some other sets of land use changes which are more acceptable to them (Chen, 2003; Luitjen *et al.*, 2003; Rajasekaram *et al.*, 2003). Hence, the attempt is to empower the stakeholders by providing them with the freedom of choice. Moreover, the impacts of futuristic climate changes on the hydrological regime can be effectively captured through the use of modelling techniques and the remedial actions can be taken well in time.

In the present scenario, the (approximate) land uses within the Cauvery basin are:

- Agriculture = 60%
- Forests = 35%
- Others = 5%

Futuristic scenarios have been generated for three categories of land use changes.

T able 1 shows four categories of land uses, S1 to S4 in which S1 is the present land use scenario:

Table 1 List of Land Use Scenarios

i	Scenario	%AGRC	%FRST
1	S1	60	35
2	S2	65	30
3	S3	70	25
4	S4	75	20

Hydrological modelling was carried out on GIS (Arc View) platform to analyse the above mentioned categories of land use changes. The resultant variation of water yields of the basin were analysed. The results indicate that contrary to popular beliefs, as the percentage of forests decreases, water yield increases in the basin.

Climate change challenges existing water resources management practices by adding uncertainty. This adds further complications to the water resources management. The data generated in transient experiments by the "Hadley Centre for Climate Prediction" UK, at a resolution of 0.44°×0.44° latitude by longitude grid points has been obtained from IITM, Pune. The series is known as HadRM2. In order to make futuristic predictions, data pertaining to the series was extracted, processed and analysed. This consisted of daily values of precipitation, maximum and minimum temperatures, solar radiation, wind speed and relative humidity for the control as well as future climate change scenarios. The control data for the RM2 series has been compared with the actual observations for the present scenario (1970 to 1989). Precipitation has been taken as the variable of interest and its mean monthly as well as annual values have been compared over a 20 year period.The results show that an intensification of hydrological cycle on an annual basis for the future climate change scenarios can be expected.

The study demonstrates that simulation modelling can play a very significant role in climate change impact assessment as well as suggestion of suitable remedial actions by generating a series of scenarios or options for the stakeholders, so as to enable them to take sound rational decisions.

Climate Change, Information and the Risk of Critical Events in Urban Areas

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Keywords: climate change, Brazil, São Paulo, warning system, governance

Introduction/Problem Identification

Nowadays, Brazil is realising how weak is the state and society's response to extreme events such as the 2011 flood in Terezópolis region in Rio de Janeiro and the Cantareira System overflow in São Paulo. The reasons for that is a combination of factors: the growing population concentration in urban areas – today more than 80% of the country's population lives in cities – the denial in recognising the occurrence of disasters in Brazil, the lack of institutional rules concerned to urban management and the nonexistence of mechanisms to deal with extreme climate conditions in order to decrease the population vulnerability.

In this context, this article's goal is to focus on the initial attempt of climate agencies to coordinate government actions in order to avoid flooding at São Paulo metropolitan area. We will be analysing the consequences of the initial attempts and what should be considered in order to improve and to develop such tools.

Analysis/Results and Implications for Policy and/or Research

Among the different aspects that contribute to the disastrous impact of climate change in intense urbanised areas, such as São Paulo, are the permissiveness of housing localisation in risk areas, urban patronage which allows urban illegalities in response to political support, property speculation, urban corporatism that leave aside urban planning, and finally the pressure and political demands that leads to an explosive outcome such as the reproduction of urban precariousness and announced tragedies. In response to this reality, there is an urgent need to consolidate a strong and not manipulable technical bureaucracy in order to modify the logic of laissez faire present in Brazilian cities. In this context, one of the main aspects to be considered to decrease people's risk and vulnerability to extreme events is the issue of information as a low cost component of risk reduction.

To develop such assumption, this article discuss the effect of communication problems and misuse of information between the National Institute for Spatial Research (INPE) and the state government during the summer 2009/2010. Such information predicted high levels of precipitation in the headwater region which supplies the Cantareira Water System, an impressive water infrastructure built to supply the biggest urban area of Brazil: metropolitan urban area of São Paulo, with 18 million people. The lack of action from the state in relation to flooding warnings led to damages and flooding in some urban areas located in the Cantareira System region.

The Cantareira System started to operate in the 1960s, in different conditions of weather and land use when compared to today. The System's structure is comprised by five reservoir connected through pipelines that supplies 33 m^3/s of water to 8 million people who lives in São Paulo. The capacity of this system is to storage 1,453.46 Hm^3.

Considering the rainfall historical data in this region it is possible to note that during the summer period rainfall intensity increases in relation to the dry period in wintertime. INPE predicted an intense rain period mainly for the summers of 2009/2010 and 2010/2011, however such information was not considered in the management practices of the Cantareira System. Because of that, floods that occurred during summer 2009/2010 and 2010/2011 were due to the incapacity of the Cantareira System reservoirs to absorb the wave of water flows. At the same time, the São Paulo government assumed that the high water levels in the reservoirs should be solved though the release of such water once the reservoirs reach dangerous levels, even though it will cause floods in cities located downstream.

In this context, our main question is how could the information and prediction of critical events and the effects of climate change be incorporated as a new way of managing a system that was designed and built for different weather condition?

This paper will approach the context in which this situation occurred, the procedures that municipal government developed/not developed to deal with the event, the articulation/non articulation between agencies, local government and state government and the consequences and damages caused to the local population. It will also approach the need for a strategic planning and for developing an information framework, based on interviews with the main stakeholders, which focus on the existing information system and its gaps.

A Framework for the Determination of Impacts of a Changing Climate on Water Security

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Keywords: water security, climate change, risk, adaptation, hydrology

Introduction/Problem Identification

The realisation that little is known about the risks associated with a changing climate on water supply has spurred a flurry of global activity, from researching the possible impacts to determining appropriate mitigation and adaptation measures. In South Africa, the Ministry of Environment Affairs (DEA) is designated to lead this country's climate change agenda, resulting in a recently adopted Long Term Mitigation Strategy on Climate Change. Climate change is a key component of Global Change, and water quality and quantity are key elements which will be addressed in this grand challenge with one of the intended outcomes to develop the skills base required to deal with the consequences of climate change. Umgeni Water is particularly mindful of the threat that a changing climate could have on water supply in the future, and has been researching this risk for the past 3 years.

Analysis/Results and Implications for Policy and/or Research

A framework has been developed to guide efforts towards quantifying the possible impacts of a changing climate on its business. The framework can be applied to any catchment, however the Mgeni catchment was chosen for this assessment due to its importance in supplying one of South Africa's most important economic hubs, at a high level of assurance. The catchment is therefore critical to the utility's operations.

The process involved firstly setting up a daily hydrological model at a fine resolution to simulate the water resources. The strengths of this model lie in its ability to model the actual physical processes that occur in the hydrological cycle. Consequently, considerable effort was expended in ensuring accurate input data describing rainfall patterns, land cover and its water use patterns, irrigation, reservoir abstractions, wetlands, soils, and evaporation which were configured as a base scenario in the hydrological model.

Numerous potential future (to the year 2100) climate scenarios that incorporate changing rainfall, temperature and evaporation patterns have been routed through the hydrological model to model the possible impacts on future streamflow at 145 hydrological catchments in the Mgeni catchment. The climate scenarios are mainly characterised by simulations from 10 climate models (sometimes termed General Circulation Models or GCMs) incorporating largely diverse greenhouse gas emission scenarios and two climate downscaling techniques. The resulting streamflow scenarios were used in a stand alone water resources simulation model of Midmar Dam to determine the potential impact of climate change on water yield, and hence assurance of supply at this dam.

Notwithstanding the acknowledgement that the modelling of complex natural systems is challenging, and that several aspects of the modelling process are still rudimentary and need improvement, the results do indicate several trends with potentially interesting consequences for Umgeni Water's future water supply capabilities.

Indications from the assessment of streamflow in the Mgeni catchment are that streamflow could decrease marginally by ca. 10% in the immediate planning horizon (to 2030), with an increase in year-on year variability. The situation improves in the intermediate (2046-2065) and distant futures (2081-2100), where streamflow is predicted to increase with less variability. Indications are that these streamflow increases could be amplified when translated into yield with indicative increases (based on an average potential increase in yield) at Midmar Dam of ca. 15, 30 and 50% in the planning, intermediate and distant future periods respectively.

The possible climate change scenarios for the planning future have been applied to the existing and planned yields without climate change to the year 2030, and summarised as percentiles. As an indication, the median (50th percentile) prediction corresponds to a possible 15% (ca. 70 Ml/day) increase in water availability over and above the yield without climate change, by the year 2030. Similarly, the 35th percentile would correspond to the projected demand, suggesting a ca. 65% chance of a climate change induced yield being able to meet future demands for water from Midmar Dam to the city of Pietermaritzburg. Additional water resources, as a result of a changing climate, therefore has the opportunity to significantly impact on Umgeni Water's operations and long term water supply plans, mostly in a positive manner, which should be considered in Umgeni Water's water resource development plans for the Umgeni catchment.

A Soft Systems Approach to Flood Management

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Co-Author: **Dr. Basavaraj Mudgal**, Anna University, India

Keywords: urbanisation, land use change, soft systems methodology, rainfall – runoff model, adyar watershed

Introduction/Problem Identification

Due to rapid urbanisation and industrialisation, the change in the land use pattern of the catchment has resulted in irreversible anthropogenic disturbances to the hydrological processes. The increase in impervious areas associated with urban development affects the hydrologic cycle and consequently polluting both the surface and ground water. Also, there is an enhanced risk due to urban flooding. Although flood hazard is natural, human modification and alteration of nature's right of way has accentuated the problem. This is partly due to one dimensional technical approach to the control of storm water by the professionals, who gives priority to control flooding using structural and technical solutions with no overview of the watershed or social and institutional aspects of the cities.

Analysis/Results and Implications for Policy and/or Research

In this paper, Soft Systems Methodology (SSM) addresses the societal and engineering problems that arise due to flooding. It is found from the study that the effect of flooding tends to be rigorous due to formation of sand bar at riverine mouth, land use change, uncontrolled encroachment along the river banks and development along flood plains and stream channels. SSM also helps in presenting the results of an extensive consultation of stakeholders (maintenance of the river rests with State departments) in Adyar watershed on what they consider to be the main drivers, obstacles to flood management.

The land use/ land cover changes are evaluated using toposheets and satellite imageries. The analysis reveal that the urban expansion in the watershed over the study period (1976 – 2005) has resulted in significant decrease in the area of waterbodies, plantation. agricultural and scrub land.

A spatially distributed rainfall – runoff model (Hydrologic Engineering Centre's Hydrologic Modeling System – HEC HMS) is used to model the effect of land use changes on the runoff. Land use, soil type and topographic structure of the watershed are considered as the basis to run the model. The results obtained suggest that increased urbanisation increases the peak runoff even for lower return period and lower intensity of rainfall whereas flooding occurs only for higher return period and during higher intensity of rainfall for pre – settlement land use pattern. It is concluded from the study that there is a need for paradigm shift from 'flood control to flood management' and the adaptable solutions for flood management can be got only when the clear picture of the problem is understood using 'soft methods'.

Climate Change Adaptation of Frihamnen: Visualising Retreat, Defend and Attack

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Co-Authors: **Mr. Ulf Moback**, City of Gothenburg, City Planning Authority, Sweden
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Keywords: climate change, adaptation strategies, sea level rise, city structure, water management

Introduction/Problem Identification

Our poster presentation will demonstrate means to adapt to future impacts of climate change within the context of contemporary city planning. More specifically, we test three strategies in response to rising sea levels in the Frihamnen area in Gothenburg, Sweden. We build on previous research that has proposed three strategies to meet rising sea levels: retreat, defend and attack. The poster presentation visualises the three strategies in future Frihamnen and exemplifies each strategy's possible impacts on sustainable development. The project "A City Structure Adapted to Climate Change: Scenarios for Future Frihamnen" is part of the recently inaugurated research centre Mistra Urban Futures. It is a case study that provides inspiration for how city planners, in particular in coastal areas, can tackle the effects of rising sea levels, which is likely to become an important aspect of future water management.

Analysis/Results and Implications for Policy and/or Research

In order to reduce the risks and take advantage of the opportunities linked to climate change, climate change adaptation must inter alia be integrated into urban planning and water management (The Commission on Climate and Vulnerability, SOU 2007:60). The expected impacts of global warming, such as flooding in low land areas with damages on infrastructure and buildings, underlines that we will have to build for resistance and resilience. Rising sea levels are likely to become an important aspect of water management and are particularly significant for the many European cities that are located near the sea and other water bodies.

The poster presentation "Climate Change Adaptation of Frihamnen: Visualising Retreat, Defend and Attack" will demonstrate how climate change adaptation can be integrated into city planning. It will illustrate three different strategies to meet rising sea levels in urban areas. These concepts were originally developed by the Royal Institute of British Architects, Building Futures and Institution of Civil Engineers (RIBA, Building Futures and ICE, 2010) and we demonstrate their applicability in urban planning outside the United Kingdom through a case study of Frihamnen. This urban district is attractively located by the river in the second largest city in Sweden, Gothenburg, and is about to undergo a transformation from industrial docklands to a modern residential and commercial area.

The three strategies visualise each strategy in its extreme form, in order to provoke creative thinking on ways to meet the climate change challenge. The three strategies can be summarised as follows:

- Retreat: A retreat strategy means that infrastructure and buildings gradually, i.e. through a long term planned and managed process, are moved to safer ground. The city is in essence gradually reallocated, i.e. it retreats, in order to avoid flooding.
- Defend: A traditional way to protect an urban district from flooding via flood defences, e.g. walls or other "hard" measures. A defence strategy saves the city from reallocation and protects

existing infrastructure, but can be extremely costly depending on how much protection is needed and the level of risk.

- Attack: The attack strategy means that the city advances and builds out onto the water using modern technology but also traditional construction methods and designs that are adapted to flood risks and are made flexible to handle rising sea levels (RIBA, Building Futures and ICE, 2010).

The poster presentation will illustrate, based on architectural work, what the Frihamnen area might look like after having implemented any of these three different climate change adaptation strategies. The case study not only aims to supply practical material for the planning of Gothenburg, but also functions as an inspiration for how climate change adaptation can be integrated into urban planning and water management, as each strategy will have an impact on urban life and sustainable development.

The proposed poster demonstrates preliminary results from a pilot project under the recently inaugurated Mistra Urban Futures, a transdisciplinary centre for sustainable urban development. The pilot project "Future Frihamnen – Climate Adapted City Structure" will use the climate change adaptation strategy scenarios presented in the poster presentation as an important input. The project will bring together practitioners and scientists from different disciplines and produce a comprehensive assessment and report of how the three climate change adaptation strategies will affect the sustainable development in Frihamnen.

Workshop 5: Water for Sustainable Urban Growth

Water Suplly Sevice and the Wellfield Improvement in Samarkand City, Uzbekistan

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Keywords: water supply, ground waters, water wells, rehabilitation, distibution system

Introduction/Problem Identification

Ground waters are the primary source for the city of Samarkand. The city of Samarkand is 2750 years old and with population 390 000 which are almost to100% connected to the communal water supply networks. Samarkand is supplied from two underground water well-fields, Chupan Ata and Dagbit. Both of the sources lie far outside of the city.

Farkhad, Khimiki, and Khishrau communities can use as much as 150 litres per day per person According to the available information the drinking water supply network of the city of Samarkand is 700 km and about 41% of the network is older than 42 years and it my require replacement or comprehensive rehabilitation. One of the main issues in the water supply system is the significant water loss. Among the reasons for this deficiency, the leakage of water in the conveyance pipelines is considered the main cause. The conveyance pipelines are fairly old, and needs rehabilitation and/or replacement.

Analysis/Results and Implications for Policy and/or Research

Samarkand water supply system needs to improve the safety, quality, reliability, efficiency and sustainability of the water supply services.

Samarkand does have sufficient quantities of potable ground water to meet municipal needs, however several factors impede this possibilities.

The factors are:

- Irrational using of existing water intake and pump stations;
- Misuse of potable water;
- Aged infrastructure and leakage;
- Water technicians need to be trained in management and rational use of water resources;

At the present the government of Uzbekistan working on Samarkand Water Supply project that totally could improve the situation in the city. Samarkand Water Supply project is being financed by the Republic of Uzbekistan, Samarkand water supply Utilities with a loan of IDA and IBRD.

The main purposes of the project are:

- To investigate long term development of good water supply service in the project area to cater for water demand up to year 2025
- Water wells rehabilitation and study on booster pumping station rehabilitation;
- Rehabilitation and expansion of water production system in Samarkand;
- Upgrading of water storage and booster pumping system in Samarkand;

- Rehabilitation of well water treatment system in Samarkand;
- Replacement/Rehabilitation/Upgrading of water conveyance system in Samarkand;

At the present, a vast majority of households and commercial/institutional/industrial enterprises have been connected to the existing water supply system. Samarkand Vodokanal (a municipal Department for water supply services) expects that the service area can be expanded and enhanced to provide water to all inhabitants in the city in the next few years. An analysis of Samarkand's water production, treatment and conveyance systems shows that a local water sources are limited and it needs to be used the existing water supply system/sources more rationally.

All the raw water is produced by two main wellfields and five other small wellfields. The two main well fields, namely Chupan-Ata (53 wells) and Dagbit (28 wells), which can supply 300,000m^3/day, are located near the bank of Zaravshan River. The other well-fields, namely Bogibaland, Khimiki, Farkhad, and Khishraou are located within and outside of the city boundary. Groundwater level in Samarkand is generally between 10m and 20m below ground. Raw water from these wellfields is in a reasonably good quality after the chlorination. However, some of these wells are not in a good and operable condition. There are lots of deficiencies in the well pumping system ranging from the wells themselves to the equipment and switchgear installed.

All wells are in different state in their performance and use. The further utilisation of some of the wells might be critical for various reasons, such as physical condition of the well, existing pollution or potential pollution of the water catchment area, risk for contamination, etc. The main reason for ineffective operation of wells is clogging of filters and filter area by salt deposits and corrosion products of metallic elements The impact on the supply capacities of Samarkand Vodokanal needs to be analysed and, if necessary, alternatives for covering the total production demand need to be elaborated.

The main reason for the decrease in efficiency of water wells is explained by the quality of underground waters and filling of water wells filters and near filter gravel zones with clogging deposits also with corrosion products of metallic elements of the water wells. The clogging deposits consists mainly salts calcium and iron oxides. This situation requests groundwater use management by improving efficiency existing water wells.

There are numerous causes of poor and deteriorating performance of wells. The main reason for the decrease in efficiency of water wells is explained by the filling of their filters and near filter zones with clogging deposits;

- Clogging deposits consists mainly salts (calcium and iron oxides) and corrosion deposits of metallic elements.
- Applying the technology of water well regeneration depends on studying clogging deposits, which I have done by using X-ray diffraction analyses.
- The content of two and trivalent metal ions in water leads to multicomponent difficulty due to soluble salt depositions on an interior surface of pipelines and technological equipment.

In this investigation, the dissolution of some salt depositions resulted with the use of a selective solvent. Selective solvent is the composition complexions. The composition of the selective solvent, in conjunction with the specially developed equipment, has been used to regenerate the productivity of water wells. With the use of this technology, the degree of rehabilitation of productivity of water well is 90%. The economic benefit of processing one well is $13500 US.

Water Future in Iraq in According with Current Water Policy inside and outside Iraq, Tigris River as a Case Study

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Keywords: water scarcity, benefit sharing, water policy, socio-economy, water deterioration

Introduction/Problem Identification

The main aim of this work is to find an applicable water sharing methods regarding Tigris river. The current Turkish policy towards controlling quantity through constructing dams on Tigris river before entering the Iraqi territories such as the Turkish dams along the river and GAP dams which is currently under construction, according to the TWM issue there are struggles on the river basins level commence increasingly about the projects of dams or transferring water by the countries which are in a powerful state because they are up the river streams.Countries tend to share river basins in the conditions of water shortage and population speed growth,accelerated manufacturing,agriculture, and the most thing in the deterioration the case is the continuity of organisation absence. The issue of sharing the common water between countries is an important and crucial issue. The well management of water resources is the key for many problems related to water issues internally and externally.

Analysis/Results and Implications for Policy and/or Research

According to the TWM issue internationally, there are struggles on the river basins level commence increasingly about the projects of dams construction or transferring water by the countries which are in a powerful state because they are up the river streams for its neighbors. This operation with bad internal management causes to the big and dangerous deterioration in water quality and deterioration in the river's status and changing the river's shape and its characteristics (this is the important point which needs to further study and concentration). Countries tend to share river basins in the conditions of water shortage, and population speed growth, accelerated manufacturing, agriculture, and the most thing in the deterioration the case is the continuity of organisation absence. For example, Iraq shares water resources with its neighbor Turkey for Tigris river and with Turkey, Syria for Euphrates. The concentration in this project will be put upon Tigris river regarding to my residence area and unavailability the right conditions and Euphrates study requirements. Iraq shares Tigris river with two neighbors Turkey and Syria according to the table(1).

Table (1) Length of the river reach in the basin by country (in km)

River	Turkey	SyrianArab Republic	Iraq	Iran	Total
Tigris	400 22%	44 2%	1,418 76%	0 0%	1,862
Euphrates	1,230 41%	710 24%	1,060 35%	0 0%	3,000

There is a great decrease in the river flow level in comparison with the previous years and still in continuous decrease. The decrease in the quantities of coming water into Iraq causes a change in the river flow model, and also in the river pool. There is a high and accelerating raise in the number of aquatic plants and algae in Tigris river. This was advocated by villagers, fishermen, and farmers, besides, academic researches that advocate this phenomenon that Mosul lake has negative effects on Tigris river, besides, water quality. Also, it is incompetent in generating electricity as a result of shortage of water quantities. It is worth mentioning that electricity in Mosul city which is the nearer city to the dam is available with four hours daily. Sand and gravel factories available on the river course had a negative effect through providing the river with aquatic plants and algae because it is a storehouse for the growth of algae and aquatic plants.

The results conclude that there is a real problem within the Tigris river on the Iraqi territories. Where the water confinement process inside and outside the Iraqi territories affects negatively on the quality and quantity of water, to the degree that the flow speed of Tigris river inside the Iraqi territories does not exceed 350 m^3/sec within the period of this study since entering the Iraqi territories (internet source). This is a new record considering that many studies confirm that water flow was much higher (Al-Nemaa,1980; Taleea,1981; Al-Tayar,1984). The decrease in water flow entering the Iraqi territories caused clearly by the three Turkish dams (with 300 million m^3) on the water flow for 250 km inside the Turkish territories. This problem aggravates after completing the project of GAP which includes a series of dams on Tigris and Euphrates rivers.

Therefore, if the water policy between riparian's still going on in such way, without an agreement according the IWL or benefit sharing, we may face one of the hardest decades in our history. The flow of water may reach to ZERO in Tigris river,and the decreasing is very clear from the seventeenth of last century until now (Mustafa *et al.*, 2011).

It is possible that one day future generations will not find what keeps them life, if we did not look for solutions.

At this time Iraq is moving rapidly towards the consumption of all resources, and polluting the environment In addition to the decline of public health and low levels of education plus culture.

Environmental Factors such as desertification, which crawls strongly about green areas in the country and Concrete crawl, indiscriminate expansion of cities, as well as the decline water levels, lead to water scarcity, whether rain or rivers or groundwater.

Iraqi citizen does not know how to benefit from available water resources and provides enough capacity to create a green environment offset a proportion of wasting water. On the other side the Sustainable Development concerned with Economy, Management and Governance.

Citizens Initiative to Enhance Water Governance of Khulna City

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Keywords: water governance, multi-stakeholder, climate change, potable water, vulnerability

Introduction/Problem Identification

Bangladesh is one of the most vulnerable countries in the world to climate change. Southwest coastal region of Bangladesh has a rich biodiversity; geographical location has given it a brackish water regime of sedimentation, tidal and wind actions of the coastal rivers. Degradation of environment due to climate change and human interventions without considering its ecology, causing reduction of water flow from upstream, obstruction in the natural flow of tides, river erosion, silting and salinity increase.

Reason of unavailability of potable water and most of the water from shallow tube-wells contains excessive amounts of toxic metal and chemical. Hence, the problem of safe water in Khulna city is more serious than other parts of the country. Unsafe water also leads to rise in incidence of water related diseases causing loss in income that weakens working capacity of the people. Thus, women and children become victims of diseases and the lives and livelihoods have become vulnerable.

Analysis/Results and Implications for Policy and/or Research

Khulna City Corporation (KCC) is the third largest city in Bangladesh. It's located on a natural levee of the Rupsha and Bhairab River in the southwest coastal region. Rivers and characterised by Ganges tidal floodplains with low relief, criss-crossed by rivers and water channels and surrounded by tidal marshes and swamps. Administratively KCC is divided into 31 Ward and five Metropolitan Police station, and a total area of 59.57 square km with a population around 1,500,000. Gross population density is very high about 18,000 per sq. km.

Increase and intensity of salinity in the southwest coastal region as well as Khulna city area, started after the commencement of the Farakka Barrage (in1975) by India and Coastal Embankment Project (CEP) in 1960s and early 70's, which reduced the fresh water flow of the Ganges upstream of the Gorai River. Salinity near Khulna was highest in 2007 according to pervious records of past 32 years. Sea level rise and prolonged dry weather are expected to further drive up more salinity levels in this region.

Newly formed the Khulna Water Supply and Sewerage Authority (KWASA) provided water supply to Khulna city area, which mainly groundwater sources drawn from both deep and shallow tube wells. According to KWASA statistics, 75% of the people of Khulna have access to safe water, but peoples' perception is that it is not more than 55%. Most of the people in Khulna city dependent on supply water and tube wells. Poor people and slam dwellers collect water from different sources, for which they have to walk 2 to 3 km for drinking and cooling purpose. As women collect water for domestic use, their children left at home remain vulnerable. Due to excessive use of time and effort to collect water, they lose time and energy.

Actions Taken

Development organisation AOSED is implementing a one year (January to December 2011) Pilot Project for Enhancing water governance through ensuring participatory management system in Khulna city.

Stakeholders: 6500 students, 1300 youth and 12000 urban people a total of 19800 people

Working area: Two Wards of Khulna City Corporation-KCC

Activities

Group Formation

Water User group will be formed 21-25 person at Ward level of KCC. Youth group formation will be formed at each ward consisting of 15-21 members. Student group formation will be formed at ten secondary schools at Khulna city consisting of 9-11 students from each school. Those groups will be formed to consider the gender sensitivity approaches.

Capacity Building of Group Members

Different level of group members will be involved with meeting, orientation, training, and cross visit.

Awareness Rising

Awareness material develop (sticker, leaflet, easy reading booklet, audio visual documents), courtyard meeting, distribution of printing material, film show, conduct class session, by-cycle rally, water day observation and student competition.

Develop Data Base of Khulna City

Primary and secondary information collection from varies sources, data compilation and analysis, develop a water points mapping.

Conduct Advocacy

Need assessment, media campaign, demonstration, persuasion and information sharing meeting with KWASA and relevant policy actors.

Through these initiatives will be achieved:

- 6500 students, 1300 youth and 12000 urban people will be acknowledged about importance of water resource, necessity of optimum uses and maintenance of water points.
- Citizens' capacity will be enhanced for conducting advocacy with the KWASA and relevant Govt. departments.
- A participatory mechanism will be developed along with civil society groups and KWASA for information sharing and necessary steps.
- Monitoring mechanism will be developed for water quality, lack of supply and minimise the system gaps.
- KWASA will more responsible for public information centre, emergency service for repair pipeline and water points, mitigate peoples' needs and citizens' charter.
- Peoples needs were widely disseminated and draw the attention of the implementing agencies as well as policy makers to become more sensitive to meet national target for achieving MDG effectively.

Conclusion

As a result of these concerted actions through multi-stakeholders participation have been possible to enhance urban water governance and facilitate optimum water uses.

Importance of Rainwater Harvesting in Today's Urban Scenario – A Case Study

Author: **Ms. Rama Chakraborty**, Delhi Public School, India

Keywords: groundwater, water-table, aquifer, recharge, rainwater-harvesting

Introduction/Problem Identification

Water is a basic necessity for life. The need for potable water has multiplied manifold in modern, urban society Growth in population, industrialisation and urbanisation has resulted in increased water demand and greater contamination of water sources. The surface water sources are unable to meet the demand because of quality or quantity constraints. So., the viable sources of clean ground water are generally overexploited to meet the requirement during lean periods. This overexploitation results in continuous lowing of groundwater table and low yield of surface water sources in urban areas. The fresh water requirement by 2025 will be almost at par with exploitable water resources. Thereafter, additional supply will be necessary, otherwise, the gap between supply and demand will make the country water-stressed by 2050. The growing demand is asking for exploring further scope apart from successfully harnessing the available sources and efficient water conservation and management.

Analysis/Results and Implications for Policy and/or Research

In the context of the Indian cities, the effective solution to the above said challenges can be possible through:

1. Rain water harvesting
2. Artificial recharge to ground water through dug well

Urban areas provide little opportunity for natural replenishment of ground water and so, there is a need of augmenting the recharging of aquifers and conserving the rain water through rainwater harvesting. Rooftop rainwater harvesting appears to be a potential answer to the threats.

Rainwater harvesting is a simple and cost effective way to become self-sufficient in household water requirement in urban areas. A typical rainwater harvesting system consists of a catchment area, which receives the rainwater directly. In urban area this could be a paved area such as terrace, roof or courtyard or an unpaved area such as a lawn. The rainwater from these areas is carried to rainwater harvesting area through conduits or pipelines for storage or recharging. Different systems can be used for rainwater harvesting depending upon the geography and amount of rainfall. However rooftop water harvesting is best suited for urban areas, as limited space is available for such systems in cities.

For individual houses and housing societies typical rainwater harvesting systems can cost between Rs 1,500 and 85,000, depending upon the size of the premises and technology involved.

So, rooftop rainwater harvesting is best suited for densely populated urban areas like Patna as limited space is available for such systems in cities. The drinking water supply of entire Patna urban area is met through ground water right from the beginning. At present, to meet the drinking water need of about two million inhabitants, there are only 65 operative tubewells in the city, which pump groundwater at an average rate of 0.8 million gallons, i.e. per capita supply is approximately 20 gallons(80 litres) per day, which is far below the actual need and norms. Consequently, acute water scarcity is being faced by the local poor people, especially during the summer season, as they cannot have sufficient resources to enjoy the required amount of water from their private deep tube wells.

Though a large number of concrete buildings and apartments exist in Patna, the rooftop flow of water during Monsoon season is totally lost through drains, occasionally creating sanitation and water-logging problems. Hydrologically, there exists potential aquifer at a depth of about 70 m which can accept additional recharge. As the rainfall in Patna is quite high (about 1185 mm per annum), the overflow of water is reasonably high, which may be conserved safely within the deeper aquifer for utilisation at the time of need. The overflow through open area flows out through drains and finally finds its way into the rivers and is lost. If it is averted and stored underground,it will supplement peak season demand.

In Patna, the annual rainfall is about 1000 mm, 90% of which can be collected after discarding the first shower. In the urban area, the average requirement of water is about 250 litre for each household, daily. Average rooftop area of each household is 40 to 50 sq m. So, rain water available annually for the household recharging and reuse from rooftop water harvesting system of each household= 40 X 100.X.100 X 90 cu cm = 36000litre, sufficient for fulfilling the water requirement of about 144days.

The study reports the initiatives taken by various governmental, non-governmental and voluntary organisations in Patna for rainwater harvesting and its conservation. Initiatives taken at present by lowering the pumps, since water table goes down considerably in the summer months, does not seem to be a rational solution. It has also been studied that the population of the city has grown by 43.02% during the last decade and it is a rising trend. It has also been found that living standard has direct bearing with the consumption of water. Experts say that there will be shortage of fresh water in Patna in the present decade itself, if proper measures are not initiated immediately. Rainwater harvesting is certainly a renewable measure to combat such a situation. The study also reports the effect of these initiatives on groundwater table and soil moisture conditions. The study concludes the beneficial effects of rainwater harvesting and its conservation in Patna and other urban areas.

Urban Infrastructure in Transition: The Evolution of Urban Sanitation Systems

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Keywords: sanitation, waste management, urban infrastructure, environment, sustainabilty

Introduction/Problem Identification

Urban sanitation systems are a fundamental part of the urban form, and they are one of the more decisive factors for urban sustainability. Moreover, as many sanitation solutions are long-term and costly investments, decisions today have implications for long periods to come, but statistics about the evolution of urban sanitation systems are scarce. Whereas the WHO/UNICEF Joint Monitoring Program compiles water and sanitation data from over 200 countries, their reports only present data and trends about improved, not improved, shared and no sanitation. Thus, what type of sanitation systems are growing is not known. This lack of overview of the trends in urban sanitation technologies puts the discussions of urban sustainability on shaky ground. Departing from the presentation of urban sanitation systems by JMP in the year 2000, the present contribution will update this data and provide trend information relating to the major types of systems that grow in today's increasingly urban world.

Analysis/Results and Implications for Policy and/or Research

Sanitation systems in Europe and North America are around 95% sewered. The water demand of these systems is massive, and for cities located in arid regions, this has enormous effects on the regional water balance. According to the 'Global Water Supply and Sanitation Assessment 2000 Report' by WHO and UNICEF, over 90% of urban inhabitants in Asia use flush technology, with 45% relying on centrally sewered systems, 28% using septic tanks and some 18% having pour-flush toilets. Africa and Latin America present a greater mix of systems. In Latin America, about a third relied on sewered systems, a fourth on septic tanks, and another fifth unserved by any sanitation services. In Africa, less than 20% of urban systems were sewered. Nearly a third of the urban population was estimated to use simple pit latrines, and almost a fifth unserved.

How many people are being served by the different systems? And how many will be served by different systems as urban areas grow and different systems expand, while others contract?

The proportion of people with access to improved systems is important, if not least for measuring the level of achievement of the environmental Millennium Development Goals. However, to understand the fate of our increasingly urban world, and its consequences for water use, urban sprawl and quality of life for its people, we need to know the evolutionary trends of our sanitation system technologies on a more detailed level with respect to how these many and varied systems affect the long-term development of urban areas.

Departing from a review of the long-term trends in urban sanitation development, this contribution will update the Joint Monitoring Program urban sanitation system analysis from 2000 (as referred to above) with the most recently available JMP data for each country. The result will be a ten-year update (which has not been provided by the JMP work) and a trend line pointing toward the most recent changes in the longer-term evolution of urban sanitation systems.

Sustaining Aquifer Based Water Supply in Patna Urban Area – A Fast Growing Million Plus City in Eastern India

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Keywords: Patna urban agglomeration, aquifer, sustainability, piezometric level, combination well

Introduction/Problem Identification

Patna – the capital of Bihar state, India – with a population of ~1.7 and absolute dependence on groundwater sources to meet its domestic and industrial water demand, is a unique Indian example. The population of the Patna Urban Agglomeration area has increased from 6.02 lakh in 1971 to 16.97 lakhs in 2001. The present water supply of city is done through a network of 89 deep tube wells tapping the deeper aquifer in the range of 150-200m below ground. The estimated annual production of water through these wells is ~140 MCM. In addition, about 40% of the households have their own tube wells, having a depth range of 40 to 100 m in different parts of the city. The annual abstraction through these private tubewells has been assessed as ~40 MCM. Over the last 40 years, the ground water extraction in the urban area has increased from ~40 MCM to ~180 MCM; however, the contribution from aquifer storage is within 1% of the total ground water draft.

Analysis/Results and Implications for Policy and/or Research

Thick pile of alluvial sediments of Quaternary age comprising various grades of clay, silt and sand, forms the ground water reservoir of Patna. A pervasive layer of clay with or without kankar (calcareous nodules) constitutes the top of the succession. The aquifer system (based on exploratory drilling and geophysical logging) has been broadly divided into two groups. An aquitard layer made up of clay/clay mixed with sand or kankar is present between the depth range of 45 and 70 m which separates the overlying shallow aquifers with the underlying deeper aquifer. The deeper aquifer which commences below the intervening aquitard layer is made up of medium to coarse grained sand often grading to gravelly sand at the bottom. The entire alluvial thickness overlying the Precambrian basement in Patna urban area is believed to be more than 700 m. The Piezometric level of the deeper aquifer in heart of the city area during the past 2 decades has shown a decline of of 2.5 m. The groundwater regime of the shallow aquifers has not shown any major change over the years. Ground Water from the deeper aquifer which are tapped through deep tube wells have been found suitable for drinking uses. The Highly prolific aquifer system is capable of long term water supply of the Patna Urban area, however, it requires adoption of a sustainable management plan. Over the last 40 years, the ground water extraction in the urban area has increased from ~40 MCM to ~180 MCM; however, the contribution from aquifer storage is within 1% of the total ground water draft. The total ground water availability in the deeper aquifer within the urban area has been assessed as 1500 MCM. The depletion in aquifer storage (15 MCM over past 40 years) attributable to the decline in piezometric level is just 1.0% of the total resource of the deeper aquifer. It is thus apparent that the high potential deeper aquifers of Patna urban area can sustain the future water demand without any adverse effect on the aquifer regime. The decline in piezometric level does not necessarily imply a negative result as it may be simply due to well interferences and the long transient period that follow changes in aquifer water balance. The 2.5 m decline in piezometric level in the urban area over the past 2 decades is thus a manifestation of the change in aquifer water balance owing to increased abstraction. A slew of measures to make the ground water based municipal supply sustainable in Patna urban area has the following key components. i) There is substantial water loss as well as threats of contamination during transmission through the old distribution pipelines. The unaccounted flow of water (UFW) has been estimated as 40% in Patna urban area. Steps should be taken on priority to reduce the UFW to 10% through rehabilitation of the old pipeline network and providing a mechanism for proper water monitoring (i.e bulk metering and consumer metering system). ii) The storage capacity in Patna urban area (~ 6% of the total supply) is much below the standard norms of 1/3rd of the total supply. Owing to insufficient storage capacity direct supply in the distribution pipelines is made through continuous pumping for long hours leading to high frictional losses. Continuous pumping for long hours also causes interference of the drawdown cones in the eastern and the central part of the urban areas which has higher concentration of the water supply wells. iii) The high discharge municipal supply wells should be located in areas with higher transmissivity so as to have minimum drawdown, thereby indirectly saving the energy cost of pumping. iv) Artificial recharge of the deeper aquifer in Patna urban area with the intended benefit to to maintain the piezometric level so as to save the energy cost of pumping in the urban area should be planned. Recharge to the deeper aquifer can be attempted through roof top water harvesting and recharge through wells as well as through combination wells. v) To prevent the shallow aquifer system from the threats of pollution from sewage, solid and biomedical wastes along with other anthropogenic sources, proper arrangements for their safe disposal under a regulatory framework is essential and vi) to ascertain the detailed configuration of the multi-aquifer system underlying the urban area and account for the inter-aquifer interaction upto the inferred depth of ~ 700 m, deep drilling upto the basement and installation of piezometers in each aquifer system is essential.

Potential for Commercial and Industrial Reuse of Treated Urban Effluents in Niteroi, Rio de Janeiro.

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Keywords: water reuse, treated wastewater, rational use of water resource, water supply, sustainability

Introduction/Problem Identification

By the scarcity and water pollution in urban areas, the principal economic sectors that use water as an input, show interest in a sustainable and rational utilisation of water resources in their processes. Solutions that lead to autonomy for water supply, rationalising consumption and reuse options are more advantageous. In these areas of high density urban use of treated effluent attend the needs of non-potable water for industrial and commercial requirements. The effluents from sewage treatment plants (STP) should be directed to more useful purposes of a simple provision in the receiving bodies. In the central region of Niterói – Rio de Janeiro there are several units that use water for industrial and commercial purposes, which do not require the level of drinking quality. Secondary uses are for the operation of air conditioning in shops and supermarkets, in car washes, shipyard and port activities and irrigation of green areas.

Analysis/Results and Implications for Policy and/or Research

By the scarcity and water pollution in urban areas, the principal economic sectors that use water as an input, show interest in a sustainable and rational utilisation of water resources in their processes. Solutions that lead to autonomy for water supply, rationalising consumption and reuse options are more advantageous. In these areas of high density urban use of treated effluent attend the needs of non-potable water for industrial and commercial requirements. The effluents from sewage treatment plants should be directed to more useful purposes of a simple provision in the receiving bodies. In the central region of Niterói – Rio de Janeiro there are several units that use water for industrial and commercial purposes, which do not require the level of drinking quality. Secondary uses are for the operation of air conditioning in shops and supermarkets, in car washes, shipyard and port activities and irrigation of green areas.In this case there was a resource saving of about six times less, dropping from U.S. $ 22,200 to $ 3,600 per month. Regarding the use of water in large stores and supermarkets there were applications for operation of air conditioners, washing floors and discharge of toilets. The Carrefour supermarket has a monthly cost of water of about U $ 31,200, while much of the water used is for non-potable uses, which would justify the choice of reusing treated effluent, since this unit is located approximately 200 m apart Toque-Toque STP, which currently seeks their effluents to the Guanabara Bay. Shipyards units were observed, as well as the Port of Niteroi located on the outskirts of that, which use water for washing floors and boats, and in many cases could use treated wastewater insteadToque-Toque STP of potable water. Some implications of this study can be considered as part of municipal policies regarding the reuse of water. May happen in the local legislative discussions that will foster appropriate legislation to regulate such initiatives will surely reflect in a more sustainable use of water resources in Niteroi. Moreover, the issue of sustainability in the use of water resources becomes an important object of study for the Federal Fluminense University which should fulfill its role of generating knowledge that this case will contribute effectively to enable the improvement of strategies for water uses in metropolitan region of Rio de Janeiro. This is important given the current demands for water service to the Petrochemical Complex of Rio de Janeiro (Comperj), scheduled to begin operation in 2014, one of the main developments in the history of Petrobras and thereby create more than 200,000 direct and indirect jobs, in the five years of construction and after the coming into operation, all on a national scale.

Wastewater Recycling in High Rise Buildings in Mumbai: A Success Story

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Keywords: wastewater, high rise buildings, green buildings, urban growth, Mumbai India

Introduction/Problem Identification

Our own understanding of the urban ecosystem in our cities will continue to limit our competence in providing sustainable alternatives for addressing the problems of our urban habitats. One of the solutions, experts argue that is to go vertical i.e. build high rise structures, while many other experts argue about broadening the roads, adding some more flyovers, improving and modernising water supply schemes or install collection, treatment and disposal systems for urban sewage and garbage.

In this paper the success story of Municipal Corporation of Greater Mumbai (MCGM) has been presented to highlight how municipalities can intervene in promoting sustainable environmental services and ultimately can achieve a goal of decentralised urban systems. The innovative environmental management plan for the high rise buildings in Mumbai is presented. Finally, the strategy of compulsory wastewater recycling for high rise building is explained and demonstrated though success story.

Analysis/Results and Implications for Policy and/or Research

The High Rise Building committee setup by Government of Maharashtra has been given the powers to alter and modify the various structural and environmental service-related features or to reject the proposal. The commitments towards the environmental aspects are typically submitted by the developer of building to the MCGM in the format of an "environmental plan" and such plans are sanctioned by the Committee after discussion, site visits and deliberations. With these features of Mumbai's new "Green HRBs", it appears that they will be able to qualify for the "green building certification" rather easily.

Various environmental aspects and compulsory requirements from developer by committee essentially consists of water auditing, water budgeting, rainwater harvesting and storm water management, land environment and ecological aspects, management plan for solid waste as well as measures to deal with air emissions during and after the construction.

Amongst the various aspects, based on identified areas, proper interventions to implement water conservation practices were planned. Water budgeting would add new dimension i.e. Reduction to 3 R (recover, recycle and reuse) concept. The sewage generated from 90 LPCD water (mandatory provision) was treated to high standards and reused it for meeting other water demand including flushing of toilets and matched the shortfall of supply beyond 90LPCD. Typically it is expected to be 45 LPCD for toilet flushing like uses – which will be derived from recycling. The balance recycled water may also be used for the landscaping and gardening purposes. Thus, Mumbai is the first city in India making sewage water treatment and reuse mandatory for all the HRBs. Hence, this sound water budget plan submitted by developer would ensure appropriate utilisation water resources; in turn, it would promote sustainable and intelligent consumption of water.

The sewage generated from the HRBs should not directly be discharged to Municipal sewer lines and should be properly treated in the premises of HRB. The treatment should be of such a standard that it should meet the desired characteristics. The details of treatment technology, its design, drawing and the characteristics of water it would achieve should be submitted by the developer as a part of the environmental plan for approval.

Apart from sewage treatment, rain water harvesting has also been suggested by the High Rise Building Committee. Rain water harvesting in a building site includes storage or recharging into ground of rain water falling on the terrace or on any paved or unpaved surface within the building site. A detailed rain water harvesting system should be submitted stating the assumptions and references while submitting the environmental plan for approval.

The initiative of Mumbai Municipal Corporation has implications in all aspects of sustainable urban development. The initiative created systems for identifying interventions and technologies for wastewater recycling and implementation protocol. Further, a legal commitment towards environmental plan of the developer of the building is required during the phase of project clearance.

Rapid Integrated Flood Management Master Plan for Cities, Including Innovative Concept of Flood Water Collection, Treatment and Re-use Plan

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Keywords: time based rapid implementatio, inspection of drainage systems, topographical detailing, flood water treatment stations, master plan

Introduction/Problem Identification

Rapid Urban Development has raised critical issues on land use and land cover changes and related drainage systems and flood management. A well planned flood management system is absolutely essential to ensure sustained development. In developing countries like India, it is a common sight to see flooded roads and rivers every season. Every city in India goes through this tumultuous period with seldom a Plan in place to anticipate, evaluate and overcome this problem.

The paper presents a very powerful integrated approach to flood management through a Master Plan.

This Master Plan shows the clear pathway to integrate all the resources, ensure flood free cities and most importantly, puts in place a system by which this water can ACTUALLY BE USED by consumers.

This Plan, when implemented, will definitely pave way for sustained Urban Development in a manner never done before. The Master Plan is so powerful that, it has the potency to change the entire water balance scenario of a city.

Analysis/Results and Implications for Policy and/or Research

The Master Plan for flood management and water re-use is devised in the following methodology:

The Master Plan is the combination of two broad Segments of planning and work:

Segment 1 "ensure effective management of flood and prevent inundation"

Segment 2 "methodology of usage of flood water"

The details of Segment 1 are given below:
This segment is divided into individual parts placed in logical sequence. When this sequence is followed, the objective of this Segment is achieved.

Part 1: Assessment and documentation:
Flood is a common phenomenon in most cities. There are no systems in place today, to mitigate the effects of flood. Even though "research" based activities are going on, these activities are long term processes and will take years to even bring it to the level of understanding of what needs to be done. Effective flood management first needs proper database management system.

Part 1 provides the methodology of assimilation and collation of data to prioritise on the plan.

Part 1 elaborates on the creation of this DBMS:

1. Geo spatial data of city
2. Grading of each area within the city based on the existing drainage network with specifications viz.. type of drainage, year of incorporation etc..
3. On-site inspection of underground sewage network and drainage system using state-of-the-art methods
4. Classification of areas within the city based on their inundation intensities by determining past history, drainage performance as given above
5. This classification is super imposed on the Master Plan of each city and the entire city is given a "grading" based on the inundation intensity.

Part 2: Development of Plan
Based on the DBMS created for the city and based on the "grading" provided, the Plan is developed for flood management. The process of development is detailed in Part 2.

1.Division of the city based on grading system into sectors
2. Identification of repair/ augmentation / rectification works to be done in each sector
3. Drawing out the detailed specifications for such works
4. Developing the 4M resource schedule for each work – Man, Material, Machine and Money and integration of the same with time schedule.
5. Developing the financial aspects of the Plan

Part 3: Implementation of Plan
Once the plan is developed, the implementation phase begins. This is the core area of concern as such implementation needs to be done on war footing and should cover the entire geographical spectrum that needs changes in more or less the same time frame.

The problem with existing works on Flood Management is the "bits and pieces" process adopted by independent agencies, each arriving at their own conclusions and methods. The core advantage of this Master Plan is the "seamless integration" that makes it possible to involve all the stakeholders and ensure effective implementation WITHIN A SHORT PERIOD.

The core of the Plan is to "gather data in one monsoon" and "implement plan BEFORE the next monsoon".

The implementation measures are described in brief and include:

1. Setting out the technical specifications
2. Tendering the works and awarding contracts within a short span (say within 1 month)
3. Set up a separate Project Management Centre to monitor, assess and ensure compliance to standards and time
4. On-site work completion and linking of individual works to the main system

Involve the media in propaganda and to create public awareness, which is very crucial to the sustained success of the works thus implemented.

5. The implementation of these parts in logical sequence will complete the objective of Segment 1 i.e. "ensure effective management of flood and prevent inundation"

Segment 2 “methodology of usage of flood water”
This segment is a true innovation and aims at actually using the flood water instead of conveyance to the main drains.

Segment 2 starts where Segment 1 ends and develops the mechanism of re-use in the following way:
1. Collection of flood water
2. Treatment of flood water
3. Re-use of flood water through
    a) On-site advanced treatment and reuse within the sector of the city itself
    b) Pumping from intake system to the common water supply system for further treatment and usage.

Segment 2 details out the following information:
1. Design basis of de-centralised flood water intake systems
    a) Quantity criteria and design methodology
    b) Brief design of the civil structure for such intake systems
2. In-situ water quality analysis
3. In-situ filtration and water treatment systems
4. Design basis of treatment plants
    a) Design specifications and features of treatment plants
    b) Design specifications of pumping main
    c) Advanced treatment methods for “within-sector” re-use
    d) Details of advanced treatment that can be given, including tertiary filtration, dis-infection, Reverse Osmosis purification etc..
5. Example of a design with clear cost benefit analysis

SUMMARY section integrates Segment 1 and 2 and provides the HOLISTIC FLOOD MANAGEMENT MASTER PLAN.

To Construct “Watertown” Intergrating Ecopolis Development

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Keywords: watertown, ecopolis, waterbody, living environment, factors

Introduction/Problem Identification

Nanning has been planning to construct an watertown in the near future. The key point of the watertown project was the waterbody linkage among one river and five lakes. The construction of watertown is a systemic project, some relative factors were discussed in this paper.

Analysis/Results and Implications for Policy and/or Research

Nanning is the capital of Guangxi province,located in the South China. Now, Nanning is planning to construct an “watertown” in the near future in order to improve the living environment. The key point of Nanning ’s “watertown” project will be the waterbody linkage among Yong River, South Lake, Wuxiang Lake, Xiangsi Lake and Xinxu Lake, linkinng the eightteen inland rivers. According the plan, when the project is completed, people can sail by the boat in the waterbody for sightseeing of the city view.

Since the “watertown” is a systemic project and includes water environmental protection and water landscape design, some important factors such as water security, water cycling, water source protection, average rainfall, and river line conservation should be seriously take into account.

Using Video Streaming Technology to Educate the Public About Storm Water Issues in the Pacific Northwest Region of the USA

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Co-Author: **Dr. Michael Barber**, Washington State University, USA

Keywords: storm water education, urban storm water, distance education, watershed management, community involvement

Introduction/Problem Identification

Storm water is increased by impervious surfaces that are a by-product of urbanisation and land use changes from forests and farms to housing and commercial developments. Rainwater and snowmelt runoff from streets, parking lots, and roofs adds to water pollution by contributing heavy metals, trash, pet wastes, oils and other sources that increased population density produces. Since 2000 the populations of Idaho, Washington, Oregon and Alaska have grown by 19.5, 13.1, 11.8 and 11.4%, respectively. The PNW Regional Water Program, a consortium of five land-grant universities with a public outreach mandate, recognised the impacts these growth numbers were having in these rapidly developing areas and determined that public education and outreach about storm water generation and management was a logical response that the members of the team could accomplish.

Analysis/Results and Implications for Policy and/or Research

This Team from five universities had the goal of developing successful storm water educational programming through the use of video streaming technology coupled with local on-site facilitation. We conducted a series of three storm water themed educational programmes in 2005, 2006 and 2009. The storm water conference educational topics were Preventing Storm Water Pollution through Education, Storm Water Management – One Backyard at a Time, and Storm Water Management from a Watershed Perspective in 2005, 2006 and 2009, respectively. For each of the three programmes a steering committee consisting of individuals from agencies and watershed groups throughout the four-state region (Alaska, Idaho, Oregon, and Washington) was formed to develop a specific storm water issues theme for the proposed programme. The steering committee was comprised of two members from each of the land-grant institutions in the Pacific Northwest (Northwest Indian College, Oregon State University, University of Alaska, University of Idaho, Washington State University), US-EPA Region 10 staff from the Office of Ecosystems and Communities and the Office of Water, and representatives from six watershed groups in Alaska, Idaho, Oregon, and Washington. In addition to determining the conference theme, the steering committee was key in: (1) determining the regional case studies to be highlighted in the broadcast, (2) overseeing the development of written materials provided to attendees, (3) selecting the panel of experts that would speak at the live broadcast, and (4) developing the conference evaluation mechanism.

Characteristics common to these three video-streaming conferences were: (1) sets of Web-based materials developed for participants to have in-hand at each facilitated site; (2) pre-produced video segments highlighting storm water activities; (3) a live panel of experts discussing appropriate topic issues; (4) live question and answer segment hosted by panelists; (5) toll free phone, fax, and email ability for people at facilitated sites to send their questions to the moderator for the live panelists; (6) on-site facilitation at each down-linked site; and (7) the availability of the entire programme on DVD.

The ultimate success of the 2005, 2006, and 2009 regional watershed issues conferences were evaluated the following three ways: (1) using a traditional evaluation techniques – having attendees fill out a form, (2) measuring conference attendance at each event and over time, and (3) awards received from peers. Over three-quarters of all attendees completed evaluation forms for each of the video-streamed conferences. Attendees were asked to evaluate the quality and content of each conference and the perceived value of the supplemental materials on a scale of 1 (poor) to 5 (outstanding). The average evaluation score ranged from 4.0 – 5.0 for each of the three conferences. The written evaluations from each conference consisted of both objective and open-ended questions. Over 50% of the respondents took the time to provide answers to the open-ended questions. In addition to the overall positive comments, participants were not shy about providing suggestions for improvement. Many of these suggestions were acted upon in the preparation of subsequent conferences.

The second evaluation strategy was to look at attendance over the 3-year period. Attendance increased from 1,568 in 2005 to over 5,200 in 2009. This over-threefold increase in attendance is likely related to both the need for and the quality of these broadcasts. Watershed group members attending these trainings voted positively based on their increasing attendance numbers. Peer evaluation was the third method by we used to evaluate these educational trainings. We received local, regional and national awards including the 2005 Shirley Davis Award for Excellence in Teleconferencing awarded by the National University Telecommunications Network (NUTN). The Shirley Davis award recognises a member educational institution that produces an outstanding teleconference, judged by content, technical, and administrative issues.

The fact that attendance continued to increase over time is a good indication that people involved in watershed planning in the Pacific Northwest regarded the video-streamed conferences as an important part of their continuing education for storm water management. Far more people than the 9,000 detailed above have seen parts of these conferences when one considers additional potential viewers of Web-archived materials, specific video segments used by educators and agencies in trainings, and DVD copies of these programmes, which continue to be distributed largely to watershed groups in the region.

New Approaches to Disinfection of Drinking and Waste Water for Sustainable Urban Growth

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Keywords: waste water, drinking water, viral contaminant, Dezavid, urban growth

Introduction/Problem Identification

The problem of surface and underground water pollution by bacterial, viral and parasitic contaminants is a global one. Currently, in Russia 40.3% surface water and 17.2% underground water sources are out of line with the sanitary regulations and standards. Water with its ability to transfer to tens, hundreds kilometers chemical, biological and other contaminants becomes a weapon affecting hundreds and thousands of people. Focal points of enteric infection, different in the number of diseased persons, appear periodically. The amount of consumed water is a basic component of the "quality of life" idea. While drinking the polluted water people expose themselves to the risk of occurrence of infectious and parasitic diseases, immunodeficiency disorders and other pathological processes. One of the central tasks for the organisations involved in water treatment and decontamination is to supply people with epidemiologically safe water.

Analysis/Results and Implications for Policy and/or Research

In the Russian Federation, where more than 70% of water intake facilities are supplied from surface water sources, practically, 100% of wastewaters are discharged into these water sources. It becomes clear how important the wastewater disinfection stage is. The quality of potable water is vastly dependent on how and by what means wastewater disinfection will be performed. Rotavirus infection (RVI) is one of the main reasons for occurrence of diarrhea of children and adults. According to some assessments, every year 125 million people become infected with rotaviruses. In average, 6% of lethal cases among children of up to 5 years old are caused by this infection. According to WHO, every year up to 500 000 children die of RVI. Rotavirus transfer by water is one of the leading ways of dissemination of this infection as a marker of water viral contamination. Application of chlorine-based preparation is rather not ideal for human health due to formation of chlororganic compounds and absence of viricidal action (the bactericidal effect is available). Therefore, use of chlorine and chlorine-based preparations is not an efficient method of disinfection of treated wastewaters. The hardware methods of water disinfection (ultraviolet, ozonization) require high investments and considerable expenses in the process of operation.

The purpose of our research was to study the effect of rotaviruses exposure to DEZAVIDÒ, which consists of polyhexamethyleneguanidine hydrochloride and alkylbenzyl-dimethylammonium chloride. DEZAVIDÒ is registered as a disinfectant for treatment and disinfection of wastewaters and recycling water in the equipment cooling systems, water in the process water supply systems of enterprises, direct and indirect hot water supply systems, in swimming pools and water parks, as well as for prevention of biofouling. The subject of research were wastewaters with the level of viral contamination with rotaviruses equal to 1x104 – 1x108. For testing, fecal extractions of patients suffering the rotavirus infection were taken which contained the viral particles in the concentration of 1x1011 – 1x1012 in 1 ml. The time of exposure was 30 and 60 min. Detection was effected by ELISA and PCR real-time. The 8-mg/lit (0,256 mg/lit of active substance) dose of DEZAVIDÒ fully suppresses the infectious activity of rotaviruses contained in wastewaters in concentration of 1x10 1x108 viral particles during 30 min. Application of the DEZAVIDÒ preparation for disinfection of faeces of the patients suffering from rotavirus infection testifies to 100-% virulicidal effect on rotaviruses in concentration of 1x1010 in 1 g of faeces, 90-% – on rotaviruses in concentration of 1x1010 and 80-% – on rotaviruses in concentration of 1x1011 – 1x1012.

Impacts of Seawater Intrusion on Groundwater Resources in the Face of Climate Change

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Keywords: groundwater, conductivity map, Seawater intrusion, climate change, coastal aquifers

Introduction/Problem Identification

Groundwater resource exploited has always been given due consideration in the island, given its vulnerability to drought events and also its vulnerability to seawater intrusion, all the aquifers being coastal in nature and in hydraulic contact with the sea. Electrical resistivity surveys were carried out in the sixties, this method being highly suited to the heterogeneous volcanic formations of the island. The higher the water content in the volcanic basins, the higher the conductivity of the rocks recorded. The primary objective of this study was to identify geological formations that could be exploited for use. The study indicated that sea water intrusion was very pronounced in the Northern Plains aquifer, main because of the geological formations of this particular aquifer. Localised zones in the eastern part of the island were also under the threat of seawater intrusion (Proag, 1995).

Analysis/Results and Implications for Policy and/or Research

The first part of the study consisted of collecting historical data. The local water authority responsible for the development and management of water resources in Mauritius, the Water Resources Unit (WRU), uses a pressure measuring cell and a data logger to record groundwater level, temperature and conductivity. The salinity profile at one location, Sottise (located 700m inland), was established, and it was noted that brakish water was available as from a depth of 15m below ground surface and saline water as from a depth of 20m from ground surface, at that particular location, with conductivity varying from about 1000 to more than 5000μmhos/cm. The present study focused on coastal boreholes and it was noted that with the exception of a few, the conductivity was within the acceptable norms of μS/cm. Levels rose up to 4500 μS/cm in a few coastal borehole. The salinity recorded was correlated with pumping rates at the boreholes or in the vicinity. Results showed that pumping even at a small rate of about 200m^3/day, greatly enhanced the seawater movement inland. Chloride concentration, pH, sulphate and nitrate concentration were also monitored at 18 boreholes. In general the coastal boreholes were recording groundwater with pH level slightly acidic, less than 7. In addition chloride and sulphate concentration seems to correlate with levels of conductivity.

Analysis of historical data confirmed that the conductivity values were almost similar and did not vary with the dry and the wet periods. This observation can be explained by the presence of preferential pathways in this particular borehole. The aquifers of Mauritius are all in hydraulic contact with the sea. The hydraulic gradients are relatively steep and hence, groundwater movement towards the sea is relatively fast. The island currently exploits about 50% of groundwater to cater for its water demand. Groundwater abstraction tends to enhance seawater movement inland. This study highlighted the vulnerability of the most sensitive aquifer to seawater intrusion. While in general the groundwater quality is good with respect to salinity, there are some localised zones which are highly vulnerable to seawater movement. A small pumping rate is being able to increase the salinity level very high, and there is a need to map similar vulnerable spots for better management of the groundwater resource. The complexity of the geology of the Northern Plains Aquifer has given rise to preferential pathways, which are responsible for vulnerable zones where conductivity values are high. Further research is need to map these pathways, such that the vulnerable zones are clearly identified and groundwater abstraction is these regions kept under controlled.

The Losses of Drinking Water in the Algerian South: Quantification, Analysis and Cost

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Keywords: urban water consumption, water losses, distribution network, domestic water demands, Algeria

Introduction/Problem Identification

At present, most Algerian towns are facing at least one water-related problem: either with distribution (network, storage, reservoirs), or with supply, and even with drainage of the sewage. In addition to droughts, unfavourable economic factors and population problems combine to make easy access to drinking water difficult.

In this context and particularly in the arid southern areas, efficient management of water resources and minimising water losses constitute the strategic and operational tasks for the society and the economy.

Analysis/Results and Implications for Policy and/or Research

Many studies have been devoted to the study of losses from water supply distribution networks, such as those presented in the IWA conferences (Leakage 2005 and Waterloss 2007). However, very few have dealt with networks with a low level of metering and on which the supply is frequently interrupted.

The aim of this study is to provide an estimate of the water losses of the domestic water supply network in the region of Biskra located in the south of Algeria. Two methods were used:

- The first method consisted of an evaluation of the demand for drinking water through the study of a sample of consumers on whom relevant data are available, followed by an extrapolation from the results obtained to the whole population. A comparison with the production was then made.
- The second method evaluated the water losses on the water supply distribution networks through measurements of the flow of water supplied to the town of Biskra at night.

The results obtained may be relied on for an evaluation of the needs for drinking water in the South of Algeria, and for future regional development. The study indicates a high rate of water losses in the distribution network, reaching about 44%, and over-consumption due to an insufficient number of water meters and discontinuous supply.

Completion of the Flood Protection Barrier for Sustainable Growth of St. Petersburg

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Keywords: hydraulic system, flood warning system, manoeuvring, damage assessment, flood control

Introduction/Problem Identification

The St.Petersburg low-lying area of the Neva River delta is open to floods. In the historic city centre, street level is only about 2 metres above mean sea level. As a result, atmospheric depressions and associated storm winds over the Baltic Sea regularly lead to flooding of the historic central parts of the city, with the potential of causing significant human, social and economic loss. The city has suffered more than three hundred floods since its foundation in 1703. Statistically once a year the level +160 cm BS is reached, which is the official flood level. The highest flood levels recorded in St.Petersburg were +421cm BS (1824) and +380cm BS (1924). The speed of the water level rise is different under each flood. The average level rise is 25-39 cm/hour, but the maximum water level rise observed exceeded one metre per hour, that is why it is very important to have a quick response flood warning system to operate the barrier in case of emergency conditions.

Analysis/Results and Implications for Policy and/or Research

St.Petersburg Flood Protection Barrier, designed for 100 years of defense of the city from floods, is 25,4 km long. Now it is in the completion stage. The Flood Protection Barrier across Neva Bay at about 20-25 km from St.Petersburg is a complicated hydraulic system. [Mikhailenko R.R., Savin A.N., Gerritsen H., H. Van Pagee, 2005]. It consists of more than 30 constructions including 6 large sluice complexes, 2 wide navigation openings equipped with steel gates, each controlled separately, 11 dams, 7 bridges, a tunnel, etc. In normal situations the gates will be fully open to allow the free exchange of water.

The main functions of the Barrier are to protect St.Petersburg against floods and improve ecological condition in Neva Bay and the Eastern part of the Gulf of Finland by means of water flow management using water gates manoeuvring (in case of accidental oil spills, waste water discharges, algae blooming, etc.) [Guralnik D.L., Kassatsier K.E., Mikhailenko R.R., 1995]. After the completion, the Barrier will also perform the following functions:

- Serve as part of ring road around St.Petersburg;
- Improve conditions for ship navigation and port activity, recreation and tourism;
- Create nature-friendly environment around the FPB (accumulation of sand for sand nourishment of dunes, and accumulation of macrophytes along the coast and recovery of wetlands for bird habitat, fish, etc).

A successful flood control function of the Barrier depends on a reliable flood warning system. The main function of the system is to predict the flood threat early enough to optimise the timing of closing the sluices to keep the water levels in Neva Bay low enough not to flood the city The flood gates in the C-1 opening, the main of the 2 navigation sluices, are rather sensitive to high speed of water level rise and to high waves, the forecast system will help to determine the moment when these gates have to start closing. This is also important to minimise the risk for navigation.

St. Petersburg Flood Protection Barrier is located in the most eastern part of the Gulf of Finland, in the transitional area between maritime and continental climatic zones that is characterised by weather instability caused by frequent changes of air masses. The minimum air temperature recorded is –38C, the maximum – +33C. The region is covered with snow for 126-137 days per year.

For sustainable development of St. Petersburg the major activities require the highest priority:

- Completion of the Flood Protection Barrier to obtain full safety from floods;
- Development of reliable methods for management of water condition of a unique nature and technical system of St.Petersburg and its protection, because after the FPB completion Neva Bay will become an inside-city water body with a total area of 400 sq. km.

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Increasing Role of Large Reservoirs in Sustaining Urban Water Supplies in India

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Keywords: urban water supply, large reservoirs, urbanisation, population growth, India

Introduction/Problem Identification

Rapid urbanisation and industrialisation are the major factors behind growing urban water demand in India. Incidentally, the large urban areas are experiencing faster growth in population, and most of them are in arid and semiarid regions, which are naturally water-scarce. As a result, water supplies from local water resources including aquifers are falling far short of the high and concentrated demands in most of urban areas. Depletion and degradation of aquifers, water bodies and sea water intrusion often force the urban authorities to look for alternative sources of water supply. Under such situations, these large cities have to rely on distant large reservoirs. Understanding the pattern and sources of urban water demand is important for sustaining water supplies in cities. By analysing 302 urban centres in India, this study estimates the Population Elasticity of Water Supply (PEWS) which could be useful to project urban water demand in India and making plan for sourcing the water.

Analysis/Results and Implications for Policy and/or Research

Urban population in India has increased more than 11 times surpassing India's total population growth, which has increased less than 5 times during 1901 to 2001. In the same period, the CAGR of urban population was 1.8 times higher than that of the total population. Currently around 27.8% (285 million) of India's population is living in urban areas, which is expected to increase up to 40% or 550 million in 2021. The magnitude of challenge to India's future water resources planning and management would be largely determined not so much by its population growth, but by three other factors: (1) the source of this growth, i.e., whether rural or urban; (2) where this growth is likely to occur, i.e., whether in water-scarce regions or water-rich regions; and, (3) whether the growth is going to come from increase in urban centres or faster growth of the existing urban areas.

In India, a much greater share of the urban population live in Class I cities (> 0.1 million population) today as compared to the beginning of the 20th century (1991: 22% & 2001: 62%). The growth in urban population is not equally spread across Urban Agglomerations (UAs) – the CAGR of population for Class I cities and Class II towns (0.05-0.1 million) were 1.5 and 1.1 times respectively higher than the overall urban population growth. There are three reasons for the urban hierarchy becoming top heavy: (a) the growth in number of urban areas has been much lower, with not many villages transforming into towns; (b) access to basic infrastructure is not equally spread across UAs; and (c) the economic activities in larger cities have been growing at a much faster rates than the small towns.

India can be divided into 19 major drainage basins. The per capita renewable water resources and level of urbanisation vary remarkably across the basins. Except for the Brahmaputra, Meghna, Mahanadi, Narmada and WFR2 basins, annual per capita renewable water resource is lower than 2,000 kilolitre for all other basins. A comparison of annual per capita renewable water resource and level of urbanisation across the river basins shows that, except for the above five basins, there is a negative relationship between them. Incidentally, all river basins with relatively higher degree of urbanisation such as Sabarmati, Tapi, Cauvery and EFR2 are also characterised by arid or semiarid climate with extremely low renewable water availability, and therefore cannot support high degree of urbanisation unless water is drawn from sources outside the basin.

The level of dependence of larger cities on surface water is much higher than of smaller cities, and larger cities have higher average per capita water supplies. Over the years, the dependence of Class I cities on surface water sources has increased. The results of estimated multiple regression models for 209 Class I cities and 239 Class II towns show that demand for water supply grows at a faster rate than the population growth. Class I cities have better water supply (PEWS is 1.127 in 1988 and 1.289 in 1999) than Class II towns (PEWS is 0.396 in 1988 and 0.675 in 1999). The share of large reservoirs in total urban water supplies increases with population. UAs located in arid and semiarid regions have larger dependence on surface water sources. The results reinforce the fact that with the growing urban population, it is necessary to augment the water supply from sources outside the periphery of the urban centres for providing better access and coverage. In arid and semiarid parts of India, urban water supply systems are under stress and to cope up with population pressure, there is need to look for surface water sources to augment water supply. Water footprint of urban centres in India is growing up and it is mostly away from the urban centres.

The investment decisions in the water sector are largely taken on economic and political grounds. The past efforts for transfer of water from large reservoirs to cities faced severe criticism on the following grounds: cities take away water from farms; the cost of water transfer from far away places is enormously high; and the environmental impacts of dam construction and water transfer are always negative and irreversible. On the other hand, all social, economic and political considerations favour transfer of water from agriculture to domestic sector. Water for drinking is a social good, and meeting drinking water requirements is the first and foremost priority enshrined by the National Water Policy 2002. Urban dwellers generally enjoy more political clouts as compared to their rural counterparts. Urban areas are growth centres, and any reduction in supply of water to urban areas could cause much higher economic losses than the losses in rural areas with the same level of reduction to agricultural water supplies. In spite of the fact that domestic sector, including that in rural areas, accounts for only 3 to 5% of the total water consumed in India, this seems to be a daunting task.

New Application Model for Sustainable Improvement of Urban Water Under Crucial Conditions – The Gaza Strip Case – Palestine

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Keywords: urban water, pipe failure, rregression model, survival analysis, GIS

Introduction/Problem Identification

This paper presents a new tool for sustainable improvements model for water network using the most necessary basic information to increase the water efficiency. Gaza Strip is used as a case study.

The limited information in Gaza Strip as one of developing countries brought into focus the urgent need to develop assessment model for rehabilitation of water distribution systems adapted to such countries.

The rapidly growing population and expanding urbanisation in the Gaza Strip during the past few decades have increased pressure on the aquifer, contributing to its overexploitation and the formation of deep hydrological depressions. The estimated water demand for the domestic sector in the Gaza Strip is expected to double during the next decade and triple within two decades (Population growth rate in Gaza Strip is 3.29%). Thus, further increases in the size of population and consequent exploitation will diminish the aquifer's quality, as long as it serves as the primary source of water.

Analysis/Results and Implications for Policy and/or Research

The project research presented in this paper deal with problem of water pipe renewal and the condition assessment required by decision maker under crucial conditions.

The main goal of Palestinian Water Authority (PWA) is to manage and develop the water resources of Palestine in a sustainable and equitable manner, so as to secure and provide water of adequate quality and quantity for all social, economic and environmental needs. PWA in the last years used several methods to increase the water quantities in Gaza Strip through: 1) improvement the efficiency of water supply through repair and replacement more than 1200 Km. 2) Service connection replacement connections covered to 20,000 houses. 3) Meter calibration/installation.

Furthermore management systems have been improved through: improve collection of water revenues, identify illegal connections and convert to legal status, develop and update database services connections and tariffs analysis.

According to monitoring reports of PWA, there are still water losses of 30% in the network and in some parts water losses are up to 45%.

Here a model for sustainable improvement of urban water systems was developed based on the principle of limited data. In this model, the data is collected from PWA.

Geographic Information System (GIS) has been used as database and decision support system (DSS). ArcGIS9.2 software and Water Modelling software (WaterCAD) have been used to build the optimising tool. The model was applied to water supply network in Gaza City. The Gaza network supplies a population about 500,000 inhabitants within the municipality of Gaza. The supply is provided by 30 wells located in Gaza city. Water is pumped directly into the distribution system by the borehole pumps.

The data in this case study were available at the pipe level and contain both asset information and recorded bursts. The water pipes considered in this study consisted of 4,500 individual pipes, 1,260 km in total length and installed since 1970.

Only four fields describing pipe features have been considered for modelling. These are diameter, length and number of previous failure and water pressure, all available at the pipe level. Using available data, we prepared regression model to assess the parameters of survival function based on generalised linear model (GLM). The model takes into account variables linked to structural deterioration by generalised Linear Model and survival analysis. The number of pipe failures as a performance indicator has been included as the number of failures per 100km of pipeline per year. The case study reported here shows how the GLM modelling technique provides a tool that can formulate such an indicator as a function of the simplest asset features of the system (i.e., diameter and pressure). The approach is tested and verified with the development of a pipe burst prediction model derived from data available for a real PWA water system. Data mining by GLM produced good, simple and understandable relationships/models that provide a high level of statistical correlation among the variables and could be regarded as indicators of system performance.

In addition, forecast rehabilitation needs are calculated from the age distribution of the existing inventory with the life time expectancies of the different pipe types. The residual service life of a particular pipe is calculated from its total service life expectancy of the pipe type.

The selection of pipe candidates for replacement or repaired was based on condition index of pipes and predicted failures. According to model outputs, several scenarios have been illustrated for pipe replacement and renovation based on expected demand requirements in the future. Demand management has become a necessity for PWA, as well as many other countries in order to sustain its development and satisfy population needs.

The results obtained show that the model performance is efficient depends on limited data; pipe material, diameter, number of previous failures and water pressure. The model used to improve the sustainability of water network.

The output from the condition assessment model can be used for a variety of purposes in water network management. In the long term the models can be used to estimate future money budget needs for rehabilitation. In the short term the models can be used to define the important candidates for replacement based on poor structural condition.

Greywater Reuse in Vulnerable Peri-urban Communities as a Solution for Water Scarcity in Jordan

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Keywords: Jordan, water scarcity, greywater reuse, large water consumers, urban communities

Introduction/Problem Identification

Jordan is located in an arid to semi arid region where around 90% of the country's land receives an average precipitation of less than 100 mm/year while only 3% of the land receives an average annual precipitation of 300mm or more. Jordan is considered to be one of the four poorest countries worldwide in water resources, and has a population growth rate of about 2.9% (1998-2002), the 9th highest in the world. The available renewable water resources have drastically dropped to an annual per capita share of 145 m^3 in recent years, compared to 3600 m^3/cap/a in the year 1946. The country is facing a future of very limited water resources, searching sources that can help in covering the huge gap between water supply and demand is a challenge. Nowadays, irrigated agriculture is the largest consumer constituting around 64% of the overall uses compared to only 36% for municipal, industrial and tourism (MIT) purposes.

Analysis/Results and Implications for Policy and/or Research

This paper presents a case study; dealt with greywater at large water consumer level treatment and reuse.

Greywater is commonly defined as wastewater without input from toilets and kitchen. Greywater can be considered an alternative that provides non-potable water for household usage, and thus reduces the per capita water use by 50%. Treatment technologies for making greywater safe for indoor use or for irrigation are many and diverse and they vary from simple systems in single household to advanced systems for large scale reuse. Course filtration with disinfection represents the most common technology used for greywater treatment in many places in the world. However, a case study presented in this paper was funded by International Development Research Centre IDRC and implemented by Environment Consultations and Projects /Royal Scientific Society.

"Integrated Greywater Management Policies for Large Water Consumers in Vulnerable peri-urban Communities In Jordan, 2006-2009" is a project focused on the adoption of an integrated greywater management system at the university's dorms that addresses technical, institutional, social and community participation aspects taking into consideration reuse opportunities which enhance interaction and cooperation among different stakeholders. This project has succeeded in improving the community know-how in greywater management and enhanced water use efficiency by reusing greywater at Muta'a University dorms.

Water Supply in Dhaka Mega City: A Strategic View

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Keywords: water supply, unaccounted for water, strategic view, mega city, Dhaka

Introduction/Problem Identification

Dhaka mega city is densely populated with more than 16.4 million in an area about 300 sq. km. The Dhaka Water Supply and Sewerage Authority (DWASA) cannot provide the recent requirement of 2100 MLD. Moreover, with an increasing trend of population growth will create pressure on the existing water distribution system. This paper is focused on a combined water supply system comprising accounted and unaccounted for water in mega city Dhaka considering loss diminishing analysis, public acceptance and awareness and alternate source of water. The idea is to not only looking for alternative sources but also to ensure effective and sustainable use of the current sources that is best suited to meet city water demand.

Analysis/Results and Implications for Policy and/or Research

It is very tough task to meet the demand of potable and usable water unless the decision makers of the country will not pursue to lead some distinct decisions for the sake of the city dwellers. The following key-points might be useful in this aspect:

It is not possible to meet the demand of water by existing systems of DWASA unless 34.78% loss will not be minimised. The UFW that is termed as system losses of DWASA was as high as 75% in 1979. Afterwards, due to installation of water meters, improvement in the billing system and necessary arrangement for detecting illegal water connections, the system losses were narrowed down to about 41.5% in 2008-2009. The total UFW comprises with physical losses and non-physical losses. The estimated physical loss is almost 55% of the total UFW and non-physical losses comprising with billing errors, meter-under registration, broken or tampered meters, illegal connections are remaining 45% of the total UFW. The most important strategic adaptation should be applied and maintained by DWASA to minimise the system loss. DWASA management may take some strategic training from developed countries, where the system loss is less than 10%, to mitigate this issue.

The alternate future water source is the surface water because of lowering of piezometric level. But the major source of surface water like rivers and lakes are in danger because of urbanisation of the huge population. DWASA is now in search of surface water of better quality away from the city. The possible options are Meghna and Padma rivers. And it is expected that if these alternate sources will be added to the distribution network of DWASA, at least 150 MLD of water can be added to water treatment plant of the country. In this aspect, the Government of Bangladesh has signed an agreement with the Chinese Government to implement a surface water treatment plant at Pagla bringing water from Padma.

DWASA is also working on improving water supply performance and creating new source through various projects. Dhaka Integrated Environment and Water Resources Management Project, Dhaka Water Supply and Sanitation Project, Dhaka water Supply Development Project, Emergency Water

Supply System Expansion and Rehabilitation Project, Saidabad Water Treatment Plant (Phase-2) are the major ones. These projects are expected to increase water supply by improving efficiency and creating alternating sources. However coordination of all this projects must be emphasised and ensured. The average rainfall in Dhaka city is around 2000 mm per year. And with this intensity of rainfall, it is possible to store at least 30 MLD of water by constructing storage tank on the roofs of the buildings, which are readily available in Dhaka city. The people of the city must be encouraged to store rainwater and to use this water especially as a palatable purpose.

There are also some industries, commercial places where water is used only for cooling or washing purposes or may be used in boilers that require specific treatment for the purpose not all treatment as performed by DWASA. So it will be handy to have a secondary supply line in industrial zones where preliminary treatment of water will be done and in some cases specific treatment if necessary. The cost of this new network can be recovered from the respected industries. Considering only 5% recovery the total consumption of 180 lpcd per person (future Dhaka Population 15 million) and, it is possible to add more than 100 MLD to the distribution network.

Groundwater in Urban Coastal Areas: Hydrogeochemical Based Approach for Managing the Bou-Areg Aquifer (North Morocco)

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Keywords: groundwater salinisation, coastal aquifers, Bou-Areg, hydrogeochemisty, strategic partnership

Introduction/Problem Identification

The importance of coastal aquifer to sustain ecosystems functionality and human needs is widely recognised. In particular, urban and coastal areas in arid and semi-arid climates mainly rely on groundwater resources. The continuous groundwater withdrawal often causes an alteration of the natural quality of the aquifers, with severe effects on ecosystems and human health. In addition, the rapid growth of urban population occurring in coastal areas exerts a strong pressure on the environment, since the increase in industrial and agricultural activities is accompanied by the release of by-products and wastes in the natural system. For this reason it is of paramount importance, on the one hand to identify and discriminate pollution sources and on the other to define adequate criteria to support correct water management practices

Analysis/Results and Implications for Policy and/or Research

In the framework of the Strategic Partnership for Mediterranean Sea Large Marine Ecosystem, UNESCO-IHP sub-component (Management of Coastal Aquifer and Groundwater), the present work stressed the role of groundwater in sustaining coastal lagoons and wetlands, including their habitats and ecosystems, in both the general case of the Mediterranean shores, and the specific case study of the Bou-Areg plain (Nador, Morocco).

All the issues previously highlighted were addressed by applying hydrogeochemical tools to support groundwater management practices. Geochemical analysis was applied to describe the main processes occurring in the Bou-Areg coastal plain and its interactions with the lagoon of Nador.

Experimental findings confirmed that the high salinity of the aquifer is given by the coexistence of dissolution processes of evaporative rooks and carbonates from Miocene substratum, water-rock interactions, and human impacts due to agricultural return flows. The latter represent the main contribution to groundwater salinisation, especially in the central part of the aquifer, as well as one of the major causes of the general increase in nitrate concentrations. Furthermore, the high salinisation observed in the southern part of the aquifer might be attributed to the presence of fossil and deep groundwater.

Given the hydrochemical results and the high nitrate values in the aquifer, often exceeding the WHO drinking water limit (50 mg/L), the isotopic investigation of $\delta^{15}N$ allowed for the identification of manure and septic effluents, synthetic fertilisers as the main drivers for human induced pollution.

One must also note that, the sum of the above mentioned pressures and the effects of agricultural return flows are acting in a synergic way and contemporaneously affecting the aquifer quality. Consequently, the need to better highlight at local level the non-drinkability and non-adequateness of groundwater for irrigational practices emerged. This would lead to the reduction of potential risks for human health.

The hydrogeochemical investigation allowed considering the saline water intrusion from the lagoon in the shallow aquifer to be negligible, while discharge of polluted groundwater into the lagoon has been found to partially alter its quality.

All the scientific findings of this work enclose important management implications for the future development of groundwater resources in the Bou-Areg plain. A management priority should be represented by the reduction of groundwater extraction and synthetic fertilisers employment for farming practices, since the agricultural return flow was shown to have severe impacts on the general quality of the system. A strategic alternative is instead represented by the alternate exploitation of the water distributed through the artificial channel with the treated (and purified from bacteria) one coming from the wastewater treatment plant. The latter solution would allow to employ an irrigation water characterised by a controlled nutrients concentration and composition, with the consequent decrease of synthetic components discharge into the system. Obviously, this option will involve the periodic control of the water quality across the plain in order to avoid potentially hazardous drawbacks (,e.g. the increase of dissolved nitrates concentration). Besides the remediation actions at the regional level (catchment), the complex pressures exerted by different pollution sources (punctual and diffused) highlight the need to enforce an adequate groundwater protection trough specific, local actions at the single well level. To this regard communication plans should promote the awareness of households and farmers, as well as, the public participation within the management process.

Sedimentology, Hydrogeology and the Influence of Oil Exploration on Water Resources and Environment

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Keywords: South Sudan, unity state, sedimentology, hydrogeology, influence of oil exploration, groundwater potential, aquifer characteristics

Introduction/Problem Identification

A hydrogeological study was carried out in the Unity state of South Sudan. Boreholes for potable water was sank to depths of up to 300m. The purpose was to investigate the geology, the hydrogeology, the resources as well as water sampling for further analyses. The objective of the investigation was to find the possible cause of pollution of the surface, near surface and water from boreholes in Thar Jath area and its environs. Furthermore, it was intended to study which of the deep-seated water bearing aquifer has also been affected by the exploration and production of the oil in the area.

Analysis/Results and Implications for Policy and/or Research

The geological profile in the boreholes show very fine and unconsolidated sedimentary sequences, dominated by clay and silt layers and thinner sand layers. This sequence is water bearing. The first aquifer starts at 20 m bellow surface with a thickness of about 80 m. A very thick clay layer (> 50m) separates the first from the second aquifer. It starts at ca. 200 m depth and shows a fossil water type (sulfate-dominance). One drilled borehole ended in a clay layer at 280m depth, perhaps the base of the second aquifer. Two wells where built for rural water supply from the second aquifer.

Water samples from more than 80 locations show two different water qualities. Surface water of the swamp areas and well water from shallow hand pump wells are hydrocarbon dominated and the salinity degree is low to moderate. An exceeding of international water guideline limits was not observed. On the other hand water from contaminated shallow hand pump wells show significant high salinity degrees, process water and drilling fluids show a remarkable dominance of sodium chlorides, potassium and heavy metals. The salinity degree of affected water wells in some areas reached 8000 µS/cm.

These and the result of the water analyses will be the subject of this study, which will be presented as a poster as well as a detailed scientific paper. The results of this study will form the basis for future water and sanitation as well as guidance for future oil exploration activities in the area.

Collection of Water Sector in Mexico by Means of the Use of Receiving Bodies – A Tool for Environmental Compensation

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Keywords: hydrological-administrative, externalities, receiving bodies, environmental compensation, discharge rights

Introduction/Problem Identification

The collection in Mexico by water use concept, domestic as well as industrial, according to its performance in recent years, shows that there is a lag in assigning historical value to water. In providing drinking water and wastewater sanitation services, the authority acknowledges that economic externalities have not been considered for the definition of economic and financial costs for the service.

This, due to the character given to the nation´s waters on the legislation: not as a cycle but as a source and as a sink at the same time, both unlimited, of the hydric resources. This study focuses on the latter, the water environmental system as a final disposal in Mexico.

The proposal basically is to explore a formula that allows a more efficient collection (and equitable one as well) by this charge.

Analysis/Results and Implications for Policy and/or Research

Under the National Water Act, the Basin Organizations are the technical units, with administrative and legal powers, in those who relay specific activities and functions concerning operational, executive, administrative and legal ones on the federal level in national waters and their management. So, the territorial jurisdiction of river basin organisations – assigned to the national authority on water, CONAGUA (by its Spanish initials) – is delimited by 13 Hydrological-Administrative Regions. In every Hydrological-Administrative Region, it appears that agriculture is operated with low irrigation efficiency, which is a factor to overcome in order to reverse the distribution of consumptive uses of water in Mexico. Of these, the agricultural component is the predominant one (occupying three quarters of water extractions); a typical feature of developing countries.

Until 2000, national coverage in the treatment of collected wastewater was ranging in the order of 20% only. This, accordingly with the microeconomics perspective, which considers the emission of by-products as one else production factor in the production function of goods and services.

In 2007, there was the second revision of the national standard, NOM-001-SEMARNAT-1996, "which establishes the Maximum Permissible Limits of Pollutants in Wastewater Discharges in Water and National Assets". This review prompted the change in the Law of Federal Rights at its national waters scope, in order to motivate discounts on the payment of discharge rights for wastewater treatment. In the legislation which came into force in 2008, control parameters in the use of national water bodies as well as in bodies receiving wastewater and treated wastewater were modified in order to set it simpler for the taxpayer to calculate the discharge rights and make it easier to CONAGUA the enforcement of the maximum permissible limits. However, it is important to be noted that the latest revision of NOM-001-SEMARNAT-1996 did not result in a modification of itself, regarding the parameters and their maximum allowable limits at wastewater and treated wastewater discharges.

Through the use of receiving bodies component, in the collection of CONAGUA, analysis, it is remarkable the level of irregularity in time of the collection, in each of the 13 Hydrological-Administrative Regions; having been observed variations of the 570% order even, for a specific region from one year to another. This becomes more relevant considering that the economic dynamics of each of these regions has not varied significantly in terms of volume in time.

It was seen, too, that the evolution in the level of coverage in the treatment of wastewater in recent years had a sustained growth rate. So, it is discarded as a cause of the irregular collection by CONAGUA, in means of its use of receiving bodies component.

A problem that would explain the significant discrepancies on the collection by concept of use of receiving bodies (of water) perhaps lies in a lack of articulation between the NOM-001-SEMARNAT-1996 and the Federal Rights Law. It was found that the number of parameters provided – and their maximum allowable value-, is different in one respect to the other.

Thereore, it is urgent a greater involvement and collective responsibility in participation among different actors and sectors in order to achieve consistency within each basin, taking into account the availability and the pressure degree on water.

The federal authority counts with, in order to perform compensatory actions in this regard, the Water Banks, which National Water Act conceptualised as management instances for regulated operations of rights transmission.

As a result, water planning in Mexico must:

1. Reach a common understanding in all of Basin Organisations, on sustainable levels of extraction and water quality;
2. Promote the improving of knowledge of connectivity between surface water and grounwater through the construction of information systems significantly atrticulated, so as to allow the management of the resource as a single integrated one;
3. Motivate socio-economic analysis that result in more useful information for decision making and incorporate expert consulting services to improve their quality, building trust among citizens toward the reaching of high value environmental services;
4. Integrate more and better both the management planning of the resource and the planning of the systems of drinking water supply;
5. Provide adequate resources to develop water operational plans, and assess properly their results and;
6. Improve the monitoring of conformity assessment in the use of national water bodies as receiving ones of wastewater and treated wastewater discharges.

Conflict Hydroecological Situations as a Result of Anthropogenic Impact (by Example of Belarus)

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Keywords: urban eutrophication, hydroecological anomalies, ammonium nitrogen, sulphates, Belarus

Introduction/Problem Identification

Big and medium-sized rivers while draining urban territories play an important role in cities water use. They can be an initial stage of water use for different needs of urban population and industry (surface water intake) and constantly a final stage of water use (sewage disposal). During the usage of rivers' water signs of insufficient state of natural water have arisen. Conflict hydroecological situations appear when water quality does not meet the sanitation, economic or social requirements or in case of lack of correspondence of chemical composition of river water to the optimal functioning of aquatic systems.

As previous research has shown, within the urbanised part of rivers' basins detected negative hydroecological situations are associated with biogenic substances' concentrations growth (phosphates in the first place), pollution of river water by ammonium nitrogen and formation (under certain conditions) of anthropogenic hydrochemical anomalies.

Analysis/Results and Implications for Policy and/or Research

Urban eutrophication. In Belarus urban eutrophication arises mainly due to sewage disposal from municipal water use. These waste waters usually are not cleaned enough from phosphorus and nitrogen compounds. The most serious situation for rivers' ecosystems is related to mineral phosphates. Anthropogenic alteration of phosphates concentrations in water of controlled reaches of the main rivers of Belarus (Western Dvina, Neman, Pripiat, Dnieper, Sozh, Berezyna, Svisloch and Western Bug and their tributaries) during the four-year period (2006–2009) was studied. The data for this research were obtained in the National System of Environment Monitoring of Belarus.

The results of investigation have shown the significant changes of regime of phosphates in the water of most of concerned rivers. Anthropogenic changes of phosphates' regime become apparent by means of growth of their concentrations up to values which exceed environmentally acceptable parameters as well as maximum permissible concentration (MPC) up to several times.

Usually intake of over quantity of mineral phosphorus to rivers initiates a disturbance of natural patterns of seasonal behaviour of phosphates in water ecosystems. In anthropogenic conditions the maximal concentrations of phosphates is registered during the summer time while in natural conditions concentrations of phosphates are the minimal in the summer due to uptake of phosphorus by water organisms.

Ammonium pollution. An analysis of annual average concentrations of ammonium nitrogen in water of the main rivers of Belarus has shown that most of them are polluted by this substance. Western Dvina is polluted on the segment between Polotsk and Verhnedvinsk. High concentrations of ammonium nitrogen (up to 2.2 MPC) in water of Polota (tributary of Western Dvina) are registered during the whole year and indicate the stable pollution of this river. Neman is polluted near the town of Stolbtsy and downstream the Grodno. Western Bug is polluted near the settlement Retchitca, in certain years – near Brest and downstream of this city, Mukhovetc – between Kobrin and Brest.

Ammonium pollution of Dnieper in the last years was registered mainly near the settlements Retchitca and Loew, Sozh was polluted near Gomel. Berezyna is polluted along the whole length of the river, especially downstream the Borisow (3.2 MPC) and Svetlogorsk (2.7 MPC). Ammonium pollution of Pripiat is registered only near the city of Pinsk.

It is necessary to mention, what pollution of Belarusian rivers by mineral phosphates and ammonium nitrogen is quite low according to fishery standards but from the environmental point it indicates the disturbance of natural conditions of functioning of water ecosystems.

Anthropogenic hydrochemical anomalies. In anthropogenic conditions presence of permanent source of river pollution can lead to formation of polluted areas which can be described as anthropogenic hydrochemical anomalies. As previous research has shown anthropogenic hydrochemical anomalies of sulphates and ammonium nitrogen are clearly registered in the water of Berezina River downstream the city of Svetlogorsk. The features of hydrochemical anomaly of sulphates are the following: 1) sulphates concentrations in river's water (53.6–149.8 mg/L) exceed background concentrations 8–19 times; 2) abnormal sulphates concentrations have been revealed during 25-years period; 3) there is a permanent source of enrichment of river's water by chemical substance which can be considered as an "author" of anthropogenic hydrochemical anomaly.

The same situation is for ammonium nitrogen: pollution of Berezina by this substance has been revealed during more than forty years. An average concentration of ammonium nitrogen in water of Berezina exceeds MPC 2.7–5.2 times, background concentrations – 6–41 times.

Thus presence of permanent source of chemical impact forms a new hydrochemical situation which can lead (under certain conditions) to formation of anthropogenic hydrochemical anomalies of two types. The first type is revealed to disturbance of regime of macrocomponents. It can be identified be stable deviation of concentration of one or several macrocomponents from their regional background values. The second type of anomalies fixes an enrichment of water by substances with concentrations always higher than maximum permissible concentrations.

Anthropogenic hydrochemical anomalies exist during long time but have "pulsate" character depending on concentrations of pollutants from year to year. Decreasing of chemical load leads to anomaly's depression but the complete disappearance of anomaly requires an implementation of additional restoration measures.

Integrated Environmental Management Approach in Wastewater Sector: A Case Study of Alexandria Sanitary Drainage Company – Egypt

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Keywords: environment, integrated, management initiatives, challenges, sustainable development

Introduction/Problem Identification

Wastewater systems are built and operated, to protect the public health and the environment. They also provide users the continuous collection and treatment of wastewaters. Wastewater utilities should comply with the requirements of relevant authorities and meet specified expectations, while ensuring the long-term sustainability of the service. Today, with scarcity in the world water resources and the mandate to consider sanitary treated effluents as an essential element of the integrated management of water resources, wastewater utility managers are facing unprecedented challenges. Alexandria Sanitary Drainage Company which treats about two millions m^3 of sewage (70% Industrial source) per day is facing challenges to cover everybody in the area. The aging networks of the city coupled with the miss use of the city inhabitants, add to the problems of overflows and failures that impairs sustainable development to be the corporate philosophy.

Analysis/Results and Implications for Policy and/or Research

To respond to these challenges, the Integrated Environmental Management System with its environmental assessment methodologies could be used. This system works under the context of continual improvement – "Plan, Do, Check, Act" – management framework. It could integrate other management initiatives that work under the same framework. These management initiatives include; risk management, assets management, environmental safety & health, capacity management operations and maintenance, quality management, security management, resource usage, human resources, public relations, purchasing, best management practices (Qualeserve), etc. These management initiatives should not be seen as competing approaches. They are entirely complimentary and when used together, can provide utilities with powerful approach for helping to ensure long-term sustainability. The Integrated environmental management system would ensure that environmental considerations are fully integrated and adequately considered into all stages of the development and planning processes in order to achieve a desirable balance between conservation and development. Thus both environmental goals and business goals would be met to achieve sustainable development in wastewater sector. This paper will present the findings of assessing the needs and suggesting a proposed Integrated Environmental Management Plan (IEMP) for the Egyptian Wastewater Sector in general and for Alexandria Sanitary Drainage Company in specific. The plan is in accordance with the Deming general approach " plan, Do, Check, Act " for continual improvement, the Egyptian environmental laws and the international conventions, the aspects of Rio de Janeiro, Agenda 21 chapter 18 and its implementation report Johannesburg 2002 to attain sustainable development. The plan would consider the needs and interests of all stakeholders of the Wastewater Sector in Egypt and for Alexandria Sanitary Drainage Company in specific.

Evaluating Groundwater Ponds as Major Suppliers to Water Distribution System of Novi Sad City (Serbia)

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Keywords: groundwater pond, urban water distribution, sustainable growth, decision-making, analytic hierarchy process

Introduction/Problem Identification

A majority of Serbian cities above 30.000 population is facing the problem of assuring required quantity and quality of water for urban supplies. In most cases distribution infrastructure is satisfactory; however growing population led to shortages in supplies and recognised need for investment into a new or reconstruction of existing distribution network. In the Novi Sad City, second largest in Serbia, assessment of existing three major city groundwater ponds is performed to identify possible development options. It was shown that their capacities and overall performance, not only technical but also social-ecological, could be improved if proper structural and non structural measures are applied. The analytic hierarchy process, a multi-criteria optimisation method, is used to determine importance (mutual weights) of ponds and to trace possible strategy in investment and technical realisation of infrastructure (distribution system for fresh water provision) connected to the ponds.

Analysis/Results and Implications for Policy and/or Research

There are three major and two secondary groundwater ponds for supplying fresh water to the city of Novi Sad, capital of Vojvodina Province, Serbia. Major ponds, Strand, Petrovaradinska ada and Ratno ostrvo are in full 24-hour operation and their exploitation is supported on an intervening base by two other ponds known as Kamenjar and Detelinara. For various reasons, mostly technical, the last two ponds were not considered in recent studies.

All three major groundwater ponds are located near the shoreline of the Danube River. Because Danube passes almost through the city centre, ponds are within the core city area. Two ponds, Strand and Ratno ostrvo, are located on the left river side at 5.5 km distance from each other. Strand pond is more upstream, located close to the campus of the University of Novi Sad. The third pond, Petrovaradinska ada, is located at the opposite river side, approximately across the Ratno ostrvo pond.

Experienced experts in groundwater hydrology, urban water supply, and distribution network engineering are asked to participate on consensus basis in a group assessment of the three ponds, respecting requirement that their expert decision will trace a strategy on how to assure sustainable urban growth by reconstruction of local infrastructure and preserving harmonised developments of overall urban water distribution infrastructure sourcing from ponds. The expert team adopted the following set of criterions for evaluating ponds: capacity, water quality, cost of water, natural protection, recharging capabilities, technical accessibility, and environmental impacts. Capacity of a pond is defined as total well's capacity installed. Water quality is understood as necessity for water treatment. The unit cost of water is defined as cost of m^3 of installed pump capacity. The natural protection criterion received flexible interpretation by experts, e.g. which if low-permeable layers (such as clays or sandy clays) cover water-bearing layers, then the more massive protecting layers are – the better natural protection of the pond is. Recharging capability aggregates both natural and artificial recharging possibilities that exclude any hazardous pollution. Technical accessibility of the pond is considered as global measure of technical characteristics of wells, pumps, local infrastructure etc. Finally, criterion environmental impacts served to account for interrelations between ponds, water factories, society interests and other environment factors; certain psychological issues are considered to be included in evaluations under this criterion, too.

Evaluation of ponds' importance and perspectives of their reconstruction is considered as a decision-making process based on prior systematic analysis of all relevant ponds' characteristics. To relate a variety of factors and determine their impacts and importance in future infrastructural developments, the Analytic Hierarchy Process (AHP) is selected as supporting decision-making tool. This method enables to determine exact dominance of one factor over the other by investigating different dominant/weak hierarchical structures. In fact, it requires decomposition of a problem into hierarchy and assures that both qualitative and quantitative aspects of a problem are incorporated in evaluation process. If global goal is defined as to define the order (by quality and importance) and mutual relative weights of three major ponds, then a set of 7 criteria is adopted as sufficient to create consistent and coherent evaluation filtering mechanism applicable to the alternatives (ponds). A three level hierarchy (goal-criteria-ponds) is created and AHP application produced satisfactory outcome that is accepted as trustful by all involved participants in the decision-making group.

In this work we describe created framework for straightforward evaluation and ranking of the three major groundwater ponds for supplying the Novi Sad City. A mechanism for follow-up of ponds' future development within urban water distribution system, according to the weights they obtained by the AHP methodology, is also presented in brief.

"Functional Facies" for 3D Modeling of Contaminant Mobility and Water Management Alternatives (Göteborg, Sweden, and Niger Delta Environments)

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Keywords: pollution, GIS modelling, Niger Delta, Gothenburg, multi-criteria evaluation

Introduction/Problem Identification

Environmental and resource management is often restricted to the geographic two dimensions that are most easily observed. Factors that limit our perspective include: 1) the predominance of surface information, 2) a poor conceptual understanding of subsurface processes, and 3) data-processing software with 2D restrictions (e.g. spatial Geographic Information Systems, GIS). In contrast, the physical, geochemical and biological conditions that constitute a sustainable system are decidedly 3D, especially over longer time periods. We illustrate the use of a classification structure that allows sequential incorporation of both empirical and conceptual information, focusing on the 3D ground conditions as an integrated system. The two application examples, the city of Gothenburg, Sweden, and an area of the Niger Delta, have contrasting ground conditions, pollution histories and different scales of information detail.

Analysis/Results and Implications for Policy and/or Research

Several advantages are realised by integrating the FF concepts into database construction and management. FF help to identify significant statistical and structural relationships within the database that are naturally related by the biological-geological relationships that define ground conditions and influence contaminant trends. The FF concepts are valuable for more detailed modelling activities, such as contaminant budgeting, site-specific contaminant classifications and process interpretations. In the two study areas we focus on the applications for storm water planning (Gothenburg) and for water resources issues (Niger Delta). Our use of Functional Facies is somewhat similar to "hydrological type environments" (Swedish EPA and others), but usually with more detail. We propose a point system similar to that in the "Environmental Sensitivity Index" (NOAA) for ecological vulnerability to oil spills. In addition to the protective goals, our FF modelling also aims to rank the remedial and alternative-resource options with more variable pollution sources.

Case study area 1 – Gothenburg city

This work is part of the on-going EU Interreg project "DIPOL" (Impact of Climate Change on the Quality of Urban and Coastal Waters). FF mapping for areas along the streams Mölndalsån and Säveån in Gothenburg is used to characterise: 1) contaminant sources, 2) transport pathways and 3) recipient areas. Both water and contaminant budgets are then calculated using four seasonal scenarios. Within each FF area, the parameters for supply, infiltration, runoff and sewage connectivity are quantified using mainly air photos, geological and geotechnical databases, and other archive data, supported by personal communication with relevant city offices and our field observations. GIS calculations result in maps that separately present individual parameter variations and total fluxes within the FF or total study areas. Environmental impact and decision-support criteria are also facilitated by the GIS format, where multi-criteria evaluation is used to weight the importance of the individual modelled contaminants and their variability in the seasonal scenarios.

Heavy metals, hydrocarbon pollutants and PCBs in the study area are related to different types of land uses and building constructions, especially traffic intensity and the extent of metallic roofing in each FF area. Atmospheric deposition is also important. The 3D perspective is illustrated in our FF model in areas where hard surfaces and stormwater drainage prevent groundwater renewal to such an extent that water moves from the local stream into adjacent subsurface ground, opposite to the general trend of groundwater flow into the streams.

Case study area 2 – Niger Delta

Extensive pollution has degraded surface-water resources on the Niger Delta, both in rural and urban areas. To provide alternative resources, protect against further contamination and to evaluate remediation possibilities, FF maps are able to help identify the ecosystem risks, as well as the limitations and possibilities of different natural and land-use settings. Because of the relative inaccessibility, satellite imagery has been used for surface interpretations, which in turn are combined with geological models for the delta near-surface stratigraphy (3D structure). Initially, the FF model is therefore largely conceptual and needs to be complemented, but considerable archive data are available in connection with petroleum exploration.

Delta stratification is favourable for finding multiple groundwater reservoirs in many areas. These resources are, however, not sustainable for larger populations. Artificial infiltration is often suggested, but safeguards against further pollution spreading resource depletion are necessary and not easily guaranteed, In addition to removing the sources of pollution, several protective and remedial alternatives need to be considered. This is done using multi-criteria evaluation methods, ideally within a GIS and with FF classes that combine both surface and subsurface conditions. Our main example is in area near the Port Harcourt refinery, where untreated waste water and petroleum products are released and impact on the adjacent creeks, mudflats, coastal areas, water supply, fishing and agricultural crops. Diffuse pollution is also significant, and the sources often more difficult to identify and reduce. The problems of this area are typical of many other delta areas, and the protective, remedial and alternative resource options can only be prioritised if their overall sustainability can be evaluated.

River Eman CMA – A Model for Integrated Water Resource Management

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Keywords: water quality monitoring, water flow regulation, public participance, service organisation, water board

Introduction/Problem Identification

River Eman is situated in the South East part of Sweden and have its river mouth in The Baltic Sea. The river has high biological values like catfish, salmon, brown trout and freshwater pearl mussel.

The river have sometimes problem with drought and flooding. One of the biggest pulp mills in the world is situated near the river mouth, and use the water from the river in their process. Several municipalities also use the water for drinking water.

There are a lot of stakeholders along he river using the water for different purposes. This caused in the beginning of the 90-ties big conflicts between the pulp mill, the county authorities, the municipalities and the farmers along the river.

Something had to done to solve that problem. The county authorities decided to create a discussion forum to gather all stakeholders around a table in order to solve the problem.

That was the start of our now exciting river basin organisation. The River Eman Catchment Management Association (CMA).

Analysis/Results and Implications for Policy and/or Research

River Eman CMA is a non-government organisation standing on five legs.

Leg one is monitoring of the water quality in the river to detect to high discharge from point sources, and to detect long time changes in the water quality. The costs for the monitoring programme are divided between activities that have an impact on the recipient, River Eman.

Leg two is regulating the water level in the biggest lakes and the water flow in the main stream and the tributaries in order to deliver enough water to the pulp mill, the municipalities and the farmers during drought periods and to reduce the impact of flooding from for example snow melting. Environmental issues are also very important in the regulation management.

Leg three is being an umbrella/discussion forum according to the European Water Framework Directive (WFD), for all stakeholders in the river basin. Public participation is very important in the WFD. It is very difficult to engage different stakeholders but it is important.

Leg four is resource for municipalities, business and other stakeholders with issues according to hydrology, limnology, fish biology and other technical issues. Most of the municipalities in the basin are pore, and cannot employ these specialists. The river Eman CMA has the competence and can supports the municipalities with that competence. This is a very cost effective way of solving different water related issues.

Leg five is consultancy activities. The CMA are doing biotope restoration, building fish bypasses and building dams for reducing nutrients from agricultural activities. The CMA is doing that commissioned by county authorities and municipalities in the southern part of Sweden.

The CMA has a board especially designed to fulfil the EFD requirement of an as broad representation as possible. All eight municipalities, the business sector, agriculture, forestry, fish water owners, fishing clubs, tourism, NCOs and the Irrigation Union are members in the board.

The public patricians and awareness is very important in the WFD. The CMA cannot reach all stakeholders in the river basin only through the members in the board. We have therefore crated a number of working groups such as fish/fishery, forestry, agriculture, spatial planning, water service, countryside development, river management group. The representatives in the working groups are civil servants from a lot of different authorities and organisations in the river basin. The CMA can through all these involved authorities and organisations get out with and collect information in an acceptable way to a lot of stakeholders. It is much better to use already exciting ways of information than to create new ones.

The CMA has been working in this context since 1992 and has got a lot of experience about how to manage a river basin organisation. We are for the moment the only running river basin organisation in Sweden with this wide management. We cannot say that we are a model for the rest of Sweden, but a lot of other river basin organisations in Sweden try to start something similar, but it is time-consuming. It is not easy to change from an administrative boarder thinking to a river basin boarder thinking.

The CMA has for the last six years been a case study for an Integrated Water Resource Managing (IWRM) training programme for people from developing countries working in different levels with water issues funded by the Swedish International Development Cooperation Agency (Sida). About 750 persons from between 60 to 70 different nations have been visiting the CMA and have got information about our way of managing IWRM. Some of that information and knowledge have been used to create similar organisations in other part of the world.

The River Eman CMA can with its 19 years experience of integrated water recourse management be, and are, a good example for other river basin organisations in the world.

Integrating Semi-centralised Wastewater Management Approaches in Urban Water Infrastructure: Case Study of Kampala City, Uganda

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Keywords: decentralised, semi-centralised, urban water, wastewater infrastructure, effluent re-use

Introduction/Problem Identification

Water and sanitation infrastructure extension is one critical but challenging aspect of urban development, especially in the developing world. In Kampala city, the sewerage net work covers only the central business area serving only 10% of the city population. Continued course of action along traditional centralised systems has been questioned on its ability to cover entire cities and the cost-effectiveness of such systems also raises concerns. There is need to investigate further non-convetional means of wastewater management to find cost effective and sustainable interventions that will help cover the vast unserved urban areas of the developing world.

Analysis/Results and Implications for Policy and/or Research

A study was conducted to assess the feasibility of integrating semi-centralised wastewater management approaches to cover low-lying areas of Kampala city. This presentation investigates the feasibility of a semi-centralised wastewater management system to address sewerage concerns in one peri-urban low-lying area in Kampala city,Katanga, as a sustainable approach to increasing sewerage coverage. A field study was conducted to assess the wastewater infrastructure in the city and gather pertinent data on the focus area. Proposals for central collection and conveyance by pumping and/or gravity fronted to solve sewerage problems in the area were evaluated against a semi-centralised option. The study employed multi-criteria decision analysis technique to evaluate the suitability of the different options to address the wastewater challenges in Katanga region.

One option recommended for the sewerage extension to Katanga involved central collection of the wastewater in the low lying area and puming it to the central network for ultimate conveyance to the central treatment plant in Bugolobi. The second option involved re-routing the wastewater to an alternative site, where a new wastewater treatment plant would be constructed, serving wider sections of the city. An alternative proposal was fronted under this study, which recommended reducing the amount of wastewater generated at source and treatment of the wastewater using higher technology options suitable for urban environment and finally using the treated effluent for golf course irrigation in the neighbourhood of the study area.

The results show that an alternative wastewater management design incorporating on-site grey water reuse can save up to 50% of the water bills for a standard student hostel in the project area. Use of on-site pre-treatment also shows a cost-saving of about 35% in the collection and transport to a semi-centralised system. With due consideration for the area limitations, a multi-criteria decision analysis reveals a rotating biological contactor as the best treatment option, with a high quality effluent (recommended for reuse in city landscape irrigation) at reasonable cost and footprint area. Overall life-cycle costs for semi-centralised treatment show close approximation to the costs of the central collection and transport. Considering the advantages of effluent water reuse and ease of phasing implementation, among others, the presentation recommends the semi-centralised option as the best intervention to solve Katanga sewerage difficulties, but calls for multi-institutional cooperation, especially on the reuse aspects.

Wastewater Reuse for Sustaining Urban Water Supply and Sanitation: A Case Study

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Keywords: domestic wastewater, linear programming, primary treatment,, groundwater pollution, medical expenses

Introduction/Problem Identification

Projections from India show that 45% of its estimated 1.64billion population in 2050 AD would be living in urban agglomerates laying claim to148 x109m^3 of fresh water supply and generate huge amount of wastewater. This water could become either be a valuable resource or a source of environmental pollution, depending upon the reuse options and the technology employed. Since major increase in urban water supply would come from diversion from agriculture and since agricultural use of wastewater also serves as a means of its treatment, it has to be a priority option. A study was undertaken to develop plan for use of sewage water from Karnal municipality in Haryana (India), a city of 300000 inhabitants with the objectives of: optimising sewage water use for maximising benefits from crop production, minimising ground water pollution and determining how much fresh water could be released from agriculture for municipal supply.

Analysis/Results and Implications for Policy and/or Research

The projected municipal sewage discharge of Karnal by 2025 AD, mainly of domestic origin, was estimated at 45 million litres per day (MLD). The water quality parameters in respect of salinity (EC 1.2 dS/m, TDS 1.3 mg l-1, SAR 1.8), nutrients(N:P:K 41:53:0.6 mg l-1), biological load (BOD, 200 mg l-1, COD 290 mgl-1) appear to favour irrigation. A linear programming model to evolve water use plan was set up. In application of this model, the primary considerations were the quantity, quality and temporal distribution of water disposed through irrigation, release into the river system and the degree of treatment (Primary and Secondary) to purify water. The implications of reuse with different levels of treatment on human health in terms of monetary loss were also evaluated.

It was revealed that during summer months, when irrigation demands were high and irrigation water supply low, 93% of the sewage water generated could be safely used for irrigation. The water use reduced to 81% during Rabi season (October-February). The minimum utilisation of 38.8% was during Kharif season (June-September) when sewage water had to be disposed off into the river. Since the river flow during monsoon season was high, the pollution load got diluted. To avoid disposal of sewage water into the river during winter season when river flows were low, some area would have to be put under forest plantation in which about 70 m^3/day/ha water can be disposed without causing any ground water pollution. The continuous use of sewage water receiving zero, primary and secondary treatments showed only 4,2.5,and 1.08 mgl-1 increase in groundwater Nitrogen after 50 years. It may be mentioned that in a recent survey of ground water in the adjoining area where raw sewage of domestic origin had been used for more that 25 years, the concentration of nitrogen in ground water, except in the immediate vicinity of the sewage disposal channel, was less than5 mg1-1. The sewage water contained 30-40 mgl-1 of nitrogen, 90% of which is NH_3-N and the balance as NO_3-N. The phosphates were in the range 5-6 mgl-1 while K is 0.5-0.6 mgl-1. It was estimated that on annual basis about 450 tons of nitrogen would be available from untreated water and it has been valued at about INR 5 millions (1USD =45INR).

Sustainability of sewage water reuse is affected by salts, heavy metals, increased nitrogen load and the pathogens in the soil and ground water. The heavy metals in sewage water at Karnal were in traces. The projected increase in nitrogen concentration after 50 years was only 4.0, 2.5 and 1.8 mgl-1 for raw, primary/secondary treatment respectively. It may be mentioned that in a recent survey of ground water in adjoining area where raw sewage of domestic origin has been used for more that 25 years, the concentration of nitrogen in ground water, except for in the immediate vicinity of the sewage disposal channel, was less than 5 mg1-1. Based on the analysis made, the benefit accruing in the case of primary treated water were low as it did not reduce the potential health hazard but increased the cost of sewage water by INR 0.67/m^3. The cost of health hazards was considered in two ways; 1) increased medical expenses and wages loss due to sickness and reduction in life expectancy. In computing the cost of health hazards with consideration for reduction in life expectancy, the probability of death due to sewage water use hazards was taken as 1 per 1000. The compensation for loss of life was assumed as INR 100,000/person. Increase in the compensation for life would reduce the benefit in a linear fashion and sewage treatment would become cost effective if a high value were put on cost to health hazards. For situation prevailing in the area (deep ground water table, no heavy metals and rice- wheat cropping in which grains do not come in contact with water), primary treatment was considered adequate for reuse. The reuse could facilitate release of 11.5 million m^3 of fresh water from agriculture sector to municipal supply continuously

Wetlands: Natural Infrastructure for Flood Risk Reduction

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Keywords: flood risk, impacts, reduction, urban environment, wetlands

Introduction/Problem Identification

Wetlands are among the most common natural landscapes in urban areas and include marshes, water ways, streams and lakes. Most of them are connected to each other either on surface or underground as ground water aquifers and continue to function as compartments of hydrological cycle. Wetlands are known to possess a number of physical, chemical and biological properties that provide invaluable services to the society. One major service that wetlands provide is their contribution to minimise flood damages, functioning as a "sponge". Healthy and fully functioning wetlands acts as a store for flood water, retaining and releasing them gradually. This paper explores how impairment of wetland services contributes to increase in flood damage in Colombo District in Sri Lanka and steps that could be taken to mitigate this problem.

Analysis/Results and Implications for Policy and/or Research

Colombo is the most populated district in Sri Lanka which is situated in the western coast and is increasingly experiences flood damages. The recent floods from November 2010 and February 2011 was devastating and was the largest in last two decades and submerged a large number of roads in the district washing away some parts of the roads and damaging many bridges and culverts. Damage to the national highway network alone of the country due to floods is around several hundreds of million rupees. The heavy rains displaced over 260,000 people in the area, thousands of houses were damaged and some completely destroyed. Several deaths reported while number of people are still missing. Normal life was disrupted for several weeks.

This situation needs immediate attention. What are the causes of such a damage? Apart from the heavy rains within a short period of time, other factors too have contributed to this disaster. With the increasing urbanisation over the past few decades, wetlands have been rapidly disappearing from the urban landscape, and those that remain are often highly degraded. Our recent survey reveals that, during the past three decades, more than 80% of marshes in Colombo have reduced in size; for example Kotte – Kolonnawa and Bellanwila – Attidiya alone have shrunken by 18-23%. The key reasons for this degradation in quantity are landfilling and encroachment due to high demand for land in urban areas. Most of the wetlands have been converted at least partially, to settlement areas and infrastructures that include roads. Sedimentation as a result of runoff and erosion had decreased the total area of wetlands. In addition, effective links among wetlands have been impeded by blockages of connecting waterways. Specially, small waterways have been blocked by construction of buildings along the edges and by rampant dumping of solid wastes. Nearly half of the waterways in Colombo were found to be malfunctioning due to anthropogenic activities. Thus, holding capacities of wetlands were diminished and flow of flood water to the sea was disrupted.

To conclude, it is evident that loss of wetlands and their connections are a key factor for increased flood damage in Colombo. Thus, it is important for regulating authorities, that they focus on the sustainable management of wetlands to facilitate their healthy functioning. But this focus should start with prioritising the wetlands to be protected. It should next recognise the importance of restoration of degraded wetlands, which are in plenty. Stakeholder participation plays a key role in these processes.

Implementation of law too is essential to prevent further degradation of wetlands and similarly, raising public awareness is vital in protecting of these important habitats. Thus, while conservation of wetlands would definitely result in other economic and social benefits, it can certainly be one of the simplest ways of ameliorating impacts of floods in urban areas.

Green River; An Integral Solution for Flood Risk Management and Fresh Water Shortage

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Keywords: Green River, Flood Protection, Integral Water Management, Fresh water supply, urban safety standard

Introduction/Problem Identification

The economic development of the coastal plains along the Bohai Gulf in China is one of the major objectives in the 5-year strategy of Chinas Central Government. One of these development areas is Cangzhou Bohai New Area (CBNA), located 300 km south of Beijing. CBNA aims at developing it's existing coal port into a 500 million tons multipurpose port. Ambitions on industrial development enhance urbanisation. It is expected that cities in CBNA will accommodate 1,4 million people in the year 2020, of which 1 million people in the city of Huanghua. At present, some 300.000 people live in Cangzhou Bohai New Area.

Analysis/Results and Implications for Policy and/or Research

In order to complete its growth objectives, CBNA aims at developing attractive cities with parks and green zones, but also high-end agriculture in the remaining rural areas. Water plays a crucial role in succeeding with these objectives, however fresh water resources are limited in this semi-arid area. Cangzhou Bohai New Area aims at realising a sustainable multi-purpose water system, based on a fresh water environment. Water makes cities more attractive, but meanwhile, water can also be a threat in terms of flooding.

The Cangzhou Bohai New Area Administrative Committee (CBNAAC) has engaged DHV BV, a Netherlands based specialised consultancy firm with offices in China, to prepare an Integrated Water Management Master Plan (IWMMP) for the Cangzhou Bohai New Area. DHV cooperates with Wageningen University Research | Alterra (WUR). The backbone of the Master Plan is the construction of a Green River as an integral solution for both flood risk and water shortage.

Fresh water shortage

CBNA faces severe fresh water shortage throughout the year, and severe flooding once in 10 to 100 years. Over-exploitation of deep ground water has reduced the fresh ground water table significantly in the last decades. Rainfall is absent during most of the year, concentrating in heavy rainstorms in July and August. Evaporation rates are high, exceeding the precipitation rate twice. Rivers run dry, are polluted and have become brackish more and more due to salinisation of the ground water. Upcoming salinisation caused by sea water intrusion in rivers and ground water, and regulations on deep fresh ground water extraction, makes fresh water shortage even larger.

Water shortage can be partly solved by re-using urban effluent and rain water harvesting. After relatively simple treatment, this water can contribute to the local fresh water system, serving both urban green as well as agriculture. Other resources of fresh water are linked to the flood protection plan of Huanghua; fresh water storage in a "green river", a sustainable solution for both flood protection and water shortage.

Flood risk

Though flooding is a rare event in CBNA, 1977 flood event has caused severe flooding of the area. Nanpai River is the most important drainage canal in the area and drains a big part of Heilonggang River Basin, bringing upstream floodwater to Bohai New Area. Due to the absence of serious flood events since the 90's, river dikes and engineering works are lacking maintenance, reducing the safety level from the design standard 1 in 20 years to a standard of probably less than 1 in 5 years. According current Chinese standards, the new city with at least 1 million people would require a safety level of 1 in 100 years. Nanpai River is now just North of the existing city of Huanghua but will eventually be an important landscaping water body within the new city centre.

Green River

Flood risk can be reduced by the realisation of floodways, connecting Nanpai River with the sea. The floodways will be constructed as "Green Rivers", meaning that they are only temporary filled with floodwater and acting like normal rural areas throughout the rest of the year. Most important Green River is planned north-east of Huanghua, following the course of a paleo-branch of the Yellow River. The Green River is able to extract 300 m^3/s from the Nanpai in case of flooding, which equals 40% peak reduction in case of the 1977 flood event. This water can either be collected in the Green River as fresh water storage or be discharged to sea. Though most of the year surface water is not suitable for irrigating agricultural plots, due to the high salt content in the water, flood water is expected to be mainly fresh. The Green River is connected to several pumping stations, filling the nearby located Nandagang wetland.

The realisation of a Green River serves multiple objectives, like fresh water storage, flood water drainage, urban greening, recreation and leisure, and water front development. Meanwhile due to the construction of the Green River, dikes along the Nanpai River don't need any heightening, being a requirement of the local construction bureau. Dike improvement is necessary anyway, due to a lack of maintenance after construction in the 70's.

The concept of using paleo river channels as "Green River" has already successfully been applied in pilot projects in Banda Aceh (Sumatra, Indonesia), and The Noordwaard (The Netherlands). Application of the "Green River" concept in these pilot areas has shown that it can be applied in both developing as well as third world countries. Especially in newly developing urban areas, where city extension has not yet taken place, the implementation of a "Green River" in the urban planning can be a very sustainable measure serving flood protection, water shortage and urban development.

What Is the True Cost of Green Certification Programmes Applied in Water Stress Areas and Sustainable Cities Concepts

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Keywords: green building certification, water stress, sustainable costs, sustainable cities, new and urban growth

Introduction/Problem Identification

Recently sustainable cities have started to determine true costs for attaining certification levels within international green building certification programmes. Several coutries are developing their own green building certification programmes based on lesson learned and strategies from existing programmes. This paper explores true costs per m^2 for both the buildings and infrastructure, as compared to business-as-usual for urban growth. We address infrastucture impacts/costs since most programmes do not fully address them. Key lessons learned from several sustainable cities (green- and brown-field) will be presented that show cost ranges for each certification level and range of costs in the point system to attain a rating. Presented will be how international certification programmes weight their scoring and point systems in water stressed environment. Economics is the third leg in triple bottomline strategy, but often addressed as an after thought. We place it on par with the others.

Analysis/Results and Implications for Policy and/or Research

This paper presents a comparision for exisitng international green building certification programmes costs for each level of certification, common needs for point scoring and weighting system, life cycle cost analysis for two case studies in a water stressed environment. We also cost out on both a CapEx/OpEx and carbon footprint basis the true costs of various certification levels and the cost range seen between each scoring category. Cost impacts will be seen for sustainable cities that want to certify their buildings and the resulting benefits or impacts that the infrastructure experiences as a result. All comparision will be illustrated from two case studies business-as-usual in water stress areas, as well as BAU in a non-water stressed area. The cost impacts and benefits to sustainable buildings and infrstructure will be presented as well as some lessons learned and design guides from two recent sustainable cities applications. In addition, guidelines on how to apply, how to score points, and reasonable certification levels will be presented that walks the reader through the certification programme, weighting systems, and point ranges within the certification level. Results show a path forward, lessons learned in applying various certification programmes, and life cycle analysis results for various options. Also, key insight on how to address infrasture "certification" levels will be provided. Finally, conclusions demonstrate that their is a wide range of costs associated with each level of certification, as well as within that certification level that can be used to attain the best certification level at the lowest costs to meet the city's vision and goals. Pathways to get certification both for buildings and communities will be discussed and shown how to best meet the make-up and demands for the urban growth and city.

Strategic Environmental Assessment of Water Development Planning, Jiulong River Watershed in Fujan Province, Southeast China

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Keywords: water resource, water development planning, strategic environmental assess, watershed, retrospective assessment

Introduction/Problem Identification

The Jiulong River located in the South of Fujian Province, P. R. China, is 272 km long and has a 9,640 km^2 watershed, and is the main water source of water supply for the downstream cities Zhangzhou and Xiamen. These two cities have a population of more than five million people. To further develop the water resources in the Jiulong River Watershed, the Fujian Government proposed an Integrated Water Exploitation Planning in the Watershed (IWEP) in 2006, which included water resource use, flood control and water drainage systems, irrigation, hydroelectric development, shipping, soil conservation, and so on. The Strategic Environmental Assessment (SEA) component of the IWEP was conducted in 2007 to improve the decision-making process.

Analysis/Results and Implications for Policy and/or Research

A retrospective environmental assessment of the Jiulong River Watershed was conducted using 20 years of data to estimate the impacts, especially cumulative ones, of water development during the past decades, and to set the stage for further predictions. The retrospective assessment found that: (1) hundreds of hydroelectric stations have been built in the main stream and branches of the Watershed in the past ten years that caused riverbed and water level decreases, and threatened the water supply of Zhangzhou City in the dry seasons; (2) the river natural characteristics were lost, for example, the retrospective assessment found that more than thirty fish species, including all migratory fish and main commercial fishes, and the fishery industry in the watershed, disappeared because the dams prevented fish migration, however, farm fisheries in those reservoirs increased; and (3) the results of the analysis also showed statistically significant correlations between inter-annual variation in river water quality and the various sources of water pollution, self-cleaning capacity of the river decreased. Additionally, other adverse impacts affected both the terrestrial ecosystem and socioeconomic status of the watershed.

The predicting assessment using scenario analysis coupled with community involvement showed that further water hydroelectric development would: (1) rise the utilisation rates of water, threaten the security of water supply for Zhangzhou and Xiamen (due to riverbed and water level changes, particularly in the dry seasons, and water quality decreases from decreasing self cleaning capacity); (2) further destroy existing and increasingly rare river and terrestrial ecosystems as well as impact the Meihuashan Natural Conservation Area because of some of dams planned to be located very close to this Area; (3) cause erosion to the Jiulong river estuary (due to the decreasing of sediment transport);

and (4) increase the risk of dam failures and increase the probability of water bloom breakouts due to eutrophication. The alternatives proposed to hydroelectric development included: cancelling dams construction planned near the Natural Conservation Area and the urban water intakes for the two cities, establishing minimum discharge flows for each dam, establishing an unified water resources management system for the watershed, constructing fish ladders, and developing a real time reservoir risk management system.

The Overexploitation of Aquifers and the Value of Water

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Keywords: overexploitation of aquifers, value of water, environmental policy, sustainable development, artificial recharge

Introduction/Problem Identification

México has over 650 registered aquifers. The estimated volume of water extracted from them is 27km^3 per year, this is 36% of water for consumptive uses (those in which water is transported to its place of use, and all or part of it does not return to the water body). Almost two thirds of water for public supply, and one third of the extracted water for agricultural purposes is obtained from groundwater sources. Although at national level the extraction is of approximately 34% of the estimated volume of the annual recharge, in the administrative regions of North Central Basins and Northern Gulf, the extraction exceeds the recharge by more than 10%, while in the Yucatan Peninsula and Southern Border, is less than 6% of the total volume of recharge. From the 654 aquifers, 112 are overexploited and 17 coastal aquifers have saline intrusion. The rational use of groundwater is essential, since in the future more regions will depend on the reserves in the ground as their main source of water.

Analysis/Results and Implications for Policy and/or Research

Environmental problems are considered to be economic problems originated by externalities that can be solved as if they were market transactions. The traditional theoretical solution to the problem of externalities was thought to force private actors so that they internalise the costs of their actions. As no one owns the resource, users have no incentive to conserve it for the future, and self interest of each of them pushed to overexploitation. The characteristics of the economic institutions that govern the use of common resources are a fundamental aspect of management.

The aim is to propose alternatives for the restoration of aquifers. This foresees the possibility of re-injecting water into aquifers through wastewater treatment and treated water and so the use of treated water in agricultural irrigation, instead of continuing with the aquifers' exploitation.

Mexico City is one of the cities that more intensively uses groundwater to supply, due that the 70% of water supplied to the network comes from the underground. In contrast, cities such as New York only uses 1% of water from aquifers; in Toronto, Canada it is not supplied from underground; and Santiago de Chile only extracts 15% from the depths for their water network. Mexico City extracts more water from groundwater than the recharged by rainfall and runoffs. Four of the major aquifers are overexploited (as reported by the National Water Commission). As water has been drawn than returned to the aquifers, their storage level has fallen considerably, so the depth of the extracting wells of the City has increased gradually.

Other overexploitation effects are: decrease of well yields, increase of extraction costs, settlement and cracking of the land, groundwater contamination, saltwater intrusion into coastal aquifers, and strong competition between sectors. In the overexploited aquifers zones, such situation undertakes the sustainable development of all sectors, with serious repercussions on national economy. Moreover, for the future it is expected a significant increase on water demand, mainly for public-urban and industrial uses, and due to global climate change, there is the possibility of occurrence of more severe droughts, prolonged and frequent. Therefore, the current approach in groundwater management tends to a comprehensive strategy that includes, among other aspects: the management of demand in all sectors (conservation and efficient use), reuse, more active participation of users in water management, the design of strategies for the stabilisation of overexploited aquifers and the application of the technology of artificial recharge to preserve and increase the groundwater reserve.

In 2003, industries across the country downloaded about 8 km^3 (258 m^3/s) of wastewater. This amounts to more than 9.5 million tons of BOD, of which only 18% were removed by treatment systems. For December 2004 the country had 1875 treatment plants of industrial wastewater that processed about 27.4m^3/s (10.6% of the generated volume). In 2002 the industries that contributed with greater amounts of contaminants were the sugar, the oil and the agriculture one. Veracruz is the state that contributed with more downloads and also that processed the highest volume of wastewater (about 40% of national total).

In this context, by supporting the Federal Government with operating costs and maintenance of treatment plants for the public sector, it is intended that those responsible for providing this service, focus their efforts on increasing the efficiency in service and to establish rates and appropriated collecting systems. In this sense, it is essential that charges for wastewater concept covering the operation and maintenance costs and externalities can be achieved. In tourist areas and for the Mexicans welfare that frequent them, it is required to build treatment plants needed, and make a special effort to reactivate those out of operation and rehabilitate the ones working with low efficiency, with the purpose of take advantage of the installed capacity.

Horizontal Pipe-driving as an Alleviation Method for Water- and Wastewater Pipe Constructions in Peri-Urban and Coastal Areas of Stockholm

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Keywords: horizontal pipe driving, water- and wastewater, peri-urban areas, cost-efficient, best available technology

Introduction/Problem Identification

Stockholm is continuously growing as new districts are developed and new inhabitants move to the city and its surroundings. In 20 years the city will increase its population with 150 000 people. This calls for a large expansion of houses. As a result of this urbanisation there is also a large in-migration to peri-urban areas of the Stockholm region creating an increased demand for improved domestic water and sewage systems. In many cases this means connecting local water and sewage systems to the existing network of Stockholm city. This is often costly and circumstantial due to the geophysical circumstances such as numerous lakes and waterways, hilly topography and exposed hardrock, prevailing buildings and constructions and a high demand for environmental consideration supported by a strong environmental code. A cost-efficient option for connecting the peri-urban areas is to place water and wastewater pipes at the bottom of lakes and the Baltic Sea.

Analysis/Results and Implications for Policy and/or Research

In order to supply peri-urban households with domestic water and sewage systems there is a need for cost-efficient and environmental friendly methods for the construction of water and sewage pipes. In the Stockholm area the many waterways and lakes have made it possible to put the piped systems at the bottom of the lakes and the Baltic Sea. Connecting isolated islands with water and sewage pipes placed at the bottom of the sea have been used for many decades. However, during the last decade placing water and sewage pipes at the bottom of lakes and in the archipelago has been used also for coastal areas not isolated by the sea. It has been shown that this technique very often is cost-efficient as compared to digging trenches inland.

When constructing pipe systems for placing at bottom of waters, short pipes are welded together and placed on wages that correspond to approximately 35% of the buoyancy of the pipe. Then the pipe can be filled with water and sink to the bottom of the lake or sea. The main environmental impact is when the pipe is constructed. Placing the pipe at the bottom is however generally not a great environmental matter of concern. However, connecting the pipes to the shore may be a concern as the shore line very often is sensitive to disturbances. For these interventions permission from the local authorities are required. Also, constructions in water require permission from the county Administrative Board.

The main advantage with using lakes and other waters for the water and sewage piped system is to avoid sensitive environment and dense build areas on land, thus avoiding many conflicts of interests. The pipes for drinking water have insignificant environmental impact once they are in position. If they would break the leakage would be a matter of supply and cost but no impact on the surrounding environment would be expected. However if a sewage pipe breaks pollutants will affect the recipient. This may be a serious matter of concern if the recipient is small and the dimension of the pipe large. This can be avoided through monitoring flow and pressure in the pipes. To minimise disturbances along the shore horizontal pipe driving has been proved a very feasible alternative to digging. The technique has been used during 30 years by now, however it is not until the last decade/ couple of years this technique has been frequently used. The impact at the shore line is limited to the shaft from where the drilling starts, thus the impact on the environment is minimised. It has been shown through experiences over the last decade that this method is both cost-efficient and environmental friendly. Now several projects over the last decade the combination of placing pipes on bottom of lakes and sea and horizontal pipe driving has been used. When connecting the village of Wira on the mainland, NE of Stockholm, a 17 km long pipe was placed at the bottom of the Baltic Sea between the island of Ljusterö and the mainland. The main purpose of this pipe is to supply the village Wira with drinking water and along its way it is now also possible for several other peri-urban areas to connect to the pipe. At five places horizontal pipe driving will be used in order to minimise environmental impact. On the way from the coast to Wira the pipe is passing a small lake, Losjön, and a so called Natura 2000 area, a natural conservation area. Instead of digging through the area horizontal pipe driving makes is possible to pass this area without affecting the environment. Today, the environmental code with its regulations including the permission process in combination with EIAs is used as instruments for regulating when different techniques are applicable or not as well as for working for best available technology.

Workshop 6: The Urban Shadow

Instruments of Territorial Planning to Protect the Drinking Water Resources in the Town of Ñemby (Paraguay)

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Keywords: territorial planning, land use, groundwater, zonification, contamination

Introduction/Problem Identification

The Development Project ORDAZUR (German Technical Cooperation) executed by the German Federal Institute of Geosciences and Natural Resources (BGR) in cooperation with the Paraguayan Environmental Board (Ministry) is working since 2007 in the district of Ñemby (170.000 habitants) as one of 5 pilot working areas. Ñemby is situated in the Capital´s Metropolitan Area in Central Paraguay where the main activities have commercial and industrial character. Ñemby, as the whole Paraguayan Central Department, provides its water from the groundwater reservoir Patiño Aquifer, which has a stretch-out of approximately 1173 km² and delivers water for around 2 million people for the socially and economically most important region in Paraguay. The contamination of the ground- and surface waters is the one of the main problems for the local population, as it causes diseases as diarhoea.

Analysis/Results and Implications for Policy and/or Research

The analysis of water samples (urban wells and surface waters), hydrogeological survey (Isotopes) and urban studies lead to the knowledge, that most of the urban drinking water has contamination problems, especially with coliform bacteria, which cause a variety of diseases such as Cholera and Diarrhoea. The contamination is related directly to the lack of a sanitary water system with adequate waste water treatment. This leads to the conclusion, that one of the main goals must be the implementation of such a system. With an Senior Expert there was designed a basic concept for such. But a further problem was discovered by the isotope analysis. In a medium term scenery, there will be a water supply conflict, not only caused by the descending water quality but also by the growing demand caused by the expected population growth. The renovation of the groundwater resource by infiltration is not that high as expected and the population growth will cause an overexploitation.

To deal with this conflict, there is a need to protect the drinking water wells, the implementation of a wasterwater-system with treatment installation, regarding the definition of recharge areas for the groundwater body.

There was already presented a regulation proposal which establishes well protection zones, defining three different protection “rings” with their individual restrictions for human activity.

At the present, the project tends to define groundwater recharge areas, based on hydrogeological data and land use mapping, which later shall be included in a general urban zonification plan.

It has to be considered, that there often exists a major conflict between the content of legislations and the actual land use reality. Often, there is no optima situation to implement the land use restrictions. Also the fast developing changes of the land use in urban areas (e.g. loss of green spaces), caused by uncontrolled migration and population growth is a limiting factor for the sustainability of urban planning concepts and frequently these processes are much faster than the implementation of legislations. That means for the planning process, that it has to be fast and has to be concerted with the main actors.

Based on this situation, on the one hand ORDAZUR tries to raise the people ´s awareness, using public relation and education methods for all ages (Videos, Games, reading materials, presentations and events). On the other hand the activities must contain a one-by-one diagnosis for the areas of major water protection interest. And it has to be worked on individual solutions for land use conflicts in those areas.

The Future of Urbanisation in California: Regional Sustainability and Inter-Regional Partnerships

Author: **Ms. Celeste Cantú**, Santa Ana Watershed Project Authority *et al.*

Keywords: regional-sustainability, watershed-management, inter-regional partnership, transfers, energy conservation

Introduction/Problem Identification

The current practices to provide for urbanisation in California are likely not sustainable, as there will be shifts in precipitation patterns due to climate change, changing values in the allocation of California's water supplies, and new urban growth policies that will continue to emerge in California. As one of the most geographically diverse and spectacular parts of the world, California's water leaders will be challenged to provide sustainable water supplies for: an additional 400,000 people per year as the state is projected to grow from the present 38 million to 51 million by 2040; an unparalleled natural landscape that will require water to support aquatic and terrestrial species; and the increasing local and world-wide demand for high quality food produced by California's farmers and ranchers. By its sheer magnitude and singular geography, California has always been on the leading edge of the intersection between economic, environmental and social policies.

Analysis/Results and Implications for Policy and/or Research

The California Legislature in late 2009 passed a new "policy of the State of California… to meet California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region…shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts" (California Water Code §85021). This new policy will be implemented against the backdrop of these large water projects that continue to provide water for the major urban areas in California.

This panel will present the current landscape for water resources management in California and the panelists will offer their different perspectives on the solutions necessary to assure regional sustainability of water resources. The panel will also discuss the future of the large urban shadow in California and explore how inter-regional partnerships, in conjunction with the large water projects, will be redefined to sustain urbanisation and important relations within the shadow. The panel includes different perspectives from throughout California by the water leaders who are helping shape these policies for future generations and will focus on institutional, legal, political and technical solutions. The panel will also feature a diverse group of water leaders throughout California, including:
David Beckman directs the Natural Resources Defense Council's water programme comprised of scientists and lawyers in five U.S. offices with a strong presence in California. He focuses on achieving safe and sufficient water for people and the environment. NRDC, a U.S. environmental NGO, is an advocate for smart growth and they use law, science and the support of 1.3 million members and online activists to protect the planet's wildlife and wild places and to ensure a safe and healthy environment for all living things. He is a graduate of the University of California, Berkeley, and Harvard Law School. A more detailed biography is at www.nrdc.org/media/expert.asp.

Celeste Cantú, Santa Ana Watershed Project Authority's (Orange County, California) General Manager, leads the One Water, One Watershed integrated plan that addresses all water-related issues, joins all entities, and hundreds of stakeholders to create a new vision of sustainability in a watershed with 6 million residents. This watershed approach takes a systems view and through collaboration creates anew rather than simply focusing on existing problems. The Authority collects salt from groundwater to improve water quality and achieve salt balance. Celeste served as Executive Director for the California State Water Resources Control Board, which is responsible for water rights and water quality. An urban planner by trade, Celeste has a BA from Yale in Urban Planning and Policy and a Masters in Public Administration from Harvard's Kennedy School of Government. www.sawpa.org/owow-generalinfo.html.

David Guy is the President of the Northern California Water Association (NCWA). In this capacity, he represents the water users and local governments in the Sacramento River hydrologic region in Northern California, which contains more than two million acres of family farms; six National Wildlife Refuges and more than 50 state wildlife management areas that serve as the cornerstone for the Pacific Flyway; the capital of California (Sacramento) and the small towns and rural communities the form the backbone of the region; and habitat for half of the endangered species in California, including the Chinook salmon. The Sacramento River, which flows through the centre of this region, is the largest river system in California and in addition to serving the region's needs, provides water to nearly all of California through the Central Valley Water Project (CVP) and the State Water Project. NCWA is committed to advance the economic, social, and environmental sustainability of the Sacramento Valley and has developed numerous inter-regional partnerships throughout California. Mr. Guy is a graduate of the University of Colorado School of Law and he has a geological sciences degree from San Diego State University. www.norcalwater.org/about/staff/david-j-guy-president/.

Jeffrey Kightlinger is General Manager and Chief Executive Officer for the Metropolitan Water District of Southern California. MWD is the largest urban water supplier in the world where they deliver high-quality water to 19 million residents in Southern California. MWD on October 12, 2010 updated its Integrated Resources Plan, providing a roadmap for maintaining regional water supply reliability over the next 25 years. He is a graduate of the University of California, Berkeley and Santa Clara University School of Law. www.mwdh2o.com/mwdh2o/pages/about/manage/kightlinger.htm.

Scenarios for Urban Development in Interfaces between Fast Growing Urban Areas and Surrounding Ecosystems

Author: **Dr. Markus Stark**, Centre for environmental management and decision support, Austria *et al.*

Keywords: assessment, ecosystems, participation, planning, scenarios

Introduction/Problem Identification

This study reports about two case studies in two of the largest Latin American cities, namely Xochimilco in Mexico City and Tigre in Buenos Aires. Both case study areas have been subject to severe pressures of urbanisation. Pressure on housing area is high and conflicts between old and new inhabitants arise. Tigre municipality in Buenos Aires is partly located on the continent, but about 8000 people live on islands in the delta of Rio de la Plata. Also the case study in Mexico City, Xochimilco has a special characteristic: a traditional form of agriculture is still practiced in this area. Appointed world cultural heritage by the UNESCO, the floating gardens (chinampas) are also an attractive site to visit for tourists and migrants from other parts of Mexico City. Further, the area of Xochimilco is of strategic importance for the recharge of the overexploited aquifers which serve as water source for the city of Mexico.

Analysis/Results and Implications for Policy and/or Research

In both case study areas conflicting interest and visions with respect to natural resources management exist, which makes it difficult to develop integrated plans for future development. This paper reports about the development of different scenarios for future development. A wide range of future studies methodologies (encompassing several techniques for visioning, brainstorming,etc.) can support the definition of development scenarios in a participatory and adaptive way. Form the wide range of available methods for scenario building, in this paper we are in particular interested in those which allow the users to participate in shaping the development of their region. An example for such a method is the Future Workshop (FW) method, developed by Jungk. This method allows participants to become involved in creating their preferred future. A "classic" FW, according to Jungk and Müller (1987), consists of five phases:

- The preparation phase
- The critique phase
- The fantasy phase
- The implementation phase
- The follow-up phase

The scenario workshops conducted under this study were based on this methodology, but adapted to the local needs and situation. Therefore, the method applied slightly differed from the ideal classic FW, and also differed between the two case studies.

Selected results of the scenario workshops for Mexico (similar results for Argentina):

Mexico: Under the past and current systems in Xochimilco natural resources have been used wasteful and deterioration of those resources continues. The current economic system does not meet the urgent needs of the population, due to special interests of big businesses. The educational models do not respond to the needs of the residents, are copies of copies of other models and nullify the reality of Xochimilco and the country. The ineffectiveness of political and educational system is accompanied by a loss of values. The case of Xochimilco is critical as also the future of whole Mexico City is connected to this area: it is as well water source as water sink of the big city, but its important function is not recognised by the municipal government. There is hope to find a solutions for the area with the chinamperos being possible leaders of the change: they are interested in change, in preserving their culture and their tradition. And water is part of their culture and tradition as the chinampa system is heavily dependant on a sufficient amount of clean water.

The visions of the participants are similar, but cannot be summarised in one single concept. Conservation of identity, which was very often mentioned during the workshop, can be partly reached by preserving water resources as they are very important part of the local culture of the chinamperos. Economy, society and the environment should be the vertices of a triangle, and have equal value. In the centre of that figure may be awareness and education. They could be starting points for technologies that consider also the tradition of the area and constitute an identity and culture focusing on social justice and a balanced environment applying criteria of sustainability. The engine of these processes should be presence of and pressure from citizens: promoting the creation of new spaces and forms of citizenship. Community-based initiatives can initiate public policies supported by governmental institutions, able to sustain over several administrations.

A first synthesis of the visions considered and the present conflicts in the study area are presented below. Three scenarios visions can be considered preliminary:

Conservation of local identity: as the aspect of “local identity” was mentioned very often during the workshop, a scenario which strengthens the local community was developed. It envisages local solutions and independency from the federal government. Water protection is a crucial component as water is highly connected to the local identity and the traditional from of cultivation in chinampas.
Economic development and tapping of touristic potential: This scenario builds on economic and touristic development of the area: the area could be a place for tourists to escape from the mega city Mexico City. A prerequisite is a functioning water supply and drainage net and a solid waste management system that makes the area for tourists an attractive, clean destination. Local products could be certified and sold in supermarkets in Mexico City to generate higher income.

Sustainable development: This is a balanced scenario that focuses on sustainable use of resources and a strong institutional body that enforces citizen participation. A common vision among all stakeholder groups concerning environmental culture and environmental education are part of this vision. Technical solutions for water supply, sanitation and solid waste can be local or decentralised and focus on environmental sound solutions with a minimum of contamination and energy use and maximal efficiency.

Implementing Integrated Water Management: From Theory to Practice; Urban Catchment Health in South East Queensland, Australia Case Study

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Keywords: integrated, governance, case, queensland, analysis

Introduction/Problem Identification

Integrated water management has been defined by diverse audiences since it emerged 60 years ago in the context of flood management. This workshop explores tested and emerging definitions and theoretical approaches and then applies the concepts in a concrete, practical way to illustrate how the analysis can be applied to improve water management in a complex urban context: South East Queensland. The workshop will demonstrate how to account for various interconnected but variant challenges that the water manager must grapple with (biophysical, social, economic, energy, and legal / governance), and how to conduct a systems analysis to identify tensions and gaps within a complex system. The findings from the systems analysis are then applied in the context of catchment health, looking at regional organisational plans, strategies and implementation efforts. This analysis is used to provide for more effective on-the-ground implementation when considering 'de-railing points' and synergies.

Analysis/Results and Implications for Policy and/or Research

Integrated water management is an evolving practice, which is highly context-specific, and immensely challenging to implement in practice. There is a tendency for practitioners either become paralysed by the complexities, or to tend to ignore factors that are outside of one's area of knowledge and expertise. This workshop provides a framework for analysis in order to successfully address urban water challenges, within the urban shadow, in an integrated and targeted manner.

Systems analysis is a visual approach that borrows from organisational development theory to illustrate relationships between different forces acting within a system. It is a logical and compelling framework that provides a basis for collaborative analysis and action. The systems analysis also helps to reveal assumptions within the system in order to more effectively deal with long and short-term unseen risks. The application of the systems analysis approach in the field of integrated water management thus far have been promising, with dialogue leading to increased effectiveness in implementation efforts.

Increasing water stress in South East Queensland (SEQ) is driving the need for good integrated water management in the region. Achieving a holistic understanding of how the management of water currently works in this context is challenging. The discussion explores the processes and results of developing conceptual frameworks and systems analyses models, based on work conducted in SEQ in 2010. A systems analysis conceptual framework was developed to illustrate how the different regional contextual factors relate to each other. It is suggested that the overlaps between these factors – rather than the factors in isolation – together with the exacerbating effect of other drivers, are key to understanding the way water is managed. Out of the framework, two key water management issues for SEQ were identified: the management of diffuse pollution and linked to this, the institutional structure as it relates to water quality in the region.

A governance conceptual framework was developed, stemming from identification of the unintended consequences arising from the focus that the institutional framework currently has on achieving regional water security. The framework highlights potential 'de-railing points' where the institutional structure can fail, resulting in water quality degradation – or where interventions can be strategically targeted. Addressing catchment health requires an integrated approach to the biophysical, social, cultural, legal and institutional components of a system. The use of conceptual frameworks allows practitioners to recognise unquantifiable factors, to better understand the tensions acting within a system, and to identify the most effective intervention points to solve problems. The analysis has been applied, in this case, in business planning for a regional partnership organisation responsible for catchment health.

The workshop provides an emphasis on process, providing a strategic approach for addressing a tremendous volume of information and using conceptual frameworks to structure that information to identify – following analysis – the key recommendations, pitfalls, and leverage points for effective water management from an integrated perspective.

The systems analysis has been applied successfully in Australia and is currently being implemented in Mozambique to address urban sludge management, in Cali Colombia regarding urban water challenges, and in France to reveal solutions to groundwater management challenges.

Degraded Ecosystems and Damaged Rivers: The Long Shadows of India's Urban Growth

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Keywords: urban growth, ecosystem goods and services, IRBM, community participation, ecosystem approach

Introduction/Problem Identification

285 Million people or 28.8% Indians now live in her cities. More than 23 Indian cities have a population exceeding 1 million. But, 27% of this urban population lives in slums, with minimal water and sanitation coverage. Such urban growth has concentrated water demands, put immense pressure on water infrastructure, led to severe pollution, inequity in water distribution and water conflicts. At the same time, ecosystems on which this supply depends have been degrading rapidly, jeopardising not only urban areas, but the rural centres, which coexist and depend on goods and services provided by these ecosystems. As an easiest way of coping with increasing water demands, cities are building large dams and diversions at great distances for water supply, creating serious environmental and social problems through submergence, absence of eflows and displacement. Community participation in rural and urban water management, through ecosystem approach holds potential to address this issue effectively.

Analysis/Results and Implications for Policy and/or Research

Centralised and techno-centric water management, hallmark of growing Indian cities, is proving to be inefficient in addressing issues related to equity and sustainability. More and more cities are now building large dams farther away from the city, in a bid to quench their growing water demands. This has been leading to complex conflicts caused by cities but away from cities. New Delhi, which receives water from large dams on rivers Sutlej, Yamuna, Ganga and Ramganga, each causing large-scale displacement and ecological destruction is now set to 'buy' more water from Renuka Dam on Giri River 300 kms away, displacing more than 6000 people, affecting Ramsar site of Renuka Wetland and submerging part of Renuka Wildlife Sanctuary. Mumbai, which receives waters from Waitarna and Tansa rivers is now demanding more water from Dams on Gargai and Waitarna, submerging thousands of hectares of forest in Tansa Sanctuary. The dams have already submerged gorges and waterfalls on Waitarna River, which supported rich riparian forests and habitats for endangered fish like Mahseer. Due to large scale deforestation, siltation rates in newly built reservoirs are worrying. Mumbai is also planning to get water from Damanganga river in Gujarat, through interbasin transfers which will submerge crestline forests and displace large proportions of tribal population. Bangalore receives its water from Kabini river, at a distance of 200 kms and is now eyeing water of rivers like River Nethravathi, at a distance of 400 kms, through canals and pumps. None of these dams are designed to release environmental flows.

Increasing urban pollution is casting long shadows on downstream water security too. Hardly 30% waste water is treated by Indian cities and downstream rural and urban areas are bearing brunt of this mismanagement. Water quality of stretches of Yamuna downstream of Delhi and Mula Mutha downstream of Pune is not fit for bathing or irrigation. Within the city too, unplanned urban growth is casting shadows on ecosystem goods and services of aquifers, riparian corridors and rivers. Channelisation, encroachments and muck disposal have become common in urban waterways.

There is immense scope for shortening this morbid shadow through measures like demand management, rainwater harvesting, using the existing lakes and water sources in cities, recycling and reusing wastewater, fixing distribution losses, etc. Unfortunately, while there is very strong political will for building costly large dams, such will is absent for implementing cost-effective, participatory measures. Thus,it is imperative that citizens of the basin themselves pave way for more sustainable urban water management, which is sensitive to its footprint on its support regions and downstream. A few case studies from India illustrate the potential of this approach.

Casestudy 1: Community Participation and river basin management in Pune: Pune lies in Bhima river basin, Western India with a population of 3.4 million.It receives water from four dams built on crestline of Western ghats, one of the biodiversity hotspots of the world and is now claiming water from a fifth dam, 100 kilometers away, which was originally built and financed for irrigation.The Municipal Corporation claims to supply 265 lpcd of water, though the disparity in supply ranges from 500-40 lpcd. Private players and PMC have encroached heavily on its rivers, straightening and channelising streams and rivers without maintaining riparian buffers. All this has severely affected the carrying capacity of the city's rivers which are also under shadow of unplanned urban growth.

In last October, Pune received record rainfall in 80 years. The encroachments and channelisation led to severe flooding in which three slum dwellers an a student lost their lives. The CSOs in Pune pro-actively formed the Pune Floods Committee, headed by a retired Chief Justice. Simultaneously, through the platform of IRBM in Bhima basin,downstream and upstream stakeholders came together and villages 200 kilometers downstream of Pune, are now protesting strongly against Pune's river pollution and increasing water abstraction, which is affecting their livelihoods. A basin-wide River Parliament 'Punya Nadi Samsad' has been constituted and stakeholders are lobbying strongly for ecological approach to urban water management, rain water harvesting and using Pune's lakes (combined capacity of 5 MCM) for catering to city's water needs. At the same time, Pune citizens are working with schools, colleges and corporate bodies in treating waste water from urban streams through ecological methods. Punya Nadi Samsad is now working on reviving city's lakes and urban streams for conjunctive water use. Municipal Corporation is now supporting these initiatives.

All in all, through ecosystem approach,community participation and strong advocacy, cities can effectively lower their burgeoning ecological footprint on ecosystems and distant communities.

The Role of Cities as Drivers of International Transboundary Water Management Processes

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Keywords: transboundary water management, international relations, urban development, water resource capture, conflict

Introduction/Problem Identification

The global population is now predominantly urbanised, the result of a long-term urbanisation process as countries pass though the various stages of economic development. Some developing countries in Africa and Asia have yet to attain the 50 percent urbanisation rate, however most are rapidly urbanising and will attain this rate within the next two or three decades. The implication for water management in arid regions of the world is that these large urban centres have had to source their water supplies from ever further away. This need to secure water as well as the services related to water has meant that cities in arid regions have become increasingly involved in international transboundary water management processes. This involvement is a factor usually overlooked in the analysis of transboundary water management processes in arid regions.

Analysis/Results and Implications for Policy and/or Research

Over the past 60 years the 264 international transboundary watercourses in the world have had more than twice the number of cooperative than conflictual events associated with. The conclusion is that states cooperate over water precisely because it is such a precious resource; it does not pay to fight over water at the inter-state level. Cooperation implies willingness between parties to change their behaviour for an improved mutual outcome. This is distinct from harmony, where no dispute exists; and discord where a state of dispute between parties exists. However, despite this history of inter-state cooperation, the problems associated with the world water crisis have not diminished over the past 60 years. Although states do not go to war over water and may engage in some degree of cooperation; there are relatively few examples of transboundary watercourses being optimally and sustainably managed to provide development to the basin states. A large body of research has sought to understand better the drivers of conflict and cooperation between states in the management of transboundary watercourses, but finding a robust theory of why states choose various approaches has proved elusive. Hegemonic states at times choose to engage in cooperative processes while at other times, or indeed in other basins, not. Data on national-level water scarcity are not good predictors of the actions taken by states; at times resulting in seemingly sub-optimal outcomes. In the majority of research efforts on transboundary water management, countries are viewed and analysed as homogenous units – with water resource use and allocation happening at the national level and cascaded down to a broad range of users. The flaw of this approach is that it leaves out sub-national actors and the role they may play in driving TWM processes at the national level. The importance of large urban centres in driving water management decisions on international transboundary watercourses in arid regions (any areas experiencing some type of water stress, broadly defined) is underestimated. This paper contends that large urban areas set the agenda in TWM in three main ways: a) their increased capacity to pay for water resources (in comparison with rural water users) means that they can commandeer large-scale water transfers for their use; b) the second way in which cities set the TWM agenda is via their need for electricity and other services linked to the development of water resources; and c) the third way that cities set the TWM agenda is through their need to secure a political power base in the rural areas. Cities such as Johannesburg, Windhoek, Lusaka, Bangkok and Cairo have all played a driving role in the development of water resources or the evolution of water management institutions in international transboundary basins around them.

With the majority of the world's population now living in urban areas and urbanisation increasing in most developing countries; it is vital to factor in the role of large urban areas in analysis of international transboundary processes. Cities, as the unsung actors in international transboundary water management, are likely to place increasing demand on watercourses and ecosystems further away from them, with implications for the "donor" region as well as the recipient (of the water).This article develops the conceptual framework for the ways in which large urban centres drive international transboundary processes in arid areas, building on discussions of the coexistence of both conflict and cooperation between states.

Virtual Water Trade as a Policy Option for the Arab States

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Keywords: virtual water, arab states, water scarcity, food security, water policy

Introduction/Problem Identification

Taking the Arab states as a case study, this paper addresses the water/food challenges facing the water-scarce region and the implications for the food economy. By accounting the volume of virtual water embedded in food imports into the countries concerned, a close relationship between water endowment and food import dependence is elaborated. The analysis also shows that although virtual water trade (VWT) is ongoing in the region, it is yet to be considered as a policy option in planning and allocating water resources. It is further elaborated that considering virtual water as a policy option is often faced with skepticism and fear of economic or political control. The culture of the Arab region constitutes an important element when discussing the need for change in current methods of planning to accommodate VWT. This paper is concerned with investigating the feasibility of one policy option that has often stirred conflicting opinions and sometimes accused of leading to insecurity.

Analysis/Results and Implications for Policy and/or Research

More often than not, scholars in the Arab region contradict the political argument that has been put forward by Tony Allan from the beginning of the virtual water debate, that virtual water trade can be an instrument in solving geopolitical problems and even prevent wars over water (Allan, 1998, 2003). The contradiction is simply based on the perception that food exporting countries are mostly western countries, and the relationship between the Arab states and western countries is dominated by skepticism and fear of domination. Thus, looking at the bigger picture it is perceived by the Arab states that by depending on food imports they are giving in to foreign domination.

Next to the political dimension, there is the economic dimension, equally stressed by Allan (1997, 1999, and 2001). The economic argument behind virtual water trade is that, according to international trade theory, nations should export products in which they possess a relative or comparative advantage in production, while they should import products in which they possess a comparative disadvantage (Wichelns, 2001). Hoekstra and Hung (2002, 2003) argue that virtual water trade between nations can be an instrument to increase 'global water use efficiency'. From an economic point of view it makes sense to produce the water-intensive products demanded in this world in those places where water is most abundantly available. In those places water is cheaper, there are smaller negative externalities to water use, and often less water is needed per unit of product. Virtual water trade from a nation where water productivity is relatively high to a nation where water productivity is relatively low implies that globally real water savings are made.

However, a major source of skepticism is whether or not a fair and secure trade with water-abundant nations can be sustained in an ever changing trade environment. An advantage for the Arab countries is that they export enough to earn the foreign exchange required to purchase the food imports they need. The second issue pertains to the level of the economic base. i.e. whether the economy of the country is well developed and diversified to take the decision of reallocating water from cereals, which provide subsistence living to large sections of rural population, to a more economically rewarding water use.

Regional cooperation on this subject is of paramount importance as it would allow countries of the region to assess and analyse the situation on a broader basis, taking into consideration common strategic issues. It would further alleviate many of the political and economic concerns. Eyes have been often directed to Sudan as the potential food basket for the Arab states due to the abundance of water resources and arable lands there. However, political instability is a barrier to taking advantage of such a golden opportunity.

Aside from the economic and political aspects of virtual water trade; growing one's food (i.e. feeding oneself) has other important aspects; the cultural and social aspects are of major influence on the decision whether or not to grow a certain crop, furthermore culture interferes with the whole acceptance of the notion of virtual water trade.

From the analysis it is important to point out several points:

1. Food imports are ongoing and imperative for compensating water resource deficiency in the Arab region, thus there is no point in opposing the concept of using food imports as a complementary factor in the food security formula;
2. In short, the concept of virtual water is well founded, provided countries have more transparent picture of its comparative advantage and accordingly they can translate it into a competitive advantage.
3. It is imperative that planners tackle the sources of skepticism related to political, economic, and socio-cultural dimensions of the virtual water trade through the potential of regional integration before introducing it as a policy option; and
4. Cultural and behavioural changes are necessary for adapting to the current water scarce situation. Nevertheless, a cultural mix would benefit the study of virtual water as a policy option to provide a holistic rather a directed assessment of the issue.

Conserving Bohol's Underground Water Sources

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Keywords: underground water sources, tourism, agriculture, salt water intrusion, multi-sectoral organisation

Introduction/Problem Identification

Bohol, an Island Province of The Philippines, is an urbanising area with promising growth and opportunities brought about by its key economic drivers–agriculture and tourism. The province is blessed with rivers and springs, yet majority of its developed water supply comes from underground water sources. The Provincial Government of Bohol has strong commitment for environmental protection and conservation. However,it's faced with water-related issues, predominantly salt water intrusion due to over extraction of underground water sources to cope with the increasing domestic and commercial demands. This is prevalent in Tagbilaran City and in some of its urbanising municipalities. This paper presents the vulnerability of Bohol's underground water sources, the limitations and unavailability of scientific data to determine the quality and quantity of underground water sources and the current unregulated practices of ground water extraction that are proliferating in its urban and rural areas.

Analysis/Results and Implications for Policy and/or Research

Initial strategies implemented to respond to these pressing concerns are discussed, focusing on actions that may effectively be undertaken through public-private partnerships and collaboration.

With the continuing economic growth and the increasing population of Bohol, the availability of water for consumers has become an issue. Water service providers have been extracting water at considerable rates that resulted to salt water intrusion in urban areas. At present, efforts of the National Water Resource Board (NWRB), the national agency task for regulating water resource extraction, is somehow ineffective when not supported by local governments and the consuming public. The generally-unregulated practices of water extraction are perceived to have caught up with the limits of the underground water resources in the province's urban centres.

Further, Bohol's karst geologic formation could be both an asset and a liability in underground water management. The importance of reliable information on these formations, which can be attained through proper research, cannot be discounted as these are necessary for sound water management. Results of studies will be utilised as bases for policy-making, legislation and law enforcement.

If emphasis will be given to proper underground water management, specifically pursuing balance and suitable extraction with recharge capacities, Bohol needs to have an integrated approach to deal with the problem. The availability and level of underground water sources is largely dependent on the general condition of the environment as characterised from the state of rivers, springs, caves and karst ecosystem.

Bohol's population is increasing at the rate of 1.06% per year. Tagbilaran City, with an estimated population of 100,501 in 2011, is growing faster with an annual rate of 2.4%. Similar trend is also observed in most of the urbanising municipalities of the province. Consequently, water demand is also rising, putting more pressure to the underground water sources. Concerned sectors in society have been advocating for sustainable approach for water supply, stressing that there is no ultimate trade-offs between environmental conservation and economic development. However, water utilities continue to source their water from underground sources. Take for example the Bohol Water Utilities Incorporated (BWUI), a privately-managed water utility that supplies 70% of the population of Tagbilaran City, has been extracting and searching for groundwater sources to meet the projected demands of its service areas. This will definitely have implications in the immediate environments and ecosystems. Supplying water for Tagbilaran City with groundwater as the main source is not sustainable as water utilities are generally limited from providing full water services to their concessionaires. BWUI is only providing 64.2% water to its service areas, while Tagbilaran City Waterworks System, another service provider, supplies 98.2% water to its consumers.

Sustainable strategies to respond to the water issues in Bohol have been pursued. Initiatives are made to push for the development of surface water as source for its potable water supply. The Bohol Integrated Water Supply System Master Plan was prepared, aiming to develop the three major river system of the province. Such plan focuses on providing water supply to Tagbilaran City and other nearby municipalities especially those with growing tourism industries. While it is still a long way to reach this desired end considering the investment requirements for surface water–based systems, several key water industry players have already expressed interest for the project. This initiative may be best carried out through government and private sector partnerships to ensure infusion of capital, full public participation and most importantly proper management of natural resources.

Part of Bohol's rich endowments is the 11 watersheds and diverse river ecosystems, but ironically, there are still several municipalities that are identified to be waterless. An approach to deal with this concern is the organisation of watershed management councils through participatory, multi-stakeholder engagement. This is also seen as an initial strategy to lessen the pressures of our underground water sources. Currently, there are 4 watershed management councils that are operating in the province.

Virtual (Green and Blue) Watersheds of Cities

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Keywords: virtual water, trade, green water, blue water, scenarios

Introduction/Problem Identification

Virtual water is not only traded across international borders, but virtual water fluxes occur at all scales, between production and consumption surplus areas. In particular cities today have large net influx of food and other commodities and the associated virtual water. These fluxes have not yet been systematically and geographically explicitly quantified.

Rapid urbanisation, globalisation of diets, transport and trade liberalisation will contribute to the future expansion of virtual watersheds of cities. Scenario analysis (for identifying sustainable development options) requires appropriate process-based tools / models.

Analysis/Results and Implications for Policy and/or Research

We have quantified the virtual water fluxes for several large cities around the world, separately for green and blue water and for 21 crop classes. We have further mapped the spatial extent of the resulting "virtual watersheds" around these cities, i.e. average distances across which each commodity is transported. This analysis is based on i) the GCWM Global Crop Water Model at 5 min resolution and ii) the LPJmL dynamic global crop, vegetation and water balance model.

We have also calculated each city's contributions to the total water footprint of the respective country, assuming the same per-capita food consumption as for the rest of the country. In reality, city dwellers probably have more water-demanding diets, but we have not yet taken this effect into account.

The size of the cities' virtual watersheds as well as the national vs. international contributions to these watersheds vary between cities and countries. We find significant differences between developing and industrialised regions. The sizes of virtual watersheds around cities are probably underestimated, given that city dwellers tend to have a higher fraction of non-local crops and products in their diets. Again, we have not yet accounted for this effect. Other differences between industrialised and developing countries include e.g. different per-capita water footprints and different fractions of basic staples.

Furthermore we have identified the source areas of some of the major imported commodities for different cities and regions.

An Adaptive Co-management Model in Rural Urban River Basins: An Action Framework Based on Experiences from Honduras and Nicaragua

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Keywords: comanagement, river basin, cross scaling, governance, Central America

Introduction/Problem Identification

Watersheds in Central America provide important environmental services that are especially important for water flow regulation and rural poverty and urban demand have generated overexploitation of natural resources in critical territories. The impacts of natural hazards such as drinking water scarcity, flooding, landslides and other natural disasters are increasing with climate change creating a vicious cycle between natural resources, environment affecting both rural and urban population. Increasingly, centralised governance approaches are evolving towards to local multi-stakeholder approaches including civil society and the private sector to participate in decision making processes on defined territories and landscapes composed of rural and urban environments. Based on these considerations and experiences an adaptive co management of watershed model has been implemented in four small watersheds in Honduras and Nicaragua and special attention to be given to rural urban relationships.

Analysis/Results and Implications for Policy and/or Research

CATIE Focuencas II programme, with the support of SIDA, Sweden, started implementation in October 2004 at four small model watersheds which included small urban centres at three sites in Honduras and Nicaragua. The method consisted in participative action research cycles by local actors and researchers to improve conditions or resolve problems and to generate knowledge and adapt actions through reflexive processes and analysis. It was proposed a general hypothesis related to an adaptive co-management model of river basins considering that local authorities, basis organisations, interest groups, national agencies, local business and all the others as NGOs and donors are able to organise themselves to develop a common territorial agenda which addresses priority issues that impact positively on the quantity and quality of water in a defined river basin.

A series of arrangements were made by local organisations related to:

- Local governance through platforms (watershed committees and equivalent structures) including mayor rural and urban stakeholder.
- Co-management plans or common territorial agenda and local monitoring systems.
- Arrangements and management of critical territories for water flow and regulation through an environmental services approach with mainly rural urban relationships.
- Local environmental fund and financial mechanism.
- Relationships of territories through scaling up and down (including rural – urban relations).

Mayor conclusion is that an adaptive co-management arrangement of watersheds may be a necessary and viable approach for addressing common goods and environmental services issues. Our experience confirms that governance is the most critical parameter for effective management and the conservation of natural resources, as has been stated by other researchers. Platforms for dialog and common agenda allow the integration of mayor urban and rural stakeholder. Especially ecosystem services relationships are based on rural offering and urban demand by water users with a mayor capacity for payments. Significant social capacities of local actors can be mobilised to achieve organisation to develop and implement a local agenda related to common interests and objectives in order to manage and conserve the natural resource base from a watershed perspective. The interaction of actors has generated institutional innovations and scaling up and down based on the local context, needs, experiences and adjustments. Each watershed committee proposed its own management solutions based on local human and environmental resources. A common agenda was a joint and social construction that generates knowledge about interests and latent conflicts and opens up options for solutions. A management style based on action research by local stakeholders was most appropriate in this respect, as there are no standard solutions for addressing problems and finding solutions. In these arrangements, social learning processes are required in order to address natural resource dilemmas and create new knowledge through repeated interaction. A major constraint demonstrated during this experience is the dependence on external financing; internal mechanisms are at an initial stage and significant changes in new funding mechanisms cannot be expected in the short term. It is crucial that contributions, taxes, fees and other mechanisms such as payments for ecosystem services be adjusted to support such structures.

Complexity increases with scale levels: at the micro level these relationships are evident, as zooming out implies more distant relationships among interest groups networking seems necessary. It is a mayor requirement to link rural and urban populations within an environmental service approach.

Waste and Energy Streams in Food Production and Consumption

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Keywords: recycling, agriculture, Food stuff, environment, consumption

Introduction/Problem Identification

Less than hundred years ago Finland was a thinly populated agricultural society. Farms and villages were practically self-sufficient with energy and natural resources. Today only three percent of the population is employed by farming and the number of people living in urban areas is constantly increasing. In this paper the environmental impact of this transformation is discussed. The target area is the south-western Finland that has a considerable impact to Baltic Sea eutrophication. In this location the excess streams of the whole food production and consumption chain are about to exceed the receiving capacity of local farming land. The potential and reasoning of bio energy production is also studied at the same target area.

Analysis/Results and Implications for Policy and/or Research

Public health engineering has been the driving force in creation of water related environmental pollution control. Due to this historical background the mission has been to purify the wastewater as well as possible. For decades the sludge produced in the process did not get much attention as there was always the easy option to dump the sludge into the landfill. Old tradition to recycle the human waste back to the fields ceased as the urban society progressed.

Food consumption and human wastes are the end of a long production line. This line should be seen as one system with different interacting stages. The line starts from the primary production in the fields, goes to food stuff processing or is fed to the domestic animals and finally gets to the consumers and is consumed. In the end most of the nutrients are in the wastewater that is taken to the environmental pollution control plant.

The harvested biomass from the fields is used either to feed the domestic animals or to produce foodstuff. The system used to be rather sustainable at the times of agricultural society. The farms were self sustainable and only limited amount of nutrients were travelling from or to the villages. Today the domestic animal units in Finland are getting larger. In addition the protein feed to the animals is often coming from the global market. The problem we are addressing in our paper is the miss match between available farm land and nutrient flows from the domestic animal units and urban areas.

In Finland the amount of solar energy is about 20.000 GJ/hectare. From this about 500 GJ/hectare is captured by the standing crop. In addition to the nutrient flows we are presenting calculations on bio energy potential of the waste and side streams of the food production line. The starting point is the amount of biomass produced by solar energy, 500 GJ/hectare.

Hundred and fifty years ago more than eighty five percent of Finns were laboring in agriculture. Today the number is less than three percent. Earlier eighty percent of the energy in daily diet was from rye. Today we eat much more animal products to fulfill our energy and protein demand. It is essential to understand this slow transformation process if we want to have good reasoning for appropriate environmental actions for the whole food production line.

City and the Countryside: The Dynamics of Resource Flows – Case Examples from Maharashtra, India

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Keywords: city, countryside, resource dynamics, inflow, outflow

Introduction/Problem Identification

As always, the city is built by laying claim to the resources of the adjoining countryside and then becoming an economic dynamo without which modern civilization would cease to prosper.

All cities, however, impact the surrounding countryside in different ways. Cities in the developed world have largely fine-tuned their resource flows such as water supply and are now focussing on reducing their impact on ecosystems further away.

Cities in the developing world, however, are mired in setting-up a system for regulating their scarcer inflows and untreated outflows. The resource dynamics can evolve in a few ways. One, the city continues to "colonise" the surrounding rural continuum; two, that the countryside is "swallowed" by the city, leaving an unmanageable megalopolis in place and three, that it technologically leapfrogs into a green city with a "closed metabolic system".

This paper will distil lessons for cities to regulate their resource flows from an analysis of these options.

Analysis/Results and Implications for Policy and/or Research

Cities and other such urban agglomerations are inherently heterotrophic in nature, that is, they are dependent on resource inflows from the rural continuum. Their waste is discharged into the urban and close by rural continuum. In the rising megalopolises, the preferred urban form of the subcontinent, these processes are already askew. Resource inflow extends deeper into the rural continuum and so does the entropic (waste) outflow making their impact felt wider in space (countryside) and time (generations).

The three options for the emerging system as mentioned earlier lead to quantifiably and qualitatively different scenarios for the future evolution of the urban forms. This paper proposes to comparatively assess examples from the Mumbai-Pune belt of Maharashtra in Western India with other more evolved city systems from across the world. In the resultant framework, the paper will, in particular, explore and evaluate the resource dynamics of water supply for Mumbai city and water supply issues in the Pune district (and Pune city).

Further, one strand of the analysis would seek to understand the impacts of the city's heterotrophic dependencies on the countryside (as in the case of water, for example). For most of the options, the flow would be inherently unstable and inequitable in terms of inflow and outflow, and would invariably act as an impediment for urban renewal, with the potential to lead to decay and, possibly, conflict.

Whenever any city is able to harness its potential for individuals to collaborate and use the technology available, the resource dynamics can be transformed from leaky and inefficient exchange pathways to a leaner and more closed system. In such a case, the city would make the transition to a sustainable habitat. The paper will attempt to understand how the resource dynamics could facilitate such a transition.

The paper will also situate the evolving resource flow system within the policy and regulatory framework in India. The analysis will determine that from the standpoint of governance and planning, a much deeper and broader ecological view is called for, especially in the context of urban renewal programmes such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and other similar initiatives in India and elsewhere in the subcontinent.

Global Cities, Local Water Sources: Where the Urban Shadow Falls

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Keywords: periurban, livelihoods, vulnerability, water security, India

Introduction/Problem Identification

This research is located in periurban Gurgaon, that has emerged as a major outsourcing, industrial and residential hub of Northest India. Gurgaon represents what many call millennium cities of the third world. These are the product of globalisation processes and neo-liberal reform packages that make greater space for multinationals and private enterprise. They are characterised by dual economies – tall skyscrapers existing amidst pockets of deprivation and resource contestation.

The growth of Gurgaon has posed tremendous stress on the city's infrastructure and water resources. Planning authorities have responded through supply augmentation from the peripheral villages; building water treatment plants and canals to carry water to the city by acquiring land from them. Urban elite have moved to the peripheries acquiring their land and water resources. This process has created dual economies within the 'global space' of the city, changing the pattern of land and water use.

Analysis/Results and Implications for Policy and/or Research

The paper describes the implications of these processes for periurban residents. It describes the many ways in which periurban residents experience and adapt to water scarcity, as the urban shadow falls on them.

They are left chasing the water table on the one hand and losing land to build water treatment plants for the city on the other. They have responded by installing high cost water extraction technologies such as submersible pump-sets to dig deeper as farm-houses of the urban elite suck water from as much as 300 feet deep into the ground. Many have had to leave their agricultural land fallow, take only one crop or switch to rainfed farming. Many have had to cut back on their livestock population as grazing lands have been acquired to build a water treatment plant to quench the urban thirst.

The small and marginal farmers are worst affected as they can no longer afford the higher costs of extraction. Some people with lands located strategically are more vulnerable, as they lose lands repeatedly for building water treatment plants and canals to quench urban thirst. The loss of water sources like tubewells has made many to depend upon urban sewerage as irrigation source. While urban sewerage is a cheap source of irrigation that does away with the need for costly pumping and application of chemical fertilisers, it has negative long-term implications for the health of the producers as well as the consumers of the produce. At the same time, urbanisation processes have further eroded the social capital through which periurban residents adapt to water scarcity. Many water users who acquired water from the sources of their friends and relatives no longer have access to them as the latters' lands have been sold off. Those who are most vulnerable are those for whom several of these stresses interact.

While scholars have been widely interested in the flows of goods and services between urban and rural areas, little attention has gone into the study of how periruban residents – on whom the urban shadow falls – adapt to the changing flows of water between urban and rural areas. Little attention has been devoted to understanding the mix of technologies and institutions that shape their adaptation responses and strategies. This research bridges this gap. It makes a case for further research on the sociotechnical regimes – the mix of technologies and institutions that shape periurban residents' access to water.

In terms of the research significance, the paper also demonstrates the value of the concept of vulnerability to look at the intersection of multiple stressors. Among those living in the urban shadow, the most vulnerable are those who face multiple stresses; the erosion of social capital, large concentrations of land in one location, fewer alternative sources of livelihoods and few alternative assets to bank upon in case of land acquisition for urban expansion and augmentation of urban water supply.

In terms of policy significance, the paper suggests that growing cities need to depend as much as possible on local solutions for water such that the ecological foot-print does not spill over into the peripheries creating patterns of stress and vulnerability. While we usually talk of urban and rural water supply in isolation as if they were distinct conceptual identities, the research suggests that we need to better understand and account for the flows of water between rural and urban areas. We need to break the conventional dichotomy between urban and rural water supply and plan for water at a micro level, taking view of the linkages and flows of water across rural and urban areas.

Another policy relevance of the study is that urban expansion plans need to be based on the studies of the carrying capacities of cities. Cities growing beyond their carrying capacity create negative implications for periurban livelihoods and the water security of periurban residents. As urbanisation processes advance in the developing world, platforms for dialogue will be needed across urban and rural water users not only to plan water resource allocation, but also to mak urbanisation processes more inclusive and equitable.

Is Peri-Urban to Urban Groundwater Market Sustainable? – A Case Study in Chennai, India

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Keywords: groundwater in peri-urban, water table depletion, agriculture, sociological tools, sustainability

Introduction/Problem Identification

Urban pressure towards the peripherals results in severe changes on the land and water resources. Chennai, one of the most water stressed cities in India does not have perennial and dependable water resources to meet the growing demands in the metropolis. The water supplied by the formal service providers is not keeping pace with the swift increase in the demand. Consequently Groundwater is extracted and marketed from the surrounding peri-urban areas for domestic, commercial, institutional and industrial purposes. The sociological tools such as stakeholders meeting, focus group discussions and semi structured interviews were conducted to the water sellers as well as affected local people. The present study aims to explore the nature of informal water market mechanisms and enlighten the role of the social interactions and tools for managing the fragmented nature of groundwater market as well as to sustain the interest of the peri-urban and urban communities.

Analysis/Results and Implications for Policy and/or Research

The city of Chennai extends its urban influence and its water problems to its surrounding areas. Most of the agricultural wells in the peripheral villages act as a source of the water market, and groundwater is transported through water tankers. The cost of one load of tanker (12,000 l) at the consumer end varies from Rs.600 to 900, whereas the water is purchased from the agricultural well owners at a cost of Rs.60–100. The packaged water companies in and around the water marketing villages, which are extracting a huge amount of groundwater and disposing the rejected water in the nearby agricultural lands without any proper safety measures; this poses adverse impacts on the agriculture, while the semi-structured interviews with selected owners of the packaged water industries reveal that approximately 4,000–4,500 water cans of the capacity of 20 litres are transported to customers every day. To make a one 20-litre can, the groundwater extracted is twice that amount and the rejection water that has total dissolved salts of more than 5,000 is disposed either in the ground or nearby agricultural fields. The water companies pump the water for more than 20 hours and most of the companies run in morning and night shifts (the whole day) even though they have got the licence/approval for the day shift (8 h) only.

The continuous pumping and transferring of groundwater without any quantification affects the peri-urban aquifer considerably. The consequential water table depletion changes the water quality and increases water-related stress in the villages, particularly to the poor while the profitable water sale shrinks the agricultural and allied activities in all the water marketing villages. The costs related to the water table depletion become external costs to marginal farmers as well as agricultural labourers. The declining trend of agriculture and the depletion of the water table force the people to move out in search of employment opportunities and vice versa. People with higher income depend on packaged water for drinking, from the packaged water industries located within their area and go in for deep bore wells for domestic purposes, but people with lower income have no other option than depending on the local available groundwater for drinking and other purposes. This creates water-related stress to the traditional users.

Stakeholder meeting is conducted to identify the various socio economic issues on groundwater development with special reference to groundwater market. Focus group discussion has been conducted to know the prevailing situation of water market and the importance from the water supplier's standpoint. As the whole study is conducted cautiously without any bias, assurance of the quality of transferred water is also encouraged by the research. This will supportive to the consumers of low income group who are primarily depending the marketed water for drinking purposes alone. A semi structured interview has been conducted with owners of water industries to comprehend the quantification of extracted water through packaged water industries. During the discussion, the research suggested the installation of recycling units and disposal of partially treated waste water which will improve the efficiency of treatment unit as well as reduce the required quantity of water. Though it does not any make significant changes in their attitude immediately, but hopefully it makes them to rethink regarding water conservation, improvement of treatment efficiency as well as sustainability of their business. Besides, it is safeguarding the aquifer at some extent. During the survey, the awareness has been created to the non selling farmers to protect their resources from further exploitation.

The informal nature of water market has led to tremendous distortion of land use patterns, intra rural socio-economic relationships and property regimes, while, on the issue of underground water resources, some 'threshold' effects have appeared, a privileged part of the former rural society shifting towards city-driven markets. In the long term, though, this 'urgency' solution may hamper the future. Frequent discussion with the experts, government officials and media people during the meetings, the research issue and progress is well encouraged and accepted. Though the private suppliers are act as service provider where public system fails to meet the increasing need of water, the institutional framework (monitoring body) with proper legalisation and water resources conservation strategies may supportive to avoid the over exploitation of groundwater issues. The study concludes the prevailing fragmented nature of the groundwater market may hamper future water security in the peri-urban areas. Researching the issue with consideration of all stakeholders and their active participation paves the way to reach the research output to the policy level for managing and regulating the valued water resources.

The Impact of Large Health Resorts That Use Highly Mineralised Water to Condition of Superficial Water

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Keywords: spa complex, mineral water, pollution, water course, sewage water

Introduction/Problem Identification

For major Health Resorts that use underground mineral waters are typical common factors that impact on the environment and the associated environmental challenges: increasing salinity, content of surface-active, organophosphorus substances, and chlorine in an open receiving waters, pollution of rivers and reservoirs.

Many of the problems connected with a mismatch between the intensity of the local network of sanatoriums, the growth of holidaymakers on the one hand and the race of reconstruction and resettlement of new sewerage networks and wastewater treatment plants are on the other. For example, a well-known to the whole of Eastern Europe Morshyn urban wastewater treatment plant was built back in 1970, and its bandwidth ability does not meet the increased volume of sewage and stormwater. Until recently, the station used to primarily provide only waters mechanical cleaning.

Analysis/Results and Implications for Policy and/or Research

In chemical composition is discharged into the river water chloride-calcium-sodium bicarbonate. In the waste water contains about 2.7 mg / dm^3 PO_4^{3-}, when the OEL for drinking-water 3.5 mg / dm 3, 24.0 mg / dm^3 ammonium (OEL ammonium 2 mg / dm^3). The potassium content is higher than in river water 3 times and calcium is in 2,7 times, total hardness above 2 times, salinity – more than twice, permanganate oxidizability (PO) – More than three-fold. Waste water have a higher total alkalinity. ON (5,3 mg O/dm^3) is characteristic of lowland rivers zone deciduous forests than for mountain rivers, where it does not exceed 3 mg O / dm^3. When such values are reduced dissolved oxygen, which adversely affects the fish fauna.

After mixing of waste water with river water, the amount of ammonium in the river water exceeds four times. Increasing of phosphorus combinations with waste water leads to the growing of plant mass in the rivers and water areas. It comes to the changing of trophic status of water basing and it leads to the growing of turbidity, salinity, of bacteria concentration of the water.

One of the possible aspects of the eutrophication process is growing of the blue-green water plants, many of them are toxic. The substances emited by these organisms are related to the phosphorus and sulphur organic combination.

Ineffective work of a cleaning station combined with uncontrolled flows, leads to the changing of natural water combination, which is formed for account unstrained and law mineralised (0,3g/m^3) hydrogen carbonates, calcium waters. Composition of river waters in basin of Morshin becomes sulphate-hydrocarbonated-chlorid, calcium, sodium and this indicated the water escaping of waste balneological salty water.

It is clear that the increasing of municipal flows pollution by washing substances is common for all health areas. The indicators of arrival of this waste water into the rivers are abnormal containing of phosphorus, ions of ammonium, chlorus and potassium in the water.

During extraction and using of the mineral underground waters for the balneologycal procedures, the mineralisation of water is increasing in the rivers lover the resort areas. So, such territories it is possible to underline as regions of formation pharmacological medicine.

For the most completely removing of SURFACTANT from waste water it is necessary a special system of water purification which consist of floaters, aerotanks of cyclic action (SBR), biological sorbers and aerotanks basins. One of the ways of utilisation and beforehead disinfected waste water is watering of vegetables in greenhouses or using it for subbing irrigation of the technical plants.

Implications of Urban Demand for Food on the Land Use and Water Sources in the Shadow Zones – A Case Study from North-Eastern Region of India

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Keywords: implications, urban demand for food, urban shadow, land and waterresources, Northeast India

Introduction/Problem Identification

The urban demand for resources extends beyond the urban limits, from the immediate vicinity and across the globe. This has large implications for land, water, energy use and other natural resources. The north-eastern region of India, having a geographical area of 255 090 km^2, is extremely rich in water resources. But its misuse and mismanagement of water resources has rendered them in a fragile state. The region receives about 510 cubic km of water as annual rainfall. It has two major rivers, Brahmaputra and Barak, which drain 194413 and 78150 km^2 area with an annual runoff of 537.0 and 59.8 km^3, respectively. The region has a total surface and ground water potential of 1064.8 and 16.6 km^3. The scenario appears to be quite encouraging but indiscriminate use of natural resources has caused land and environment degradation. An exercise was undertaken to study the implications of urban food demand in the northeast India on the land use and water sources in the shadow zones.

Analysis/Results and Implications for Policy and/or Research

The population of north eastern region is increasing at an annual compound growth rate of 2.23% as against 2.43% in urban population. The urban population in the region has increased almost five folds between 1951 to 2011, within a span of 60 years. Sudden spurt in population has put tremendous pressure on land and water resources, while the development has not kept pace to accommodate additional population growing at a faster rate. The declining trend in rainfall and frequent temperature fluctuations are a signal for climate change. Due to mismanagement of rainwater, about 3586 thousand ha of land has become prone to floods. Further, the quality of water has also deteriorated due to its being polluted with nitrates, chlorides and sulphates with increased use of fertilisers and pesticides in an effort to increase crop productivity in the region. The urban demand for different food items, energy and other items of daily use extends beyond the municipal limits, from adjoining states to other parts of the world. The pressure on fresh water system continues to grow for domestic use, agriculture, industry, energy and disposal of effluents, not only due to increase in population but change in life style of the people also. The present annual demand for fresh water stands at 27.4 km^3 and will grow by 35% in the next 20 years. Since food productivity is highly dependent on spatial and seasonal changes in water availability, the future needs for water will have to be met from the resources similar to those existing at present in the region. Prevalence of shifting cultivation has resulted in deforestation and total annual loss of soil and nutrients through erosion is 601 and 1.52 million tonnes, respectively, causing silting of riverbeds and frequent occurrence of floods. The urban population of the region is 5.765 million at present. To feed this population, it has been estimated that an annual quantity of 1.205, 0.115, 0.189, 0.150, 0.540. 0.500, 0.450, 0.042, 0.046 and 0.387 million tonnes of rice, wheat, oilseed, pulses, vegetables, fruits, potato, milk, milk products and meat are required, respectively. The people of the region are, by and large, rice and meat eaters. So, these two products are required in higher quantities. Since there is no urban agriculture in the region, all this has to be imported from adjoining rural areas, other states of the country and sometimes, from outside the country through the central government. The urban shadow area has to produce all this to feed urban people. To produce this quantity of various products about 13.665 km^3 of water is required. The rural adjoining areas have to change land use according to the urban requirement. Further, due to urban development and change in life style of the urban dwellers, the quantity and quality of demands is also changing. The land and water use in the rural areas is impacted and regulated by the demands in immediate or distant urban areas. The large and rapid changes in demands have impacted the ecosystems and adjacent rural areas in the region and has far-reaching implications and impact on land and water resources of the riparian zones.

This high concentration of people in cities has serious consequences for poverty rates and food security. The world's urban poor tend to lack the money to purchase food and lack the land and resources to grow their own. More people living in cities with limited access to food will result in an increase in the level of urban poverty from 30 to a staggering 50% by 2020. To further exacerbate the economic hardship of city-dwellers in developing countries, the cost of feeding urban areas is high compared with rural areas. Low income urban dwellers spend between 40% and 60% of their income on food each year. In order to support this lifestyle, cities must adapt, reconsidering food sources, water supplies, the end location of their waste, the fuel supplying their electricity, and the overall environmental sustainability of densely concentrated populations. Cities consume too many resources and produce too much waste, impacting land far outside the city limits. There is need for urban agriculture to reduce pressure on rural areas for supply of requirements to urban areas. Urban agriculture contributes to the greening of cities, curbs air pollution, increases humidity and lowers temperatures. Converting organic waste to manure helps improve the ecosystem's health in an otherwise environmentally degraded urban area. Whether driven by the need to provide food for a city's poor or by the desire to mitigate climate change, agriculture in adjoining areas has to be logical and beneficial.

New Wetlands Formation in Reservoirs as a Recreational Resource for Big Cities

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Keywords: recreation development, reservoir, deltas, hydromorphic landscapes, big cities

Introduction/Problem Identification

Direct effect of large water reservoirs on the environment has already explored multilaterally. Nevertheless, the important aspect of the interaction of reservoirs and rivers turned out to be insufficiently explored. Actually new deltas with hydromorphic landscapes and peculiar water regimes, flora and soil cover are formed in the upper part of reservoirs. Such processes we explored in the Dnieper cascade of water reservoirs in Ukraine (humid and sub-arid regions) and in the Kapchagay reservoir on the Ili River in Kazakhstan (arid zone).

Newly formed land resources and wetlands very quickly attract an attention of people in nearby cities. They become subjects of "wild" tourism, poaching, fishing and farming. A massive construction of "dachas" (summer houses) on those territories started as well. And corrupt elements have become to erect even luxury palaces on new lands. All this has created a range of environmental problems that require management.

Analysis/Results and Implications for Policy and/or Research

Using Landsat space imagery for 1985-2010 and surface studies with the GPS receiver use has shown that in the Dnipro cascade delta-like landscapes formation goes fastest in first (Kiev) reservoir. New islands (and new land resources) are actively formed in its upper part, and its downstream coastal waters are intensively getting overgrown with littoral vegetation (Phragmites australis, Typha angustifolia, Scirpus lacustris). In recent years, very quick expansion of the aquatic vegetation with floating leaves (Nymphaea alba, Nuphar lutea, Trapa natans) take place. Average speed of hydromorphic landscapes area increase here for 1985-2005 amounted 100-200 ha a year. However, in 2006-2010 this value exceeded 1000 hectares a year. That is why significant problems for shipping, fisheries, water quality for industries and communal water-supply were created. At the same time, recreational use of the territory outside the Chernobyl Zone was improved, and biodiversity of the region was considerably enriched.

In the Kaniv reservoir (the second one in the cascade) natural processes of hydromorphic landscapes forming are supplemented with massive inwash of new land by hydraulic dredges and subsequent buildings construction. For the 1992-2005 more than 800 hectares of new land in the water reservoir was inwashed. As a result of artificial and natural processes the area of hydromorphic landscapes for 1992-2009 have increased by 1126 ha. Average annual rate of delta-like landscapes creation has increased in recent years from 66 to 117 ha. Very fast growing of the hydromorphic landscapes area has been revealed in upper part of Kremenchuk reservoir as well. For 1988-2009 it increased by 727 ha, and growth rates have aroused in last year till 231 ha a year. Growing of the area with aquatic vegetation has the highest rate here, but a little slower – the rate of wetlands and terrestrial ecosystems area increase. Area of such landscapes in the following Dniprodzerzhinsk and Kakhovka reservoirs is increasing at a rate over 100 hectares per year. A total area of hydromorphic landscapes in the cascade has exceeded 37 000 ha.

Formation of the new delta in Kapchagay (28.1 km^3) reservoir on the Ili River (Kazakhstan) we investigated for 40 years. Accumulation of sediment runoff (11 million tons per year) and overgrow of new islands and shallow water with swampy and aquatic vegetation has led to a hydromorphic landscapes formation on the area of 6497 ha. Special feature of this new delta is the development here both fresh-water wetlands and saline soils with halophytic vegetation. Ground level raising here because of sediment accumulation leads to a waterlogging and salinisation of landscapes at southern coast of the reservoir.

There is a necessity to perform such activities for a new hydromorphic landscapes recreational development near large cities:

1. Zoning of new landscapes as a recreation subjects (shown by the example of Kakhovka and Dneprodzerzhinsk reservoirs on the Dnieper River): a) for capital construction of recreational facilities; b) for construction of summer recreation complexes; c) for initiative summer tourism, fishing, bathing; d) for protected areas for biodiversity conservation and monitoring of natural processes.
2. Organisation of actions to prevent of new landscapes pollution.
3. Limitation of recreational development (especially capital buildings construction) in new deltas if it increases a threat of flooding (by the example of the Kaniv reservoir).
4. Securing recreational facilities and people because of fluctuations in water levels in reservoirs and river deltas (by the example of the Dnieper River delta).
5. Recording of new landscapes radioactive pollution (by the example of the Kiev reservoir).

Analysis of satellite images has revealed the formation of new delta-like landscapes in reservoirs of the Colorado, Yenisei, Euphrates, Nile, Mississippi, Volga, Zambezi rivers, etc. Therefore, the study of regularities and unique features of new deltas formation in large reservoirs and recreation development becomes critical scientific and economic challenge.

Urban Expansion and Its Encroachment on Irrigated Agriculture – The Example of Egypt

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Keywords: urban expansion, water scarcity, irrigation, waste water reuse, food security

Introduction/Problem Identification

Lack of rainfall, soil degradation, desertification or soil salinity are widely recognised drivers for reducing agricultural productivity – drivers that might be exacerbated in times of climate change. However, another important factor is often neglected: Worldwide expansion of cities continuously reduces the availability of valuable cropland and seriously impacts on water resources for agriculture, thereby increasing the risk of food insecurity and hunger.

The implications for policy, research and development cooperation will be presented for the case of Egypt, where a fast growing urban population faces limited land and fresh water resources.

Analysis/Results and Implications for Policy and/or Research

In Egypt, about 95% of the population of 80 million people live in the Nile Delta and the river valley on fertile alluvial soils, the so called Old Lands. Population density there reaches over 2.600 people / km². Out of a total of 3 million hectares of land 0.9 million hectares have already been lost to urbanisation. In the last decade alone, about 1% of arable land has been lost annually due to urban expansion, leading to an average availability of a mere 400 m² of cropland per capita and making irrigated agriculture become a kind of peri-urban gardening.

At the same time, fresh water resources are limited. In Egypt, water availability per capita per year is below of what is considered the water scarcity line of 1000 m³. In addition, water pollution from returning untreated urban waste water into the canals and the river seriously limits the potential for re-using water and limits the agricultural potential of the country. This means that Egypt's water resources constrain more and more the food production for its rapidly growing population.

Ensuring a safe re-use of water along the river course between Assuan and the Mediterranean Sea however is a pre-condition for satisfying the demand in the Old Lands and conveying part of the river water out of the valley to the so called New Lands, extending the irrigated area to reclaimed desert soils. Despite a much lower fertility of those mostly sandy soils, and despite much higher costs for conveying and distributing water far from the river, this policy aims to compensate for urbanisation of cultivable areas in the Old Lands.

A second, recently adopted strategy is geared to secure water and land resources outside the national borders, in order to add to existing food imports and the embedded virtual water to make up for the internal deficit.

The third and most important strategy however remains the further improvement of cultivable land and water use under the given conditions.

Recommendations from international cooperation projects include proposals for better matching water supply and demand through involving an effective water administration on one hand, and the agricultural water users on the other. Increasing water use efficiency in irrigated agriculture through incentives to grow water-efficient crops as well as limiting urban water demand through an appropriate demand management strategy (pricing and regulation) are well known recommendations, but difficult to implement. Acceptance of the constraints imposed by the limited natural resources of water and crop land has become even more difficult now that the recent revolution has raised enormous hopes for better living conditions for all categories of the population.

In this context, an overarching question remains: how to bridge the gap between the urban requirements of larger Cairo with an estimated population of 20 million people, with regard to fresh water and food, and the needs of the rural population to secure their own livelihood and to contribute to supplying urban markets with affordable agricultural produce. One answer might be to make huge investments for building wastewater treatment plants in sub-urban areas and linking them with collection and distribution networks in order to enable a safe re-use of treated waste water in agriculture.

In a rapidly urbanising world, the question of coping with the impact of cities, especially of mega-cities on land and water resources in their vicinity is gaining increased importance. Experiences made and strategies developed in Cairo may well be useful for urban centres elsewhere. At the same time, policies adopted in Egypt may consider the example of the capital of Jordan, Amman, which is approaching the final stage of such a development: the largest part of water for irrigated crop production in the Jordan valley consists of treated waste-water.

Urban Exploitation of Footprint Region's Water Resources – A Case Study in Perungavur Village, Chennai, India

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Keywords: peri-urban resources, urbanisation, occupational shift, PRA tools, SPSS software

Introduction/Problem Identification

Urbanisation, industrialisation, economic growths etc are the words which sounds good and pleasing to any developing country. But the curses which lie behind this big boon of development are many. Urban shadow region which is usually a peri-urban area neighboring the urban land becomes the prey for the urbanisation. The increasing urban demands can be met only with the rural resources, thus changing and exploiting it slowly. The sustainability of the peri-urban regions and their ecosystem is given least botheration compared to that in the cities. Though this shadowed region is beyond the city limit only a few kilometers away from it, the scenario which is prevalent there is never matching to the city. The problems identified were the occupational shift, less profit from agriculture, labour deficiency etc. The major problem is the depletion and degradation of the peri-urban water resources.

Analysis/Results and Implications for Policy and/or Research

The analysis was done in Perungavur village, 10 km from city outskirts. PRA (participatory rural appraisal) tools were used in this study to understand the social convention which prevails among the people of the shadowed region. Tools like social mapping, resource mapping, mobility mapping, cause and effect diagram, timeline, trend analysis, daily routine diagram and seasonality diagram gave the qualitative data of the Perungavur village and its people. The comments were studied using SPSS, statistical software in which qualitative data analysis can be done. The demographic and economic information in support of resource management initiatives were also collected. It was concluded that Village Resource management is needed to improve the livelihood of vulnerable groups in a sustainable manner through improved management of their resource base in a way that contributes to preservation and restoration of the environment. Capacity Building Activities, Economic Livelihood Activities, Income Earning for Poor Household People, Community based Biodiversity Conversion, Social Sector Activities, Village Road and Electrification, Rural Development, Mineral Resource Exploitation and Dairy Farming. The water marketing should be stopped by educating the importance of groundwater to the public. The ground water exploitation because of extraction should be explained to them using working models, diagrams and charts. The shadowed region should be brought to light with the cooperation of the people there.

Workshop 7: Urban Inequities: Service Delivery and Social Development

Conflicting Principles of Water and Sanitation Management in the Context of Rapid Urbanisation: Comparative Analysis of India, Brazil and South Africa

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Keywords: governance, conflict, India, Brazil, South Africa

Introduction/Problem Identification

In spite of their growing economic power, megacities around the developing world still struggle to provide their populace with basic services, such as water and sanitation (W&S). In this paper we situate these struggles in terms of the multiple (and often conflicting) framings of W&S with reference to economic, social, ecological, and human rights issues. The basic premise underlying this work is that understanding these conflicts is key to addressing not only the current problems in access but also the emergent risks and vulnerabilities – particularly in the context of climate change – and the opportunities for social learning and institutional innovations.

Analysis/Results and Implications for Policy and/or Research

Taking the case of three major megacities in the global South – Delhi, Johannesburg, and São Paulo – we use census data to first examine the spatial distribution of household access to W&S and its correlation with socio-economic, demographic, hydrologic, and bio-physical variables. Previous studies have looked at the issue of water and sanitation in isolation. Our integrated analysis reveals how access to these two services is correlated quite differently with the underlying socio-economic and demographic variables both within and across the cities in the study. The second part of the analysis uses spatial clustering techniques to identify hot spots where these problems with access to W&S converge. Interestingly, we find that these hot spots are also areas where conflicts arising from unmet human needs (such as inadequate housing), ecological threats, and economic constraints are particularly acute. The third part of the paper uses a cross-comparative approach to understand what these conflicts are, how these have been addressed (or not) through the formal and informal legal structures, policy instruments, and governance mechanisms at play in each context. The paper concludes with comparison of outcomes through the lens of human rights and sustainability, analysing the efficacy and generalisability of attempted solutions, mechanisms, and strategies across these contexts.

Water Provision under Border Conditions: The Case of Medellín, Colombia

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Keywords: periurban population, affordability, border conditions, human welfare, shared value

Introduction/Problem Identification

Peri-urban population of cities in developing countries living in poverty faces innumerable access problems, being affordability the most common. The lack of financial capacity to afford to a minimum water service allowance, and capacity to save in order to pay for it, and other conditions associated with poverty in these areas such as violence, unemployment, underemployment, urban displacement threaten the economic efforts to guarantee service access. In many third world cities, this population not only live under "border" economic conditions, but also under border social, legal, and institutional conditions. The paper shows the experience of the city of Medellín in Colombia, where the municipality in association with EPM, the water provider, are addressing the access problem to the poorest population, working in a human welfare model joining formal public policies of the municipality with EPM's corporate social responsibility policies to create shared value in population

Analysis/Results and Implications for Policy and/or Research

Utilities have a crucial role in the provision of public goods such as water, safe environment, and public health. This is the main reason why most of the times it is in the governments 'economic and social agenda. Developing countries face innumerable problems linked with service provision, mainly in the weakest segment of the population that is peri-urban population of cities living in poverty.

To address the access problem countries have implemented wrong. They have copied the developed countries model looking for their high standards of living. Due to social, economic, legal and culture conditions are different between developed and developing system, the model cannot be just transferred.

Colombia, as in the case of many Latin-American countries, has implemented different economic reforms to improve its living standards. In the utilities arena, this topic represented a paradigm shift on issues like private and state-owned companies, tariff structure and a new institutional framework. However, reality shows that this model does not cover whole population because our countries have different conditions that are not adaptable to the developed countries model. That's mean we have a model with economic, social and legal entry barriers and as a result we have an important percentage of people without guarantees. Those barriers exclude some people of the legal world. This is an invisible world where rights depend on the incomes.

This people living in poverty faces innumerable access problems related with the lack of financial capacity to afford to a minimum water service allowance, and to save in order to pay for it. This has been a crucial issue in the water sector in the developing world for years. In addition, experience shows that low or no income is not the only factor affecting the access to the service. Other conditions associated with poverty in these areas, such as violence, unemployment, and underemployment, urban displacement, and other concomitant factors, threatens the economic efforts to guarantee service access. In many third world cities, poor peri-urban population not only live under "border" economic conditions, entering and exiting to and from the formal world, but also under border social, legal, and institutional conditions.

These "border conditions" where the formal world ends and the informal one emerges, is characterised by population living with US$1 dollar a day or less, where there is no savings capacity and income is an intermittent privilege, that is also characterised by a weak or non state presence, favouring violence, and where informal administration of justice, security, and social benefits are most of the times self-guaranteed.

There are four issues why we think the current utility model in many developing countries should be reviewed: 1) there are two parallel worlds in service provision with different realities; 2) one of those looks like an invisible world for the legal system; 3) there are not an alternative model (maybe there should be no) for those who live under "border conditions" because rights depend on money; and as a result, 4) service provision model should be focused on a human welfare model. Let us develop a little bit this issues.

The Colombian model has been successful in achieving over 95% coverage in urban areas. The model work for consumers with i) a minimum level of income and no intermittent, ii) savings capacity to pay for the bill at the end of the providers' billing cycle, and iii) a financial scheme with service allowance. This model matches interests: quality service and fair prices for consumers and a reasonable return for enterprises.

However some people have problem to stay connected or access the service. There are many reasons related with poverty conditions. In fact they do not have service because they do not have money. This is the border for the two worlds where "cohabit" people who can pay the bill and those who not.

Under the Colombian law, utilities are pressured by regulation to disconnect consumers who do not pay their bills. They do not have a choice. The model excludes these people from the possibility of having service. Therefore they are invisible for the system. Population without financial capacity also lost any guarantees and allowances from the legal system. In other words, they lost the right to access because they live in what we call "border conditions".

Municipalities in association with utilities in the third world do have a role addressing the problems of provision of these services. EPM, the water provider, in Medellín, Colombia, has found a way to provide services across this border, in association with the municipality. We have a sort of self-regulation. We want to show the experience of our city in a human welfare model joining formal public policies of the municipality with EPM's corporate social responsibility policies to create shared value in the weakest segment of the population.

Project Reach – Reaching the Urban Poor with Water and Sanitation Services

Author: **Mr. Babatope Babalobi,** Bread Of Life Development Foundation, Nigeria

Keywords: urban poor, slums, public public partnerships, water and sanitation, small scale providers

Introduction/Problem Identification

The Bread of Life Development Foundation with the support of the European Union conducted a Water and Sanitation Poverty mapping in 20 f urban towns of Anambra state, South East Nigeria in 2010.

The background to the action including the following:

1. Generally, there is no Strategic framework in Anambra state South East Nigeria to deliver Water and Sanitation service to poor urban communities.
2. There is undefined interaction between Informal service providers and the Public WSS Utility leading to unregulated tariffs per pit/load for sanitation and for differing quantities for water.

The objective of the action was therefore to ensure more efficient service delivery by Informal service providers and facilitate partnerships between the Informal service providers partnerships and the Public WSS utilities agencies for better service delivery.

The study was conducted using various methods including, Census, Household surveys, and GIS applications.

Analysis/Results and Implications for Policy and/or Research

The overall access to WASH services in all the focus towns reveals the following:

1. On coverage by improved source of drinking water, out of a total of 1922 households surveyed, 1218 households have improved source of drinking water representing 63.40%.
2. Access to improved source of drinking water was also surveyed. Out of total number 5098 households surveyed, only 2970 households have access to improved source of drinking water. This figure represents 58.30%.
3. On Access to essential hand washing supplies, a total number of 3755 households were surveyed. The findings show that only 1767 households have access to essential hand washing supplies, representing just 47.00%.
4. The survey also investigated appropriate hand washing behaviour. A total number of 1161 households were surveyed, but only 322 households have appropriate hand washing behaviour, representing 27.70%.
5. The percentage of households that do water treatment is 64.40%. This because out of a total number of 576 households surveyed a total of 371 households use household water treatment.
6. The survey of household safe water storage revealed that out of 4,286 households investigated, 2,647 households have household safe water storage. This figure represents 61.80%.
7. The survey also investigated Availability of soap for hand washing. Out of a total number of 750 households surveyed, a total number of 453 households have soap for hand washing. This figure represents 62.10%.

Other major findings are:

1. There are wide disparities in the coverage and access to an Improved source of water supply in Urban towns in Anambra state. While some towns have good coverage, others have very poor coverage. This reveals that there is no planned development of water service provision in the state.
2. Coverage and use of an Improved toilet facility is generally poor in urban towns in the state. While Pour flush to pit followed by flush to septic tank remains the most popular toilet facilities, open defecation remains the mode of sanitation is some small towns like Omor in Ayamelum LGA. As a matter of fact, 16% of total households surveyed still practice open defecation.
3. Majority of households surveyed about 63% travel more than 200 metres to access water supply, meaning most of these citizens do not have physical access to water. The same percentage do not always have sufficient water to use for domestic purposes.
4. Lack of water supply and insufficient funds are the two greatest factors that hinder access to water in Urban slumss surveyed, though in few towns like Omor, distance to water points is considered as the main factor hindering access.
5. The Anambra State Government is not presently implementing any kind of WASH projects in most of the Urban towns in the state. 63% of the overall respondents affirm that there is no ongoing WASH projects in their communities.
6. Small Towns Water Supply programmes is yet to be implemented in all the towns surveyed. Almost all the respondents said that no Water Consumers Association exist in their towns.
7. Small Scale Suppliers of Water Services are more predominant and more unionised mainly in Urban towns as the survey shows that Water Vendors Association exists mainly in big urban towns of Onitsha, Awka, Ekwulobia and Nnewi.
8. Most water consumers 45% of people surveyed, spend more that N1000 monthly to access water supply. This is very peculiar to big towns of Onitsha, Ekwulobia and Nnewi. In Awka South, Anambra East and Abagana, water consumers surveyed spent less than N500 monthly to access water supply.
9. Most people in the focus towns spend a high percentage of their high income to access water. 38% of respondents say they spend between 25%-50% of their monthly income to access water supply, while 63% say they spend less than 25%.
10. Most of the people surveyed (40%) believe Government is best placed to solve their water and sanitation problems, while 27% believe the problem of water supply can be solved by the private sector (Truck drivers and Borehole water producers)

Recommendations from the Study for Anambra State Government

1. The government of Anambra States should declare a state of emergency in the Water sector and consider the provision of water supply and sanitation service its primary responsibility.
2. The Anambra State Government should adopt and implement the right to water in the state.
3. Efforts to revive the Anambra State Water Corporation to enable it deliver services efficiently should be step up.
4. The Ministry of Public Utilities, Water Resources and Community Development should facilitate the formation of Water Consumer Associations In the state.
5. Government should set up a regulatory body to regulate water tariffs by Small Scale providers.
6. Recommendations for Civil Society Organisations

CSOs should campaign for the implementation of the right to water in Anambra state.

Services and Supply Chains: The Role of Informal Water Vendors in Dar es Salaam

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Keywords: Tanzania, water, urban, informal, Dar es Salaam

Introduction/Problem Identification

This is one of three studies sponsored by UNDP examining the role of the domestic private sector in the delivery of urban water. Throughout sub-Saharan Africa many rely on informal water vendors, yet there is no common policy approach to this method of supply. Vendors are perceived as dynamic and competitive as well as collusive and exploitative. Largely in the informal sector, most exist beyond the scope of sector policy and formal regulation. This research set out to explore the nature of water entrepreneurs in Dar es Salaam and appropriate policy responses. We selected three areas of the city to incorporate diverse water supply systems ranging from a complete absence of utility infrastructure, to the existence of infrastructure with no bulk water and finally to an area with piped water but where many have intermittent supply or no connections. We conducted interviews with vendors along the supply chain from the bulk sources in each of three areas to mobile vendors to end-users.

Analysis/Results and Implications for Policy and/or Research

Dar es Salaam is rapidly urbanising and population growth has far outstripped the ability of the city's utility to provide sufficient water. Hence, most households rely on informal private vendors. Water vendors are a diverse group with activities ranging from selling jerry cans from a pushcart to managing piped networks with several houses and kiosks. Water is regarded as a business like any other by water vendors who respond with agility to the business opportunities presented by water scarcity. There seems to be plenty of demand to go round and many livelihoods depend on water. Yet, despite their significance, vendors rarely feature in water policy.

Our research explored the incremental tariffs along the water supply chains. The price of water from a connection to the utility network is US$0.59 per cubic metre. Water from an official utility kiosk is slightly higher at $1.38. Then costs go up with the introduction of links in the supply chain as well as transportation. Water from a truck vendor is around US$7 per cubic metre. The highest prices are paid by those who buy water by the jerry can from a mobile pushcart vendor, who may themselves have bought this from a truck or tanker vendor. These are the furthest from the piped network and they do not have capacity to store water delivered by tanker. These households pay the equivalent of around US$17 for a cubic metre. Thus, our research indicates that, water vending, as a system of delivery, is far from efficient, even if individual businesses operate efficiently. It is fragmented and operates at high cost. The system is extremely regressive as some low-income households can pay the highest price for water – sometimes 30 times as much as the price of water from a piped connection and this is for water of questionable quality.

In terms of coping strategies, we found that low-income households use different types of water for different uses. Water that is of drinking quality is used sparingly by households and alternative water sources, from boreholes or shallow wells, are used for washing and cleaning, where such alternatives are available. Thus, concepts such as 'affordability' are misleading because households have to cope with the high price of water but this does not mean that it is 'affordable.' Our research challenges conventional perceptions about methods of water access for poor households in the city. We found that utility water reached far further than the tap at which it is delivered via vendor supply chains (at high cost). Meanwhile conventional targeting methods such as kiosks were often not functioning. Furthermore, we found that households often pay a premium for water which does not classify as 'improved' under the MDGs (vendor water) rather than using a source that is considered safe (covered wells and boreholes) because the taste of vendor water is preferred.

There is a perception that water vendors make large profits. While water vending provided a reasonable income for many in poor communities, we found little indication that the people we met were making super profits. However, there were reports of some absent owners that had several water businesses in different parts of the city. Market concentration may lead to greater monopolistic strength and higher rent extraction. In addition there were suggestions of vested interests. Residents complained that some vendors seemed to have water flowing while the taps were dry in neighbouring households.

Water vendors present a policy conundrum. On one level they provide an essential service, without which many would not have water, and vending provides livelihoods in poor communities. But there is little positive that can be said about the system as a whole which is inefficient, fragmented, expensive and regressive. Sector policy has been focused on strengthening the performance of the utility while neglecting how people access water in reality. Policy intervention is urgently required to address the massive inequality emerging in the existing system. Immediate options fall under four headings:

- Regulation – although most activity is informal and efforts are price regulation have not been effective.
- Support for the private sector – this could include providing finance to strengthen piped networks and treatment for borehole water to make it drinkable.
- Support for community provision – this approach may provide water more cheaply than private vendors with less pressure for rent extraction. There are successes and failures here but research and mentoring could encourage positive outcomes.
- Compete with the private sector – the public utility, while not being able to provide a comprehensive piped network could maybe consider providing its own off-grid networks and transporting its own water.

Emerging Trends in Public-Private Partnerships in the Water and Sanitation Sector

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Keywords: financing, regulation, contract, stakeholder engagement, PPPs

Introduction/Problem Identification

This paper presents an overview of research undertaken by Building Partnerships for Development in Water and Sanitation (BPD) to understand emerging shifts in approaches to PPPs in the water and sanitation sector. The research is based on interviews with a range of professionals who are actively involved in the field and focuses on four areas: contracts, regulation, finance and stakeholder engagement.

Analysis/Results and Implications for Policy and/or Research

Over the last ten years, PPP contracts have shifted from high risk investments, such as concession contracts, to lower risk service and management contracts. These contracts are taking on new forms with a greater emphasis on performance targets and are being entered into by new players, for example with public utilities being contracted to work in other jurisdictions. Many lessons have been learned about how best to shape management contracts and affermage-lease contracts. The institutional arrangements that govern these contracts continue to evolve to meet political and institutional contexts. As the landscape of PPPs continues to shift rapidly, there will need to be continual reflection and sharing of experiences on how best to shape these contracts. Some have questioned whether this space (once led in particular by the World Bank) currently exists in the WS sectors.

Performance targets are evolving as a key focus of PPP contracts. While these hold much promise, lessons from other public service areas illustrate that meeting performance targets does not always guarantee improved service delivery. More research is required to understand how performance targets will shape delivery in the WS sector.

The political dimensions of the water sector continue to pose challenges to achieving cost recovery. The sector needs to develop innovative financing mechanisms that are suited to the blurred boundaries between public and private institutions. The financial crisis has necessitated a more urgent assessment of how the sector can secure additional investment.

Establishing sound regulation continues to be a major challenge for the sector. While many factors pose a challenge to regulation, such as political interference that keep tariffs low, the biggest challenge is obtaining accurate data that is needed to design performance-based contracts and which forms the basis for regulatory decisions. Establishing monitoring protocols, developing accurate baseline datasets and implementing appropriate IT systems to support this information should continue to be a priority for the sector.

Finally, stakeholder engagement is vitally important for effective WS service delivery. In the past, stakeholders have rightly demanded that private companies meet their promises to improve service delivery across all income groups. With the public sector dominating service delivery, there is a recognised need to develop tools that keep public institutions equally accountable.

The research outlines three new areas that are changing the PPP landscape: PPPs with local companies, PPPs in small towns and rural areas with communities more engaged in contract management, and private sector involvement in sanitation and wastewater treatment. Across the board, there is now a growing sense that the focus for delivery should be shifted towards understanding what works best within limited budgets. To achieve this, the sector needs to focus on gathering and communicating performance information and providing stakeholders with tools to keep all utilities (public, private and everything in between) more accountable to their service delivery promises.

Addressing Inequities in Port Au Prince, Haiti Watsan Recovery Programming through Government Capacity Building and Accountability to Beneficiaries

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Keywords: water, sanitaion, urban, partnership, Haiti

Introduction/Problem Identification

After the 2010 Haiti earthquake, equitable access to water and sanitation was significantly impacted by the displacement of more than one million people into makeshift IDP camps. The Red Cross Red Crescent Movement (Movement) has played a significant role in meeting the emergency water and sanitation service needs of this population. The primary watsan services being employed by the international community are trucking of drinking water and desluding of temporary latrines using vacuum trucks. The Movement is currently working to simultaneously build the service capacity of the government while ensuring that hundreds of thousands of the most vulnerable continue to receive equitable access to the water and sanitation that is their human right. Transition of service responsibility from emergency agencies to government is a common issue, but the scale of the Haiti emergency is unprecedented and the urban context presents both new challenges and an opportunity to learn for the future.

Analysis/Results and Implications for Policy and/or Research

Inequities in the levels of access by Haitians to water and sanitation services, which were already among the most severe in Latin America and the Caribbean, increased dramatically after the earthquake and came into full focus when a cholera outbreak began 10 months later. More than one year after the earthquake the Movement is, after the Haitian government, the largest service provider of water and sanitation in the country. The combined efforts of the Movement over the past 12 months has led to the provision of potable water to more than 315,000 people and sanitation services to an estimated 265,000 people on a daily basis. The current service levels of water and sanitation are not sustainable for a civil society group. However, the risk of disease and lack of dignity faced by a population whose government is not currently able to ensure equitable access to water and sanitation to all of citizens is too great to reduce service without a managed transition.

The Movement acts as an auxiliary to government, not a replacement. Nor is it a construction firm. The Movement is clearly not suited to undertaking the kind of large scale infrastructure projects necessary to provide the residents of Port au Prince with sustainable water and sewerage service. However, there is a role for civil society in these projects to ensure that governments receive the resources to provide equitable water and sanitation services and that the most vulnerable are heard and served while infrastructure is designed and built. Transition of service responsibility from non-profit agencies to government is a common issue in both acute emergencies and long term development. Yet the scale of the Haiti operation is unprecedented and the urban context presents an opportunity to learn for the future.

The Movement is currently working to simultaneously build the service capacity of the Direction Nationale de l'Eau Potable et de l'Assainissement (DINEPA) while ensuring the most vulnerable are included in plans to provide equitable access to the water and sanitation that is their human right. The Movement's DINEPA Capacity Building Project and the Accountability to Beneficiaries (A to B) programme can serve as a model for partnerships between civil society and government, even under the most challenging circumstances. These two facets play on the Movement's strengths as both a large international humanitarian network, with substantial resources to assist the Haitian government provide services better than before the earthquake, and the Haitian Red Cross Society's national network of thousands of volunteers that provide a direct link with the community.

First, the Movement is initiating the handover of water and sanitation service to government control through a multimillion dollar DINEPA Capacity Building Project. This partnership will allow Movement resources to improve DINEPA's capacity to provide assistance and support water and sanitation services. The partnership, taking the form of an MOU between DINEPA and the Movement, covers equipment (everything from trucks to uniforms), water kiosk repair, and training of DINEPA staff. The partnership is vital in ensuring the consistent provision of water and sanitation services as IDP populations move from camps to communities.

Second, as the Movement membership scales down and eventually ends emergency watsan services in IDP camps, it is also developing and executing a robust accountability to beneficiary (A to B) programme in IDP camps which effectively and transparently communicates the government and Movement's intentions with regard to current and future programmes and services. This programme is not limited to Watsan activities, but is integrated across sectors and Movement membership. Such a programme is necessary for a responsible scaling down of watsan services in camps in order to encourage a sense of ownership and to support beneficiary decision making. Key activities of the A to B Programme include determining dissemination and feedback mechanisms, developing communication plans based on watsan emergency and recovery plans of action, and training of community mobilisers. With significant numbers of volunteers at the grassroots level, the Haitian Red Cross has direct access to communities that governments and private firms often lack. This access improves the likelihood that water and sanitation infrastructure is put in place in a manner that considers the desires of a range of stakeholders, not only the most powerful.

The dual approach of building government service capacity and increasing accountability offers the opportunity for other governments, development agencies, and private industry to improve the quality and accountability of large and small scale water and sanitation infrastructure programmes in urban environments across the developing world.

Reinterpretation of Traditional Symbolism Associated with Water of River Yamuna Among the 'Shehri' Dhobis in City of Delhi

Author: **Mr. Vivek Chauhan**, University of Delhi, India

Keywords: river water, symbolic meanings, re-interpretation, negotiations, 'shehri dhobis'

Introduction/Problem Identification

'Shehri dhobi' is a caste group in the northern parts of India, engaged in their family occupation of washing clothes. In the city of Delhi, since many centuries they have been washing clothes along the bank of river Yamuna. They share the larger Hindu conceptualisation of the water and the river along with their own beliefs, folklores, and myths; something that is quite evident in their everyday life and identity of being a dhobi. Today these beliefs have been re-interpreted and negotiated from within the community to justify the changing external world, one of the many causes of which is unprecedented urbanisation of the city. The paper aims to describe these re-interpretation and negotiations of traditional symbolic and textual meanings of river water among 'shehri dhobis' in the city of Delhi. The paper is based on fieldwork carried out among dhobis of Minto Bridge, New Delhi during the summers of year 2009.

Analysis/Results and Implications for Policy and/or Research

Historically Delhi had seen several distinct wave of urbanisation and each of this urbanisation of the present city of Delhi can be attributed more to the political factors than to trade, religious pilgrimage or neighbourhood development. And the political will to settle a city in present region constituting Delhi had most of the time was guided by military, geographic and ecological advantage it offered to build a city. The rest of the occupations groups (castes) had always followed these decisions and have adapted themselves to the new processes by re-interpreting/ negotiating their traditional worldview.

Dhobis is one such occupation group that have followed the political will and decisions and got themselves settled along the bank of river Yamuna as part of their professional and personal lives. During my fieldwork I found that while they are open to the opportunities presented by the urbanisation like washing powder, cloth dryers and jobs, they value the ecology around the river and want control of pollution. I came across numerous instances where dhobis would recollect the purity and beningness of the river and its water, even when they have been relocated by the state to a new place (Minto bridge) far from the river. Their daily life is a pure reflection of the importance of water in their lives. Dhobis on an average work in water for 14 to 16 hours a day. At times they are knee deep in water and they continue to work in chilling winters of Delhi in the same manner. They believe strongly that they will never fall to cold, to which rest of the population is so susceptible because they have been blessed by the river goddess, their mother Yamuna. They attribute pollution to the human greed and failure of will to define the limits for rich and powerful. These constructs are different and more sustainable from the decision makers but have never been brought out.

Dhobis have also followed the direction of these waves of urbanisation, guided by their cultural definitions, symbols and meanings. In recent times their traditional symbols and meanings were first challenged by the state's ideology of water management and then by the pollution control schemes, in the name of which they were displaced and relocated far away from the river. The traditional symbols and meanings of river water were accordingly re-interpreted and negotiated within their community.

With time they had experienced the greed of bottled water industry and real estate developers who wanted the water and the river for themselves. They have been dealing through the 'sarkari' (governmental) machinery and their attitudes, along with the media's sponsored news clippings and cleanliness drives.

While each of these processes of urbanisation and/or development merits its own discourse, these people have faced them directly even when their own lives were undergoing major changes such as increase in conflict over access to river; loss of communal source of food and fresh water; dilution of identity; spread of chemical agents and diseases; disruption of their means of earning and global involvement on the 'river affairs'.

Such an understanding will help in providing an alternate viewpoint to the mainstream view of river water in the city. The study is a small attempt to bring the local knowledge, re-interpretations and negotiations that the urbanisation brings in the relationship of water and the communities. The findings in turn can be applied to generate participation at ground level and develop river centric policies.

Safe Water Campaign in Schools and the Community

Author: **Mr. Ronald Ddungu**, Gayaza High School, Uganda

Keywords: safe water, waterborne, affliction, sensiisation, aquasafe

Introduction/Problem Identification

In our community water is scarce and even the little that is available is unsafe and this has led to a high infant mortality rate and many people suffer from water related diseases in our communities like diarrhoea. Most schools and families get water directly from unclean sources and use it for drinking, washing hands and preparing food for children. Last year we embarked on a safe water sensitisation project in schools and the nearby community where we teach the teachers, students and the community members on how to harvest rain water and keep water safe for home use.We have adopted the method of treating water using the aqua safe tablet. We encourage Schools and the community members to treat water and to use this treated water for all the activities within a homestead and in schools to avoid related diseases. This will enable more children to have more school days utilised effectively.

Analysis/Results and Implications for Policy and/or Research

The status quo in schools and our homes is that children go without drinking water the whole day, wash hands and fruits with unclean water and in other cases drink the available dirty water when thirsty which causes them to suffer from all sorts of water borne diseases and leads to loss in school days. When children fall sick in a home, it is the mothers' duty to look after them at home or in the clinic causing loss of time that could otherwise be used for farming and other income generating activities. Boiling large amounts of water requires one to have enough firewood which is no longer possible due to the changing climate and also leads to substantial deforestation. Our aim is to sensitise the schools about the need to use safe water and empower the children to change the habits at home. In the community, our main focus is on women who look after the children and grandchildren. This helps the women not only to learn about how to get water but how to make it safe, thus reduced water borne diseases in the community.

As quoted by Uganda Health Marketing Group (UHMG) an NGO,Safe drinking water remains inaccessible for about 1.1 billion people in the world, and the hourly toll from biological contamination of drinking water is 400 deaths of children (below age 5). An estimated 1.6 million children under five die every year from simple diarrhea, a water-borne affliction that can be deadly to the young and poor.

Due to the growing population in Uganda and the poor disposal of waste, the available water sources have ceased to be safe. Schools try to provide safe drinking water but with the big numbers provision of such a service has become a challenge and many students are seen to drink the un-boiled water direct from the taps. This could be a source of all water borne diseases which will in turn affect the youth.

The community members point out that boiling water requires someone to have enough firewood in a homestead which is no longer possible due to the changing climate. Those who use charcoal say that it is very expensive and creates a lot of deforestation. In a rural home, women move long distances every morning in search of firewood and at times do not succeed. The money spent on buying fuel that would prepare safe drinking water for a home is exorbitant.

This sensitisation was first carried out in school where the students where educated on the importance of water and the dangers of using unsafe water. During the sensitisation, the girls were taught how to use a water tablet known as Aqua safe to treat water and make it safe for drinking and washing hands.

Later on we went to schools in the community to sensitise them about the need to drink clean and safe water and make use of the pupils to change the habits at home. In schools where the administration could not provide for a common point at which students could draw safe and clean water for drinking especially in the Universal primary schools, we provided a 120litre tank and aqua safe tablets for three months.

In the community, our main focus is on women and old women who look after their grandchildren. The students visit various homes to sensitise the women and also distribute a 20 litre water jerry-can to each home. They encourage the women to practice rain water harvesting and also use Aqua safe tablets in the treatment of water.

Below are the extracts of responses from the evaluation sessions with community members;

- The method of treating water using the Aqua safe tablet is convenient and easy to use.
- It cuts out the hassle of boiling large quantities of water for big families and hence saves time for mothers and grandmothers to do other house chores.
- The community members pointed out that boiling water requires someone to have enough firewood in a homestead which is no longer possible due to the changing climate. Those who use charcoal said that it is very expensive since the charcoal vendors say there is a lot of deforestation and wood is not available.
- One of the teachers in the neighbouring primary schools commented that the programme has helped the pupils a lot since now very few of them miss classes for they no longer suffer from simple diseases like headaches and other waterborne diseases. They are also more responsible for their lives since they can now go back home to educate their parents on the use of Aqua safe.

Modelling Sanitation Chaos? Sanitation System Decision Support Tool

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Keywords: system approach, sanitation, decision making tool, open source, paper and digital version

Introduction/Problem Identification

The selection of suitable sanitation options is a complex issue. There are many factors that influence the performance of each system. Sanitation suitable for use in low-income housing areas in developing countries is normally based on a combination of options specific to the local context. That makes it really difficult to develop an effective tool for decision-making. To date, decision support tools have failed to make a long-term impact on the choice for sanitation services in rural as well as urban and peri-urban settlements in developing countries. Most relate the choice of a sanitation option to one element (i.e. septic tank or pit latrine) rather than considering the sanitation system as a whole. Some lack transparency or are guided by personal choices and asumptions. Decision-models are generally complex to understand and use and sometimes seem inconsistent. There is a need for a practical support instrument to facilitate informed choice of sanitation systems.

Analysis/Results and Implications for Policy and/or Research

Many centralised treatment systems directly copied from western societies have failed or ended up to be unsustainable in the developing world environment. Most of them were abandoned due to high operation and maintenance costs (Van Lier, 1998). While most local engineers educated under western development programmes support the implementation of these systems, their lack of appropriateness is attributed to the disregard for the culture and traditions of the population, the characteristics of the land and the climate of the area where these technologies are intended to be used.

Moreover deficient data and knowledge available about the conditions of the slums, illegal settlements or highly dense peri-urban areas in developing countries impedes the proper implementation of any sanitation system. In the same line the lack of tools for urban planners to select appropriate sanitation technologies, compliant with the site-specific conditions, reinforce their over-reliance on conventional systems.

Since the 80's, comparative criteria on the appropriateness of sanitation systems have been developed in order to assess its suitability on diverse environments. Such criteria include land and water availability, groundwater table, terrain conditions, housing density, operating costs, institutional requirements, reuse potential, etc. Each sanitation system is limited by different factors and values. Several authors such as Franceys (1992) or Kalbermatten (1982) agree to the same common limitations, where mainly the physical conditions correspond to the layout of the settlement. Physical site conditions are regarded as relatively permanent and consistent, offering the basic frame from where to operate. However less constant factors as population size and density, the availability of reliable water supply and distance to formal services, also play an extremely important role in the choice for appropriate implementation of any sanitation system.

Two of the main factors for success of a decision support tool is the approach to produce knowledge from the data acquired in its frame and the way it is presented to the end users. (Engelen, 2000) In order to achieve the most favourable application, decision support tools should enhance a set of criteria such as transparency, interactivity and level of detail. Additionally experience in the design of decision support tools identifies the significance of the factors flexibility, user-friendliness and adaptability (Henderson 1985). In this way a list of 6 criteria has been established in order to assess the weaknesses and strengths of the decision support tool described in this paper. The selected criteria aim to illustrate the distinctive features of the structural design as well as the implications for its operation and end-users.

Evaluative criteria:

- User-friendliness: the ease with which the system can be used by its intended end-user (simplicity) (Engelen 2000).
- Transparency: the tractability of the results generated by the system as well as the documentation of the different tasks carried out by the system (Engelen 2000).
- Flexibility: the capability of incorporating user remarks, local knowledge and new information sensitive to the local context (RBA Centre, 2003).
- Versatility/Adaptability: the ability to address more than one problem or situation and applicability in different settings for different purposes (Cloete F. 2001).
- Interactivity: the ease with which the end-user can interact with the system. What tools are available to support the user in carrying out the analytical (Engelen 2000).
- Level of Detail: the level of completeness (Engelen 2000).

Service Delivery and Development: Let Us Not Forget Sanitation! A Brief Review of Innovative Approaches

Author: **Mr. Julien Eyrard**, Action Contre la Faim, France

Keywords: sanitation, urban poor, CLTS, new products, financial tool

Introduction/Problem Identification

Sanitation remains bellow water access in terms of funding, investments, infrastructures in most of the developing world's major cities. Urban poor and slums dwellers often have to pay a lot of money for bad sanitation services. People who can't afford services do not have access to sanitation and put themselves and the others at risk. The consequences are well known: Health impact, impaired development, economical consequences and environmental disasters. Sanitation must meet 3 components: technology, social mobilisation and financial tool. Amount of works and Investments in town are often seen as huge and therefore discouraging for most agencies. This may be true if we stick to the paradigm of the conventional sewer. But other solutions exist. This submission will focus on urban sanitation projects supported by ACF in Haiti, Sierra Leone and Mongolia. We will examine how it is feasible to promote innovative and environment friendly sanitation projects in urban areas.

Analysis/Results and Implications for Policy and/or Research

3 continents, 3 towns, 3 realities of the lack of sanitation: Les Gonaives, Freetown, Ulan Bator. The 3 cities have one common point: an uncontrolled growth due to rural to urban migration and a lack of planning for basic services access. The people have to manage sanitation themselves, with what they know and what they can access in terms of equipment, building materials etc. The result is most of the times not satisfactory in terms of environmental safety: latrines too close to a water point, cess pool without emptying facility, "flying toilets"… When NGO's, donors or governments realise the danger of the situation (if there is cholera or other disease outbreak), it is often difficult to construct a better system: investments are too high and there are a lot of objective difficulties such as narrow streets, quality of the soil etc. Priority is rather put in the extension of the water network, with semi centralised distribution solutions such as kiosks (Gonaives, Ulan Bator) or public tap stands. Such a solution is not feasible for sanitation: public toilets in urban areas are often not used by the people.

This brings our first question: the technical solution. To be accepted, used and maintained by users, toilets should be attractive, easy to use, to clean and to install. ACF have developed in Mongolia a new design of latrine with urine diversion and faeces collection in a bag that can easily be lift up with a small crane and a pick up truck. The faeces are treated in a composting plant (due to the cold weather it is not possible to do compost at home). This system is offering all guaranties in terms of safety and environment and is a good way to sanitise and reuse (for farming) human excreta. In various developing countries, private companies in the trade of plastic injection moulded sanitation are offering ranges of cheap, nice and attractive products for both on site and piped sanitation. Piped sanitation is not necessarily the paradigm; other options are to be considered and the project must include the sanitation chain, from the user's interface to the collection, transportation and final destination of the sludge in good environmental conditions.

The second point is the social aspect or social mobilisation. Working in urban areas often requires changes to the methodologies used by NGO's. A common pattern to the 3 cities is the level of knowledge / awareness people have regarding sanitation. This level of knowledge can easily be assessed by the “KAP” survey methodology. Another indicator is the coverage rate of latrines, which is sometimes quite high in urban areas: 75% in Gonaives (according to ACF survey), almost 95% in Ulan Bator… This coverage rate, however, should be taken with caution: to have a latrine doesn’t mean that this latrine is safe, properly used and emptied in good environmental conditions. A survey conducted by ACF in Freetown showed that among causes of the cholera where latrines built on the sloops of the hills surrounding the town, which were not waterproof and were leaking from the stone terraces were houses were built, bringing contamination down hill. People did the effort to construct latrines but these were not environmentally safe. This brings up the question of the community mobilisation and capacity building. To encourage people to build latrines is a starting point. To train latrines builders to do a better work is the next step. There are today several well known and proven methodologies, such as the Community Lead Total Sanitation, that can be used in urban areas. However, if it is possible in rural areas to let the user choose and construct himself its latrines, this may be more problematic in urban areas, for space constraints and environmental safety. CLTS in urban area is still possible, but should be supported by training the masons, traditional latrines builders (bayakou in Haiti) or the local sanitary inspectors of the MOH.

The third point is the financial tool. Once the user is convince that he should have a sanitation system, once the product (and the choice) is available, there should be a financial tool to help the user to access sanitation. Micro credit is done by ACF in Mongolia, in partnership with a local bank. Other solutions may exist, such as subsidised sales.

Sanitation in urban areas is often neglected and left beyond water access. Both should be linked and equally treated. Users are most of the time ready to pay to access water, but less prone to pay to access sanitation. The money collected for water access can also be used to support sanitation. What we would like to emphasis here is the necessary link between water and sanitation. The same methodologies, community mobilisation and work with local authorities as well as legal framework should be applied to water and sanitation. This idea may go without saying for most of us, but at grass root level, excreta management is still the poor relation of water and sanitation.

Providing Pro Poor Water Services in Urban Areas through Multi Partnership: The Streams of Knowledge Experience

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Keywords: pro poor, water provision, multi partnership, urban poor, WASH fund

Introduction/Problem Identification

Pangarap Village is an urban poor community in the Caloocan City with a population of 317,000. While the community is within the concession area of Maynilad Water Services, Inc, no water service can be provided due to case pending in court on land ownership. For the last 15 years, Pangarap Village has no access to piped water supply. As a result the community rely heavily on water vendors that comes as truckers who sell water at exorbitant prices. Water is sold and delivered to the households at US$3.3 per cubic meter. Given the price of water, an average households spends at least US$ 4.4.for their daily water needs. Hence, a substantial part of the household income is spent on water. This situation is common among poor urban and peri urban areas where the poor pay more for water than those who are connected to the system who pays only US$1 per cubic meter. Moreover, water quality is not assured which in turn may affect the health conditions of the poor urban consumers.

Analysis/Results and Implications for Policy and/or Research

In line with joint project of the Streams of Knowledge (STREAMS), a global coalition of water, sanitation and hygiened (WASH) resource centres engage in policy advocacy and capacity development and the UNDP-Public Private Partnership for Urban Environment, the Tubigan sa Pangarap (TSP) was developed and implemented as pilot project. It was to be a test case of a different mode of public-private partnership with STREAMS; the Maynilad Water Services (MAYNILAD), the water concessionnaires for West Zone covering the community; and the 2 urban poor barangays (181 and 182). Designed under the framework of public-private partnership, this multipartite partnership among the 3 entities was made possible through a Memorandum of Agreement (MOA) whose main objective was to help provide sustainable water supply to urban poor communties through a new mechanism involving public and private sector partnership. There were 2 sets of MOAs: one between Streams and Maynilad for the bulk water supply; and the other between STREAMS and the local government (barangays) for the provision of water supply.

Under the agreement of STREAMS with the concessionnaire, MAYNILAD is responsible for supplying bulk water and installed two bulk water meter connections in the community for free. This is the main investment of the concessionnaire. In addition, bulk water is provided to STREAMS under a special discounted rate for bulk water sales.

STREAMS in partnership with a small water service provider (SWPS), IWADCO, provided the intitial investment to put up the internal reticulation system in order to bring the water to the residents the community. STREAMS and IWADCO were also responsible for ensuring the water quality through the conduct of monthly water testing, the result of which is to be displayed in the community hall.

In turn, the 2 barangays who are the direct beneficiaries were not not only consumers but at the same time shared the responsibility in water distribution scheme. As consumers, a deposit amounting to USD 5 was required per household. To help in water distribution, a water coordinator is being designated who in turn will be responsible for providing water to at least 10 to 50 households.

S/he is also tasked to collect the payment on a daily basis and remit the same to STREAMS. From this, the water coordinator gets a percentage which serves as his compensation.

The agreement also provided that the community get a share in the income derived from the project in the form of the Barangay water, sanitation and hygiene (WASH) funds. The fund was intended to finance WASH projects of the 2 barangays.

In term of water regulatory arrangement, the Metropolitan Waterworks and Sewerage System (MWSS), in particular the Regulatory Office was the government entity that monitors compliance of Maynilad and STREAMS to the provisions of the Agreement. Similarly, the National Water Resource Board (NWRB) was given the responsibility to to regulate the agreement between STREAMS and the 2 barangays (the local government units), particularly water tariff setting ensuring that the pass on rate to the consumers is not only acceptable to the community but at the same time profitable to the small water service providers.

Three years after the start of the Tubigan sa Pangarap in April, 2008, the pilot project has successfully achieved the following: a) significantly lowered the cost of water in the community has been from US$ 3.3 per cubic meter to US$ 1.6; b) provision of WASH funds for the community which amounted to more than US$ 20,000 which was used to support water, sanitation and hygiene activities in the community; c) provided additional source of income to the 101 men and women water coordinators; d) provided a working and functional pro poor model of providing water to poor urban communities through a multi-partnership agreement among private and public partners; e) provided a basis for a regulatory framework that is appropriate to such as water service delivery mode.

Moreover, at present, the pro poor water service delivery model developed by STREAMS and its partners is now being replicated within the concession areas as way to help government meet its MDG committment on sustainable water. Cognisant of the role of small water service providers(SWSPs) in bridging water service delivery gaps, especially in urban and peri urban poor communities, the model has provided SWSPs a scheme to work in partnership with main water utilities and local government units and communities in providing affordable water.

Water as a Business: An Experiment in Malawi Goes to Scale

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Keywords: kiosk management, water board, cost recovery, water as a business, informal settlements

Introduction/Problem Identification

Malawi is one of fastest urbanising countries in Southern Africa experiencing an urbanisation rate of +5.2% per year. Blantyre City, situated in the southern region of the country, accounts for almost two-fifths of this migration trend.

The most visible impact of this phenomenon was the rapid manifestation of unplanned informal settlements within Blantyre. Despite the obvious pressure that these areas bring on social service structures, there were inappropriate policies to inform a coordinated response to such settlement developments. As such, the urbanisation increased rapidly (currently 7 in 10 people live in informal settlements) without the commensurate economic growth to absorb its effects or appropriate policy to regulate and manage it.

As a result, the quality of life in these areas, particularly water supply and sanitation, was dismal and even described as "worse than in rural areas" and dubbed "Malawi's Silent Crisis."

Analysis/Results and Implications for Policy and/or Research

In response to subsequent high frequencies of water-borne disease outbreaks during the 90s, the water utility company, Blantyre Water Board (BWB), in partnership with the Blantyre City Assembly (BCA), endeavoured to solve the water, sanitation and hygiene (WASH) problem in these informal settlements. Due to the informal nature of the settlements, in 1995, it was agreed that a more informal service provision arrangement was needed and thus kiosk management committees (KMC) became the chosen mechanism.

Though theoretically sound, KMCs were plagued for several years with major service disruptions due to reports of cronyism and financial mismanagement that resulted in bill arrears of over US$105,000 by April 2007. Such arrears were unsustainable for BWB to bear and, as such, the water kiosks were disconnected.

In response to this problem, the Water Users Association (WUA) was conceived to respond the challenges that the KMCs were facing and provide an alternative management model.

This paper will outline four years-worth of learning by Water For People (W4P), an international NGO that went into partnership with BWB and BCA to facilitate an improved kiosk management system. As part of a pilot in 2007, Nkolokoti-Kachere, an area situated in the eastern outskirts, was identified as the area where the WUA concept would be tested.

Before the pilot, the KMCs in the area had water bill arrears amounting to US$10,500 that still had to be repaid to BWB. It was established that the KMCs were facing several challenges that led to their financial situation.

Critical among these were:

- Poor Management Systems
- Political Interference
- Lack of 'real' community ownership
- Poor coordination and communication between BWB, BCA and KMCs

By focusing on knowledge sharing, mobilisation, advocacy, cost recovery, solid financial management, transparent staff hiring and training, the WUA was able to overcome a situation of intense corruption, disrepair, vandalism and near-total service disruption. By December 2010, the WUA had settled all the outstanding bills it had inherited from the KMCs and has never had supply disruptions for non-payment of bills. The WUA is currently operating 54 water kiosks, each generating average monthly revenues of US$152.00.

Through this improved management model the water kiosks are now servicing about 14,286 (92% of the total area population) extra people that were not receiving services before. Also the improved management has resulted in an increased number of water kiosks, which have lowered the kisok per person ration from 1: 493 in 2007 to 1:265 in 2010. There are also much fewer incidents of service disruption.

Based on the success of the Nkolokoti-Kachere WUA, the Malawi Government, with financing from European Investment Bank and European Union, has initiated a four-year Blantyre-wide water supply and sanitation project that will, among other things, replicate the WUA approach in its entirety. The model is being replicated in 21 low income areas of Blantyre and would potentially service an un-served population of 311,000.

This paper will explain the process of shifting the kiosk management model from a top-down approach to a sustainable, integrated, service delivery approach. In the new model the community would not only be trained, but would also earn an income from the WUA. In the old KMC system, communities were expected to work on voluntarily basis, while with the WUA system, if properly managed, community-employees would have monthly salaries. Thus the community was incentivised to manage the WUA effectively. As such, the WUA currently employs 80 people on full cost recovery basis. The WUA also carries out rehabilitation and maintenance works of its kiosks and ensures sanitation and hygiene around the water points.

Part of the success is attributable to ongoing and new approaches to monitoring and evaluation (M&E), which will also be explained in this paper and should have important implications for policy change and future research. As an example, organisationally W4P now commits to undertaking 10 years of M&E for all of its programmes using a tool called FLOW – the paper will also explain this tool and how it is influencing change amongst other water sector partners.

The Blantyre WUA model is an important case study of how critical the "software," such as building shared experience, finding the correct incentives and dealing head-on with political problems, is for the success and sustainability of water service delivery projects. It is also an important case study of how important the "Water as a Business" concept is for sustainability. The practical results that will be conveyed in this paper have the potential to guide and shape other attempts to ensure better management and improved sustainability of water service delivery systems.

M-Water – A Transformative Model for Urban Water Services

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Keywords: mobile communications, smart water systems, urban water services, social development, technology innovation

Introduction/Problem Identification

Inequities in urban water supply in developing regions reflect technical, institutional and financial under-performance which disproportionately prejudice the least advantaged. Global trends in population growth, climatic variability and economic development indicate water resources will be placed under unprecedented stress in coming years as competing demands for food production, ecosystem conservation and industrial expansion will be underpinned by population expansion, of which 90% is predicted to occur in urban areas. Urban water service delivery in developing regions has had decades of water rationing due to insufficient water service production. It is now recognised that this is a major factor in a spiral of decline resulting in disillusioned consumers, and an unwillingness to pay. Most prejudiced in this story are the urban poor and vulnerable who are excluded from network provision who pay higher volumetric and opportunity costs in securing water of dubious quality outside.

Analysis/Results and Implications for Policy and/or Research

A global literature review of innovations in the mobile communications and smart water metering sectors led to the identification of a suite of competing benefits to increase efficiency, equity and sustainability of urban water services. We tested eight competing hypotheses with 58 senior urban water sector professionals in Kenya and Zambia in 2010/11, including government ministries and departments, water service regulators, water service trust funds, water service providers, international donors, and practitioners. Our findings illustrate three key findings: a) all actors recognise and support the transformative role that mobile communications can harness for more sustainable urban water services, b) actors have significant levels of disagreement in the priority ranking of benefits, and c) improving water service coverage ranks below more efficient billing/payment systems and resource conservation. The qualitative and quantitative findings demonstrate that different actors in the governance of urban water systems will naturally focus on areas which coincide with their interests and expertise. Sub-optimal outcomes are likely as the potentially transformative potential of harnessing mobile payments and smart metering in tandem are unlikely to be realised without a coherent and compelling framework, which we label 'M-Water'. We set out the conditions for how M-Water will improve the financial and operational efficiency of urban water systems, ensure accountable and transparent governance systems, and incentivise water providers to target and include the urban poor in more innovative delivery models that are sustainable over time.

M-Water is the application of mobile technology innovations and smart water systems for sustainable water supplies. Mobile water payment systems and smart water metering are innovations which could be coupled in innovative ways to address core challenges of a) resource conservation, b) revenue efficiency, c) regulatory innovation, d) crowding-in investment, e) social inclusion, and f) system sustainability. With mobile coverage and handset ownership reaching the majority of urban residents, exciting opportunities exist to develop new and direct relationships between water service providers and water consumers, particularly the poor. Deploying smart metering and mobile banking solutions at scale could drive a step change in water sector accountability and transparency, thereby improving governance, reducing risk and creating a new business case for water sector investment.

Urban Development, Social Inequalities and Water Problems in Lima, Peru: Multiple Challenges to Improve Water Services in Latin American Metropolises

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Keywords: water governance, institutional reforms, Peru, public services, water scarcity

Introduction/Problem Identification

This paper discusses the failures of water services and the growing scarcity of water in Lima, capital of Peru. Institutional reforms and large-scale investments in the water sector in the city have been strongly influenced by wider economic adjustments and the reconfiguration of the national state. The modernisation of the water sector is described as a multifaceted phenomenon that depends on techno-environmental improvements, the marketisation of water management and the search for political legitimacy. The second part of our paper considers the relative basis of water scarcity and resource abundance. A condition of water scarcity goes beyond the physical insufficiency of resources and vividly contains the inadequacy of social institutions. Scarcity is never a single phenomenon but develops into unavoidably associations with other manifestations of shortage and deprivation. The multiple features of scarcity are not only interconnected, but are interdependent and mutually reinforcing.

Analysis/Results and Implications for Policy and/or Research

In the last century, Lima experienced one of the highest rates of population growth among the large metropolitan areas of the world. The city expanded from 645,000 inhabitants in 1940 to more than 8.5 million in 2009 (approximately 30% of the Peruvian population and almost half of the GDP). What happened here was not uncommon to other parts of the Latin American continent, but the negative consequences of such unanticipated growth were particularly severe in Lima. Only 32% of its terrain is suitable for urban and agriculture development, which nonetheless did not prevent the sprawl of new settlements over remote, sandy areas with limited access to water services (around 43% of the residents live in illegal or semi-illegal dwellings). If the growing deficit of water in Lima is not dramatically different than the other large metropolises, the availability of less than 100 m^3/hab/year (below the threshold of 500 m^3/hab/year) is an issue of serious concern. In 2010, water demand reached 25.5 m^3/s (above the average supply of 21 m^3/s) and is expected to rise to 28 m^3/s in 2015 and 34 m^3/s in 2030. Despite recent investments, the last assessment available (2007) shows still 8.5% of the population (around 720,000 inhabitants) depended on water lorries, 3.9% on public fountains and 4.3% extracted water from boreholes or watercourses. Water scarcity has been magnified by the widespread degradation of urban catchments due to mining activities, lack of sewage treatment and inadequate rubbish disposal.

Our intention here is to explore how the ongoing reforms and reinterpretation of the water problems of Lima has encapsulated those three converging vectors of the contemporary agenda of water governance. Water reforms and the geography of scarcity represented a privileged entry point into the kaleidoscopic interlinkages that constitute the socio-politics of the city. Based on three case study areas in Lima (Pachacútec, Huaycán and Villa El Salvador), the paper will examine the interconnection between investments, selective abundances and persistent scarcities. It will review why the inversion of money and technology in the water sector in the last two decades has failed to offer a solution to the metabolism of scarcity. Although the modernisation of water services has been based on fleeting investments and on the business-like management of the public utility and of alternative water systems (e.g. micro-credit schemes), the responses to water problems remain centred on the appropriation of scarcity as a key productive force. In the end, the material and symbolic production of scarcity in the Latin American metropolis continues to be predicated upon practices of spatial exclusion and social discrimination.

Overall, the complexity of the institutional reforms in Lima suggests that the metropolitan water sector has travelled a long journey since the introduction of a new regulatory apparatus and calls for environmental governance promoted by multilateral agencies in the 1990s. Successive programmes have included a discourse of public participation, environmental sustainability and even social justice, but also incorporated incentives for the circulation of capital and the maximisation of private profits. In that sense, the case study of Lima intensely exemplifies the growing sophistication of water reform strategies, but also represents a relevant illustration of the intricate urban policies adopted in recent years. Substantial sums of money have been invested in infrastructure and management – which has attracted more international operators than the company can actually handle – while much less attention has been dedicated to creating specific solutions to the concrete reality of water problems in different parts of Lima or to increasing the resilience of the water system.

Unfortunately, due to the symbolism attached to large-scale projects (under the banner 'without water there is no democracy' promoted by president Alan García), community-based, low-cost alternatives are largely disregarded as unfeasible.

The relation between the water utility and the population continues to be marked by selective channels of communication that ignore the specific demands and the organisation of local communities in the periphery of the metropolis. The prevailing confusion about the ultimate goals of the recent water reforms has affected the mobilisation capacity of low-income communities and weakened the leadership of protest groups. The insufficiencies and contradictions of the water governance initiatives are becoming increasingly more evident and the allocation and use of water in Lima remain highly contested. Genuine alternatives will require further efforts in terms of public engagement and shared decision-making, as well as reforms in urban policies and the promotion of a more equitable basis of national development.

Decentralised Service Delivery and Drinking Water Supply in Karnataka: Case of Manaul Scavenging in Select Towns and Cities (A Policy Perspective)

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Keywords: decentralisation, governance, manual scavenging, gender, water and sanitation

Introduction/Problem Identification

Decentralised planning and governance system was introduced in India through the 72nd, 73rd & 74th amendment of the constitution during the years 1988-1993. Such a shift from centralised approach was also expected to reduce corruption and elite capture. It was also considered useful to move from a "best practice" approach to a "good fit" approach. Water is the elixir of life, whether for ruralites or urbanites. It is indispensable for sanitation. Manual scevenging is still practiced in several towns and cities due to scarcity of water for drinking and domestic use. This is affecting the people engaged in cleaning toilets in urban areas. Women from these households are targeted to do the cleaning due to a patrairchal system in operation and class as cross-cutting issues the paper has the objective of looking into governance aspects of keeping urban areas clean. It makes a case for continued oppression of safai karmacharis in India who are untouched by legislation and modern technology.

Analysis/Results and Implications for Policy and/or Research

Policy-relevant knowledge on strategies to improve the access of poor and marginalised groups and women in towns and cities to sanitation facilities and potable drinking water is the issue here. This is more important considering that more than 33.3 per cent of elected representatives in urban local bodies are women and drawn from all strata of society such as the SC and ST population who are the most-oppressed and degraded, socially and economically.

The scavengers and sweepers in urban areas especially small towns and cities live in very poor condition and work on private-contractual basis, with no security of income or livelihood. They have poor working conditions and suffer from social stigma unparelleled. They all come from the lowest strata of society, formerly untouchables and socially ostracised, due to the polluting occupation they were forced to undertake. The analysis has shown that despite globalisation and allround development, their status continues to be very deplorable, receive paltry sums of not even quarter of a $ as wages, live in dilapidaed housing condition; women are workers in most cases as there is sub-letting of work by family male on females; they receive less wages and more workload, working conditions are devoid of any social security benefits for food security (food coupons, housing and sanitation. child labour is common among them. stratification along caste and class lines has led to intra community (of sweepers) exploitation and divisions.

As an after-effect of privatisation process, the work is now given to contractors who are further exploiting the workers. Paucity of water in towns to be used for sanitatin facilities by households has led to failure of flush toilets as alternative and it is common sight to see men women and children using open space for defacation. This again has led to much impurities to spread and contaminating water sources used for drinking and domestic purposes.

knowledge aobut governmental or constitutional provisions for their benefits is unknown to nearly 60 per cent of the respondents. there are agents amongst their own localities who provide them jobs, he lower the caste ranking is most unclen the work is: like cleaning drains and public toilets near bus and train stations, market and commercial places, hospitals etc is dumped on the most low caste among the sweeper community.

Now, the question is how is the living condition of sweepers and scavengers related to the issue of 'Water in an urbanising world? It is quite strongly linked as the efforts of the Indian government and of the states to provide adequate and good quality of water to its citizens in urban areas is thwarted by the situation where the ugly and disgusting practice of night soil carrying is continued for want of infrastructure for improvement. There is also the bias against improving the downtrodden by the upper castes and classes with in the downtrodden. Legislative measures have to come to have a limited impact. Younger generation in the families of these sweepers and scanvengers are lacking in better future; they are frustrated and are migrating to bigger cities to undertake wage labour. But the situation is not good there either since they are viewed with bias and do not get opportunities.

Public private partnership programme is one that has been successfully changing scenarios at least to a certain extent in some other respects. Here in this context, non-governmental organisations have been working with the affected community, encouraging women to join self-help groups. But the result is not attractive and satisfying since they lack steady income to pay for their own savings in the SHG. they are also discriminated against by upper castes, hence are forced to join homogenous groups. but the problem here is that they lack in effective performance due to poverty. Thus, bank linkage for higher credit facility is deprived to them.

Decentralisation is viewed as the alternative giving people choices to rule themselves as they know their own problems better. it is self rule. Dalit (oppressed group) assertion is working well in some cities and awareness created by the dalit organisations has empowered these workers. But they need to work in better conditions, protecting their own health; save childen from rag picking and send them to school.women have to be protected from dealing in filth by providing masks. there is a mass movement under way participated by right thinking citizens, members of voluntary agencies, youth and representatives of the affected group itself. There is interference by the National Human Rights Commission of India. alternative employment opportunities are mooted by a convergence of government department programmes. women are offered income generating occupations as alternatives but these lack strict forwad and backward linkages (raw material and market). Illiteracy of these people (women) is another major problem, that is being addressed.

What Kind of Water for What Kind of People? Inequities in the Water Supply in Greater Khartoum, Soudan

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Keywords: water supply, water quality, water management, supply inequity, Greater Khartoum

Introduction/Problem Identification

From 3 million inhabitants in 1993, the agglomeration of Khartoum has reached nearly 6 million inhabitants now (last census: 2008). The city receives each year large populations fleeing starvation in resource scarce areas and war zones, mainly from Darfur and South-Sudan. The newcomers settle in the periphery of Khartoum, the poorest zones, far from the waterworks which treat the Nile's water. Thus they don't have an option but to use groundwater, polluted by a sinking sewage system.

The Khartoum State Water Corporation (KSWC) has upgraded the treatment plants, the networks and the quality control processes of water in Khartoum since 2000, with a global investment plan exceeding 150 million Euros. Complaints about cuts and water quality however are still very numerous and water related diseases show no abatement.

Analysis/Results and Implications for Policy and/or Research

Our research, which is part of a larger Franco-German-Sudanese research project about water management in Khartoum (WAMAKHAIR), revealed that on the one hand there is a clear distinction between the centre and the peripheral areas with regard to water quantity, with much more accessibility in the rich centre; on the other hand, this spatial distinction does not occur at a qualitative level. The storage of water (to avoid scarcity during water cuts) and the distance from the waterworks or borehole is a more important factor than the social-economic level of the area.

Our presentation will focus on two pieces of research:

- An ongoing geography Ph-D study conducted by Laure Crombé about water management and identification of quantitative problems in Omdurman, the western part of Greater Khartoum, from the rich centre to the poorest peripheral areas. This study started as a Master thesis in 2009 from which some of our results are taken.
- A past study (2010) in geography about water quality in Greater Khartoum, conducted by Emilie Lavie. In order to test our hypothesis, two preliminary steps were carried out by the WAMAKHAIR research group:
    1. The description of the Khartoum waterscape at a municipal level, in order to see how water is distributed and to select the potential contamination points. Sociological descriptions of different neighbourhoods were also conducted at this stage, based on the 2008 census.
    2. The description with in-depth interviews of water usage within the households, focusing on where people store water, why, and for how long.

The last step was to link water management, water quantity and water quality, which, while not an original link to make, had not been done at a local level in Sudan.

Thus, we understood that most of qualitative problems were due to the inefficiency of the waterworks. The city is fed by 1,150,000 m^3 of drinking water, provinding each Khartoum inhabitant with 191 litres of drinking water per day, which is close, for example, to the European average and is grossly superior to the minimum requirement according to the WHO: 20 l/d./inhab. In spite of the fact that there is enough water to feed the whole agglomeration, the lack of structural organisation in the peripheral areas, including problems with the maintenance of infrastructure, causes quantitative losses into the network, which are estimated around 40%.

On the one hand the existing waterworks do not have the capacity to treat so much water. Therefore it is not well treated on the physical plan (turbidity). People do not have an option but to use private filtration and decantation methods, which increase the risk of bacteria developing.

On the other hand, the lack of maintenance of the networks obliges the population to store drinking water, which entails the same consequences at a bacteriological level.

Even though the Khartoum State Water Corporation is supposed to unify the water supply system and centralise water management, Khartoum's waterscape stays splintered and takes different forms according to the area and the population served. Diversity inside the same district or between neighbourhoods is obvious. Inside a same area, the ability of inhabitants to equip houses with pumps and tanks creates disparities in water access. It also increases the vulnerability of some households by disturbing the pressure and the availability of water in the common network.

At a smaller scale, since the 2000's, micro-networks have been built gradually in Khartoum peripheral areas. Those new networks supply drinking water to few habitations blocks and each one is connected to a specific borehole. This evolution in water systems could lead to improve integration as per KSWC standards. Currently differences persist in the ways of managing networks, in the price people pay for water (even if monthly rates exist), and moreover in the time it takes for networks to be built. Efficiency and quality of water system is also linked with the presence or lack of local stakeholders involved in water management.

Risks and Vulnerabilities of Water Scarcity in the Urban Environment: The Case of Curitiba, Brazil

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Keywords: Brazil, Curitiba, urban risk and vulnerability, water scarcity, urban water management

Introduction/Problem Identification

The urban expansion of Brazilian cities has been increasing this last century. This accelerated urbanisation diminished the quality of life of the inhabitants creating socio-environmental risks and vulnerabilities that entail complex and interdisciplinary management approach. Water is a fundamental, limited resource, crucial to sustaining life and development. Access to this resource in Brazilian medium- and large-size cities, like Curitiba, has become progressively more unstable because of modern societal demands that create risks and vulnerabilities in the water supply system. This paper analyses, in an interdisciplinary perspective, the causes of water scarcity, identifies the risks and vulnerabilities in the system and points out the most vulnerable and marginalised socioeconomic sectors of the population in Curitiba in this respect. The focus of the research was the year of 2006, when there was water rationing under a rotating water supply system amongst the different city zones.

Analysis/Results and Implications for Policy and/or Research

This work analysis was approached through an interdisciplinary perspective by examining the written local media and interviewing key informants from different social classes, work backgrounds and environments. The purpose was to explore the natural, socio-ecological, management and technological risks and vulnerabilities associated with water scarcity in the city of Curitiba, located in the southern Brazilian state of Paraná. Brazil´s National Water Policy and Paraná State water resources legislation were examined and analysed. The research identified that the most vulnerable inhabitants to water scarcity in the city of Curitiba were those who live in the suburban areas, the less wealthy classes, the poor. The wealthier classes have different means of fighting water scarcity with the use of water reservoirs located on the roofs of their dwellings, exploring water wells or even buying bottled water. The research pointed out that the major causes of water scarcity in Curitiba were the mismanagement of the water supply system, the lack of the capacity to preview droughts, to plan and build water reservoir with enough capacity that would be able to overcome critical water scarcity and the lack of land use policies that would prevent the illegal occupation of water reservoirs adjacent zones. New integrated urban water management approaches are suggested as alternatives for managing this indispensible resource and to ensure a sustainable and equitable water supply (in terms of both quantity and quality) for all of the city's inhabitants.

Provision of Water Services for the Urban Poor: Experience of Bhubaneswar City

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Keywords: Bhubaneswar, slum settlement, urban poor, Piyush (nectar), water works rule

Introduction/Problem Identification

Bhubaneswar, the capital city of Orissa, India has nearly one third of its population living in slums without access to water and sanitation. While this section of population is accounted for in planning of water and sanitation services, they remain excluded from provision of these services. High connection fees, complex and time consuming legal and procedural requirement, ineffective service and sometimes insecure land tenure act as barriers for access to water and sanitation. This violates fundamental right to equity. It is no surprise that majority slum dwellers did not have access to piped water supply network and two thirds of them defecate in open public space creating highly unsanitary conditions.

A pilot project was implemented in the city to improve access to water and sanitation services for the urban poor in partnership with a local NGO, the City and State Organisations with support from an International agency. The pilot project was intended to serve as a model.

Analysis/Results and Implications for Policy and/or Research

In the year 2001, Bhubaneswar had a population of 648,032 spread over 135 sq. km. out of which 58,485 people lived in 190 slum settlements. By 2008, the city's population grew to one million and 0.308 million people lived in slums. The number of slums increased to 377. The average number of households in a slum settlement is around 159. Only 63 slum settlements had access to piped water supply through public stand posts, supply being intermittent. 153 settlements depended on hand pumps tube wells and the remaining lacked reliable safe source of water. Only 4% of slum households were accessing drinking water supply inside the house. Only 18% of slum households had private toilet and 8% had access to community toilets. These suggest that more than two thirds of the slum population defecate in the open space. During 2006-07, the Capital Hospital reported 34,500 jaundice-positive cases, mostly from the slums. Between February and July 2008, there were 4084 reported cases of diarrohea, 2419 cases of gastroenteritis, 1340 cases of infectious hepatitis and 674 cases of typhoid among the people living in slum.

The city developed a "Slum Upgrading Strategy" and envisaged Bhubaneswar as "slum free" and "open defecation free city. The city's vision was documented in the City Development Plan. Three slums were selected for pilot and "Gyannagar", a slum located on the banks of Bindu Sagar pond with 83 households and 351 people was considered as a model. The selection criteria were based on existing access to basic services, poverty, land tenure, resident's willingness to invest in their homes/ community, proximity to heritage sites and need for integration of settlement with the urban services and nearby infrastructure networks.

The pilot study revealed that high water and sewer connection fees (Rs.3060 and Rs.1500 per connection) are unaffordable to poor even when there is land ownership and willingness to connect legally.

An unfriendly legal procedure, absence of comprehensive slum policy and strategy and lack of collective voice of the slum communities also inhibited service provision in slum areas.

The pilot was designed to provide legal water supply and sewer connections and individual household toilets to each house of the slum through a process of community mobilisation and access to credit. A slum profile was prepared for the first time in the city documenting area, location, population, land tenure, access to city utility services in GIS platform. Interactions with the community discussing the broad objectives of the project and proposed interventions were followed with formation and mobilisation of women's Self-Help Groups to mobilise resources for investment. Four such groups were formed in Gyannagar slum with 73 women members. The work of planning, designing and execution of infrastructure works outside the households were done with external funding. The on-plot work was the responsibility of each household and hence its full cost was covered by the concerned household. Some households paid this money upfront through their own savings. Since most households had not enough money saved to cover the full cost, arrangements were made to access loan from micro credit scheme. While the works were under construction, applications for water and sewer connections from the city networks for the intending households were facilitated by the NGO such as filling up of the forms, deposit of the applications along with required connection fees, clearance of land tenure issues and finally arranged to get the sanctions for individual legal connections as a group in one go. The households became proud customers liable to pay monthly user charges for the services received. The pilot thus put in place user charge repayment on the principle of 'willingness to pay' for good quality household level services among the poor households.

The State Government simplified the "Orissa Water Works Rules" which significantly helped in faster sanctions and quicker house connections. It introduced a scheme known as "Piyush" (meaning nectar). Some of the features of this simplification and scheme are:

- Elimination of rigorous paperwork,
- Decentralisation of power to sanction,
- Substitution of rigorous engineering drawings by simple hand sketches,
- Introduction of one-week timeframe for sanction of house connection applications, and
- "Piyush" aimed at reduction of connection fees for the urban poor to be paid in installments and reduction of monthly water tariff.

Each household in Gyannagar has at least one water tap inside the plot to collect safe and adequate drinking water from the city distribution network. Most households have an individual private toilet connected to the city sewerage system. Open defecation in the streets dropped from 90% to less than 20% within a year of work. The success was due to the effort of the pilot.

Innovative Techniques and Approaches for Water and Sanitation Services Improvement in Nairobi's Informal Settlements

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Keywords: innovative, poor, informal settlements, institutional strengthening, sustainable access

Introduction/Problem Identification

In Nairobi, 58% of the total households, mostly residing in informal settlements, obtain water from water kiosks, informal water delivery services, such as hand carts and illegal water connections. The inadequate physical planning of these areas coupled with the high population densities has resulted to low levels of access to public services including water and sanitation. Nearly two thirds of households (64 percent) dispose-off excreta through pit latrines which have to be emptied on a regular basis. By 2006, only 19 percent of Nairobi's informal settlements households had access to a supply of piped water, in the form of either an in-house water connection or a yard tap. The main limiting factors are poverty, lack of city wide physical planning and institutionalisation of initiatives, poor coordination amongst various infrastructure development activities, few scaled up sustainable solutions and innovative solutions to improve access in informal settlements.

Analysis/Results and Implications for Policy and/or Research

Using the lessons learnt in earlier worldwide initiatives an approach is currently being implemented which is based on innovative use of bottom-up citizen planning, developing partnerships with organisations, setting up of informal settlements units in utilities, use of GIS and Google for settlements mapping, leveraging infrastructure finance, social connections policies to support pro poor household connections, and promotion of the use of mobile telephone cash transfers for bills payment. The results of this approach are shared in this paper to demonstrate the need for policy formulation, institutional strengthening, innovative mapping techniques, mobilising funds and residents led implementation to providing suitable service delivery mechanisms for the urban poor.

Phase 1: Institutional Strengthening

A regional informal settlements policy was developed for the Athi Water Services Board (AWSB) in charge of assets development in Nairobi. The policy was aimed at institutionalisation of programmes with targets to increase access of water and sanitation services in informal settlements based on successful experiences in other countries using appropriate solutions. Following the adoption of the policy in AWSB, the Nairobi City Water and Sewerage Company (NCWSC) developed strategic guidelines for interventions in informal settlement through a consultative process with all stakeholders. The guidelines laid the guiding principles for affordable and reliable water and sanitation services focusing on community participation which saw the establishment of an informal settlements unit headed by a senior manager.

Phase 2: Projects development and implementation

In the second phase, under the leadership of the AWSB and NWSC, projects were developed building based on the GIS and Google household and infrastructure mapping activities with the informal settlements residents. The projects, now under implementation, are informed by the need to have a more systematic, coherent and strategic focus to improve WSS service to the informal settlements and to move beyond piecemeal efforts, while maximising long-term impact and ensuring efficient use of resources from development partners. The projects address both the supply and the demand side by improving and extending water supply and sanitation infrastructure on the one hand while reducing Non-Revenue Water (NRW), eliminating illegal/unauthorised connections and reducing leakages which contribute to water losses and affect water quality through contamination on the other hand.

Results

The results to date on ongoing projects financed by the EU Water Facility and World Bank are shown below as follows;

1. Financing for water and sanitation services in Nairobi for informal settlements totalling over 7 million US $
2. Contractual relationships between Water Utility and other partners working in the informal settlements
3. Better coordination through the establishment of the NGO co-ordination forum
4. Development of the social connection policy focusing on instalments repayment of connection fees and credit facility for the poor households promoting convenient payments using mobile telephones
5. Availability of baseline data in informal settlements and development of solutions using GIS and Google maps with the residents
6. Residents led construction of WSS infrastructure including over 20 kms of water and 20 kms sewerage reticulation, water vending points and latrines targeting over 50,000 residents

Recommendations

The results achieved to date support the hypothesis that a holistic approach is required supports the improvement of water and sanitation services in informal settlements. In the case of Nairobi informal settlements, use of innovative techniques and approaches, institutional capacity building of institutions responsible for services delivery, involvement of key stakeholders, scaled up financing, coordination of key actors and the involvement of residents has led to scaling up improved and sustainable access.

The Role of Communities in Water Provision and Distribution in Southeast Asian Cities: A Comparative Analysis of Kuala Lumpur-Jakarta-Manila

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Keywords: community participation, urban water management, Jakarta, Manila, Kuala Lumpur

Introduction/Problem Identification

The research evaluates the role of community participation in the provision and distribution of urban water in Jakarta, Manila and Kuala Lumpur conurbations, especially among the urban poor. Recent developments in these three countries have shown an increasingly proactive level of participation among community members in securing access to that important resource. The research analyses the scope and process of participation in these three cities as an attempt to measure its true impact and sustainability in ensuring consistent water supply.

Although the cities share common features such as privatisation and regular patterns of participation, each demonstrates different levels and types of community involvement due to unique socio-economic contexts. The paper thus identifies the social dynamics that drive community engagement based on the community's involvement and interaction with local and international non-government organisations, private concessionaires and policymakers.

Analysis/Results and Implications for Policy and/or Research

The constant cycle of inequity in the provision of basic services such as water in urban areas has resulted in an inter-play of actors from various backgrounds, both formal and informal, each with diverse agenda and vested interests. The challenge lies in reconciling these interests to form cohesive partnerships that will result in improved service delivery and ultimately meaningful change. Participation from the community has often been cited by many local and international non-governmental organisations as a critical tool in addressing this.

The participatory activities in urban water provision and distribution could span from collaboration, negotiation, to confrontation. These patterns define the relationship of three broadly categorised actors in water provision: the government or the public sector, the corporation or the private sector, and the people or the community.

However, there is a need to understand the real implication of participation as a catalyst for policy change and ultimately service improvement. Participation is widely considered as empowering, but its process also 'upsets' the existing status quo and more often than not creates tension/conflict among various actors before a resolution can be reached. There is also the question of whether the participatory process is truly representative as it could be dominated by a few privileged actors/parties as opposed to the wider section of the community. As such, the research attempts to identify various models of community engagement in Asian cities by addressing the scope, extent and types of participation that include indicators such as sense of ownership, direct and indirect outcomes and the sustainability of the participatory process and its results.

In most cities, an increased level of participation is usually triggered by conflict with existing or proposed policies, and is understandably more prevalent among the marginalised with immediate concerns and needs. Despite all three cities having experienced privatisation of water in the past decade, they all demonstrate different approaches to the models of community engagement. While the private sector actively engages the urban poor in Manila, it is the local and international non-government organisations (NGOs) who play an active role fostering participation in Jakarta. On the other hand, although Kuala Lumpur shares the common feature of local NGOs being the initiators in the participatory process, recent changes in regulatory framework have also become an indirect incentive/motivation for the people to actively participate in the resolution of their water woes. For example, a new regulation for residential high-rise apartments mandates that a committee of residents (instead of the developer) be appointed to manage the maintenance of their building (including water connections). However the extent of participation this regulatory amendment encourages is debatable, especially among the low to middle income high-rise residents who face long-standing water disputes due to shared/bulk meters.

But the majority of training and advocacy for improved services continue to lie with the NGOs, as the concessionaires and the government/policymakers are more often than not hard-pressed for resources such as manpower and time, in addition to lacking the necessary expertise and relationship with the community. The level of cooperation and trust among NGOs, government and corporations also differ among the three cities, thus resulting in different participatory approaches. In both Manila and Jakarta, the idea of community participation in water provision and distribution for the poor is more readily accepted by the government and the private sector, whereas in Kuala Lumpur the very same concept endures a certain level of hostility especially when NGOs are involved.

Another key feature of a participatory approach witnessed in these three cities is the long-term empowerment of the community, which potentially contributes to societal development as a larger whole. The skills and confidence obtained from knowledge of one's rights and abilities enhances both the community and the individual's capacity to understand their circumstances and to question policies that affect their lives. This in turn drives communities towards constant self-improvement, and subsequently stronger capacities in seeking not only improved access to basic services such as water, but also in demanding equitable progress in other areas of concern such as health and education. Furthermore, the adoption of community-based, participatory approaches by the private sector in those cities have also shown that social capital and market capital can contribute to each other's existence in a feedback loop. However, the next major issue would then be the challenge of institutionalising participation as a mandatory/natural element or foundation of policies because presently, participation usually happens as and when situations arise.

Human Values – Based Integrated Education for a New Water Ethic: Factors that Can Impact Service Delivery and Social Development

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Keywords: cognitive affective teaching, education in human values, integrated approach, social development, problem solving approach

Introduction/Problem Identification

Rapid urbanisation has impacted issues regarding health, politics, technological advancement and human rights at various levels. Past literature depicts that water issues are interconnected and complex. Values-based Water Education, an important initiative, is part of the United Nations Human Settlements Program and The Asian Development Bank's support to the Asia Pacific region in the development of a new water ethic for water governance in cities. According to UNHABITAT "children and youth could be the best ambassadors to bring about these attitudinal changes" (2003.p.3). This study presents a brief overview of the success of education in human values for character development in academic settings and then elaborates on the use of the Human Values Integrated Instructional Model (HVIIM) for a new water ethic in many parts of Southeast Asia. This study reports on the impact of education in human values on a small sample of students and teachers in Thailand for social development.

Analysis/Results and Implications for Policy and/or Research

The study presents three important aspects that can have a transformational impact on future students' social development and service delivery skills.

The first part reviews studies of education in the human values programme through documentary analysis for both social development and development of skills in learners for service delivery. Documentary analysis revealed that education in the human values programme has had moderate success in the implementation of education in human values in students for positive attitudes and social development. The results of the review of studies reveals that in order for students to develop a positive attitude for building citizenship skills teachers have to include and adapt novel skills in their teaching methods. The changes have to be both at policy as well as curricular level. The studies also highlight the importance of community participation in the social process of the students.

The second part of the study analyses the impact of the Human Values Integrated Instructional Model. Analysis of sixteen teachers' beliefs regarding the principles of HVIIM (cooperative learning, educare and role modelling) have shown that teachers' beliefs and perceptions of the impact of the HVIIM depends on the cultural and contextual settings for developing a new water ethic. This study reports teachers' narratives of the use of HVIIM in multicultural settings and how they view the impact of HVWSHE on students' attitudes and behaviours. The mixed method used here is based on Teddlie and Tashakkori's strategies to explore teachers' beliefs and perceptions. Data analysis used both qualitative and quantitative strategies. The results highlight that a student centred teaching approach is needed to impact education for a new water ethic and further research has to be done using longitudinal studies. The success of the HVIIM depends on teachers' conceptual understanding of the HVWSHE. The study further highlights the advantages and disadvantages in using the HVIIM in academic settings. The results of the study of HVWSHE show five emerging factors that can impact students' development of positive attitudes for a new water ethic. They are the teaching pedagogies teachers use for development of intangible aspects such as raising awareness through human values in classroom settings, constructivist teaching approaches, cognitive affective teaching, role modelling and educare (integrating and eliciting human values from lessons). Secondly the study reports of the impact of HVIIM on tangible aspects such as problem solving issues and collaborative skill development in the form of teacher narratives. The study concludes with further recommendations for policy changes for creating a new water ethic through teacher training for professional development, support groups of teacher modelling for novice teachers, and the introduction of HVWSHE in new settings. The third section of the study reports a general review of studies of environmental education related within a broader framework. This section reports the need for a new water literacy for producing a new water ethic which will require curricular changes that incorporate skills to network for future collaborative settings, the use of problem solving approaches for serving delivery, a recognition of the significance of local knowledge and awareness of ethical issues that arise in both urban and rural areas.

Inclusion of Low Income Urban Community for Improved Water Supply Facilities – A Sri Lankan Case Study

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Keywords: improved water supply, urban poor participation, cost of water, public awareness, pro-poor public service

Introduction/Problem Identification

The urban poor in Sri-Lanka face severe hardships because they lack convenient access to efficient water supply services. To solve this pathetic issue in a sustainable manner, the Government of Sri-Lanka has embarked on a significant urban water supply sector reform programme and invited all the government and non government organisation as placing high sense of beneficiary involvement in decision making at all stage of sub project implementation. Lack of funds to improve the WS systems, water rights and competition in water use and exclusion of low income group from the water scheme were resulted to unsatisfactory performance in technical, financial and management of the urban WS systems. Hence, these water supply systems are not being managed to meet the aspiration of low income people and as a result significant percentage of urban poor community have dropped from the service delivery in urban water schemes

Analysis/Results and Implications for Policy and/or Research

AKURANA is a town hamlet in the Greater Kandy Urban Water Supply Project (GKWSP) which drinking water is scarce and the majority of communities have faced severe hardship. Existence of poverty was very significant in the area and infrastructure facilities have been extremely poor. As considering this issue, the GKWSP has stepped into this area to provide drinking water facilities. Even though, the project has arranged the maximum facility to provide pipe water for all houses and commercial centres in the area, still 35% of registered house holders do not have any interest to obtain the drinking water supply facilities. This issue was assessed and observed on public opinion for community reluctance to obtain water supply connection for their houses. It was revealed that poverty is the most significant factor for this community reluctance and people are more concerned on the cost of water rather than its availability. To avoid this unfavourable situation, National Water Supply and Drainage Board (NWSDB) has suggested that beneficiary community involvement to be strengthened and specific assistance to be granted at the all phases of delivery in pro-poor public services.

How urban poor get in to the benefit?

Why do urban poor communities not get access to services? Consultations with a broad range of stakeholders in GKWSP resulted in the identification of obstacles to improving service to the poor. These obstacles have been grouped under five proposed action areas as follows:

- Give the poor a voice. Create sense of ownership through community consultation
- Eliminate administrative and legal barriers. Land ownership and tenure issues often create a barrier to the provision of service to the poor. The poor may be unaware of administrative and legal requirements, or find it difficult to understand them and comply.
- Strengthen capacity, autonomy, and accountability of service providers and provide incentives to serve the poor. Public service providers sometimes lack the autonomy, as well as financial and human resources and incentives required to provide services to the urban poor.

- Adopt appropriate financial policies. Poor households find it difficult to pay connection fees upfront and also difficult to pay monthly bills.
- Perform well established community based public awareness campaign as promotion tool for community interest.

Strategy application

- Create a sense of ownership through community consultation
  Community Consultation is one of the important actions in promoting urban poor participation regarding their public opinion on aspects such as scheme implementation, its need, consumer affordability and willingness to pay for improved water supply.
- Promotion of unskilled labour and reduction of construction cost
  The potential consumers could be mobilised to provide voluntary unskilled labour for the laying and backfilling of pipes and to provide skilled labour for the construction activities. Such contributions will reduce the construction cost of the schemes and also create a sense of ownership of the scheme and subsequently act as partners of the schemes rather than service receivers.
- Easy payment and moderate price for water connection
  General practice in city water supply was to select the most developed areas of the city to provide facilities while excluding poor and low-income groups to meet the high demand for piped water. Some poor families were left out due to their inability to find cash to pay connection fees or unbearable cost of the plumbing involved in their housing units or high water tariff. Hence, it was recommended to introduce an appropriate mechanism for poor people to participate and offer their unskilled labour and ensure their inclusion into project benefits. The remunerations rewarded for urban poor HHs are;
  - Installment based easy payment for house connections
  - Low interest credit facility for house connections
  - Reduction of given labour dates from the connection charge.
- Applies a rising block tariff
  Applies a rising block tariff in which the unit charge increases as the user's consumption increases. This tariff structure has two objectives: to cross-subsidies small consumers (presumed to be poor) from large consumers, and to reduce wastage of water

Results and conclusion

Application of proposed actions and effective awareness have brought significant improvement in usage of pipe water and recent studies highlighted that 95% of urban poor in the AKURANA town hamlet has been benefitted through the pro-poor public service delivered by the National Water supply and Drainage Board.

Actions recommended practical and tactical strategies for overcoming obstacles to improving water supply services for the urban poor but, in many cases, overcoming the obstacles will require more than tactical strategies. It will require changes in policies or legislation, or their implementation.

Lessons for Regulators, Utilities and Citizens in Promoting Accountability and the Human Right to Safe Urban Water and Sanitation Services

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Keywords: regulation, accountability, feedback, water, poor

Introduction/Problem Identification

Before year 2000 Kenya's water sector was characterised by deficiencies in the management of water and sanitation services leading to growing discontent of water users in both rural and urban areas. The management of water services was vested in the Ministry of Water and Irrigation, often leading to conflicts in roles between policy, service delivery and Regulation. To stem the discontent from deteriorating services, the government commenced on sector reforms culminating in the Water Act of 2002, which separated roles, decentralised responsibilities and provided for increased stakeholder participation in the management of services. One of the new institutions created by the Act was the Water Services Regulatory Board (WASREB). This paper describes an initiative undertaken by WASREB to change to orientation of utilities, improve accountability to consumers, facilitate citizen engagement, enhance monitoring of services especially for the urban poor.

Analysis/Results and Implications for Policy and/or Research

Consumer protection is a primary mandate of infrastructure regulators; feedback is a crucial element for those tasked to monitor and enforce standards that directly affect consumers. In 2007 a Citizen Report Card led by civil society organisations highlighted important citizen concerns regarding low provider responsiveness and information, and priorities regarding the quality and quantity of services being accessed, especially by the poor. A significant recommendation was that citizens desired increased face to face interaction with their providers.

WASREB in response to this and the new National Water and Sanitation Sector Strategy held a brainstorming meeting to develop a feedback concept. This was followed by stakeholder training on accountability mechanisms. The outcome of this was an action research concept note and Terms of Reference for 'Water and Sanitation Action Groups,' or WAGS in short, which was piloted in the cities of Kisumu, Kakamega, Mombasa and Nairobi from 2010 – 2011 in partnership with utilities, boards, WSP Africa and GIZ. The objective of the action research project was to (i) establish how to ensure regular and targeted feedback from citizens to water service utilities(ii) provide a means for citizen dialogue and participation around planned and ongoing investment projects (iii) improve customer orientation and accountability to consumers by institutions implementing the reforms (iv) structure consumer input into regulatory decision making in addition to their existing tools. The methodology adopted for the action research was based on partnership (citizen representatives and civil society + utility providers + WSBs and WASREB); action learning (adjusting methodology as partners reflect on what works), and process documentation (requiring all partners to reflect on and record their experiences through multiple communication channels from the beginning). Tools used for action learning included consumer complaints forms, focus group discussions within communities, public forums and hearings and scheduled meetings between citizen representatives (WAGs), utilities, boards and WASREB.

The action research demonstrated that structured feedback from consumers has a strong impact on the pace and focus of sector reforms and can dramatically influence public perception of the sector. From June to November 2010, WAG team members handled 405 consumer complaints. This averages out at 67 cases each month in each pilot city. Many of these were complaints of an enduring nature that had lasted for more than three months. Such consumer complaints ranged from issues of billing and metering, bursts and leakages (both sewerage and water), illegal connections, dilapidated or absent infrastructure, poor workmanship on installations, open manholes and vandalism, overcharging, corruption, quality of service and conflicts between consumers.

About 63% of the complaints handled by WAGs were resolved to the satisfaction of consumers between March 2010 to November 2010 although it is noted that percentages differed from city to city with Kakamega at 39%; Nairobi 73%; Mombasa 75.4% and Kisumu 84%. The data gathered by WAGs through this process gave an overview of the dominant concerns of consumers and allowed assessment of the degree to which these were matched by the utility and board responses. The WAGs Pilot has supported progress towards the attainment of performance standards; for example, referencing of complaints has improved in all four pilot areas at different rates with Kisumu WAGs reporting almost 100% referencing. Cumulatively, thousands of community members were reached through the public forums convened by WAG teams under this pilot process providing opportunities for raised awareness of the implication of sector reforms. Despite progress, challenges remain, both at administrative and programmatic levels which are the current focus of attention during the scale up and institutionalisation phase. Initial suspicion, resistance to change and even hostility to the WAGs initiative from sector staff was experienced. Processing the feedback was time consuming for the citizen WAG volunteers, leading to recommendations to adopt an electronic solution. The paper will highlight the key lessons learnt and innovations introduced to ensure that more citizens in the country benefit from the strengthened regulatory oversight which the WAG initiative offers.

Equitable Access to Water: Opportunities and Constraints in Urban India

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Keywords: equity, water access, urban water, India, gender

Introduction/Problem Identification

Equity in access to water is a significant problem in urban India. Different kinds of settlements are supplied water in accordance with certain standards based on differential living standards. While these standards may not truly reflect the water needs of different segments, what is alarming is that even these stratified standards fail to be met, the worst to suffer being the marginalised communities. An in-depth study was carried out in the capital city of Delhi where the standard needs are estimated to range between 130 lpcd (litres per capita per day) and 200 lpcd. Accordingly, the water supply targets range between 225 lpcd for all planned colonies and 50 lpcd for slum clusters. However, in reality, while 5-star hotels and top politicians' residences consume several thousands of litres per day, the slum clusters remain in a state of perpetual water crisis. What drives this inequity and what are the opportunities and constraints for ensuring greater equity in water supply?

Analysis/Results and Implications for Policy and/or Research

1. Nature of the problem

Almost 3/4th of the city's 16 million population is estimated to be marginalised, distributed in >1100 slum clusters, 1500 unauthorised colonies, 52 resettlement colonies and 216 urban villages. These are largely the ones that face water crisis on a day-to-day basis. Most of these settlements are not served by pipelines managed by the 'Delhi Jal Board' (DJB) that is also responsible for supplying water on a daily basis to the unconnected areas through >1200 tankers. However, these water tankers come to the marginalised colonies only once or twice a week without any regular time schedule, and when they do, these allotted domestic consumers have to buy the water. Rest of the time, the tanker water is illegally sold out to hotels, guest houses, and other non-domestic consumers at higher prices.

In some of the resettlement and unauthorised colonies, public tapstands have been provided especially for drinking water, but the supply at these tapstands is extremely erratic. The residents have installed their own shallow handpumps for other domestic uses, but due to the erratic drinking water supply, they are also forced to use the groundwater for drinking. The groundwater in the areas close to the Yamuna riverbed is unsafe, and the residents have to either spend much on medical treatment or procure potable water from other sources, often at a good price.

On the whole, inadequate and irregular water supply brings great hardships to the people, especially women and children, who have to either waste several hours waiting for the water or resort to buying 'unsafe' water from alternate sources. In turn, this thwarts their economic well-being and development, hampers education of children, and adversely affects everyone's health.

2. Opportunities

In response to the lacunae of the water supply system faced by the marginalised urban communities of Delhi, a number of alternate water supply systems have been developed, which however, fall outside the legalised framework. In some areas, water mafias have stepped in to rescue people from their woes: by laying down their own pipelines and supplying groundwater directly into households from their illegal borewells, for which a regular fee is charged.

In some other areas, the water supply business is run through private tankers that illegally draw water either from the DJB water-filling points or from illegal borewells and supply to the needy public at a good price. A third option is opened by those indulging in bottled water business, which in many cases is run through illegal units. These units sell large cans of supposedly safe water at cheaper prices to the residents of the marginalised urban settlements. At a number of places, the residents have organised themselves into pressure groups that have successfully brought new water supply alternatives to their colonies.

3. Constraints

The opportunities available for addressing the deficiencies in the water supply system of Delhi from equity perspective suffer from some significant constraints. On the one hand is the physical constraint of a dangerously low water table which makes the option of water provision using groundwater clearly unsustainable. Due to high rate of groundwater withdrawal and low recharge rates, Delhi is fast becoming water-scarce and this makes the borewells run dry especially in the dry season. On the other hand is the resultant mandatory requirement for any individual or agency to seek a formal permission from the Central Groundwater Board before sinking a borewell. All private agencies that provide different water supply options to the marginalised urban residents undoubtedly flout this rule. Also, since these options have been privately developed on a large scale without any sanction from concerned authorities and these indulge in large-scale profit-making business without any accountability, the legality is put to further question. Further, the bottled water entrepreneurs do not fulfill the basic water treatment requirements and run illegal units. The challenge lies in initiating all these hitherto unauthorised private water service providers to meaningfully contribute to equitable, just, accountable and sustainable water supply provision in the city.

Implications for policy

Given the limitations of DJB in supplying water equitably to all users across Delhi,working together with the hitherto unauthorised private water suppliers provides a viable option. These can be brought into the legal fold through development of public-private partnerships at the local level.While on the one hand, this would help reduce corruption at various levels, on the other hand this would promote improved quality of services and enable some control over prices which largely becomes unaffordable for the economically weaker marginalised urban communities.These should be adequately regulated and made more accountable through promotion of public supervision by residents'/users' groups.

Mapping Poverty for Determining Urban Equities

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Keywords: poverty mapping, investments in poverty pockets, situational analysis (PPSA), inter poverty pocket disparity, basic infrastructure deficie

Introduction/Problem Identification

The poor do not live only in slums. Poverty pockets may as well be in other parts of the city. This paper is based on a study for mapping poverty in four million plus cities of India with the purpose of determining citywide deficiencies in basic urban services. The Poverty Mapping exercise/study was to develop an approach and take necessary actions with regard to the environmental sanitation with the following two objectives in view:

Citywide integrated environmental sanitation and waste management programmes, including need based lowcost sewerage and on-site sanitation, aiming at improved health and hygiene behaviour change.

An initial assessments of the sanitation situation was undertaken that was further followed by an implementation of demonstration pilots for scaling up to city wide programmes;

Mapping the urban poor in its entirety, generating high quality GIS maps and development of a city specific pro-poor water and sanitation governance strategy.

Analysis/Results and Implications for Policy and/or Research

Mapping Poverty for Determining Urban Equities

A base line situational analysis was carried out with a view to develop the base line indicators. Quantitative and Qualitative tools were used to get an objective idea of the situation in various poverty pockets/slums. Household Questionnaires were administered across all the households of the selected slums, along with Focus Group Discussions.

The Poverty Mapping exercise in these four cities of India was carried out with the objective of taking a Slums Environmental Sanitation Initiative (SESI). Poverty Pocket Situation Analysis (PPSA) was carried out with the purpose of developing a strategy for Pro Poor Water and Sanitation Governance in the State of Madhya Pradesh for contributing to attain the Millennium Development Goals (MDGs) on water and sanitation and slum upgrading with a special focus on the urban poor.

An analysis of the Poverty Pockets Mapping in the four cities has given an overview of the scenario in Poverty Pockets relating to (i) Below Poverty Line Households (ii) Status of Water Availability (iii) Status of Sanitation (iv) Status of Drainage and Water Logging Status in Poverty Pockets (v) Status of Grey Water and Solid Waste Disposal (vi) Status of Roads, Street Lights and Community Activity Areas (vii) Status of Schools and Public Health Centre Service.

The Poverty Mapping has also highlighted the (a) Inter Poverty Pocket Disparity Status (b) Categorisation of Poverty Pockets on MAPP parameters and (c) Categorisation of Poverty Pockets on MDG parameters. The major findings of these poverty mapping exercises relate to (1) Basic Infrastructure: Road, Electricity, School, Anganwadi, Baalwadi and Health Centres, Community Activity Area (2)

Availability of Water in the Poverty Pockets (3) Sanitation: Access and Availability (4) Water and Sanitation in Schools and (5) Sanitary Condition of Poverty Pockets particularly relating to Solid Waste and Waste Water Disposal.

The paper presents the findings of the baseline situational analysis. It provides an in depth analysis as well as a larger picture of the existing water and sanitation infrastructure. It also has been able to identify the gaps in the infrastructure.

The paper highlights the extremely poor access to sanitation infrastructure, low levels of access to piped water systems, the lack of an institutional platform for the poor to participate and low levels of governance and the negativities of lack of basic minimum water and sanitation facilities, being borne largely by the women and young children. It reinforces the fact that any interventions in the poverty pockets and slums have to take into consideration all these factors, to develop a comprehensive people centred plan.

The paper underscores the need for base line surveys for situational analysis that may prove to be a guide to stakeholders in improving the existing water and sanitation infrastructure in the poverty pockets and slums. It highlights the extremely poor access to sanitation infrastructure, low levels of access to piped water systems, lack of institutional platform for the poor to participate and low levels of governance. It underscores the need for mapping poverty for determining urban inequities and for improving the existing infrastructure deficiencies in the poverty pockets and slums. Poverty mapping also assists the city administration in undertaking participatory planning exercises that meet the needs of the urban poor and focus on sustained improvements in effective and efficient management of water supply, sanitation, garbage collection, and disposal, through city level infrastructure development.

As a result of these findings of the Poverty Mapping in four cities, namely, Bhopal, Indore, Gwalior and Jabalpur, a pilot Slums Environmental Sanitation Initiative (SESI) in the slums and other poverty pockets of the four cities was executed. This has demonstrated an integrated approach to environmental sanitation, waste management, low-cost sewerage and/or on-site sanitation, for improved change in health and hygiene behaviour.

Urban Growth and Related Problems in Managing Water Distribution Systems and Services in Major Serbian Cities

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Keywords: urban growth, urban waters, Serbian cities, uncontrolled urbanisation, new planners required

Introduction/Problem Identification

Rapid urban growth in Serbia is primarily recognisable in several largest cities such as state capitol Belgrade, provincial capitol Novi Sad and regional centre Nis. Uncontrolled building of houses and apartments for newcomers from rural areas, or refugees arrived from neighbor countries (involved in civil wars in nineties of the last century), immediately provoked problems in urban water sector such as lowering the pressure in distribution networks, frequent failures and collapses of water services, increase of pollution, etc. New situation requires a new profile of urban water planners educated and skilled to act flexibly and to understand on-going societal and economic movements, but with a vision of how to convert mostly undesired processes of urban development into harmonic urban growth for benefit of all.

Analysis/Results and Implications for Policy and/or Research

The need for better urban management is becoming more intense. More than half of the world's population now lives in cities, which is an effect of the massive urban growth in developing countries, including Serbia. Several largest cities in Serbia (national capitol Belgrade, Provincial capitol Novi Sad and regional centre Nis) grew by 7.6 percent between 1990 and 2010, more than fifteen times the rate of growth in wealthier global regions in the world. This is primarily due to civil wars in Balkan region and huge replacement of Serbs (primarily) from neighbor countries and provinces, societal changes from socialism to capitalism, and more recently economic crisis worldwide.

Rapid urbanisation and growth of these cities is not easy to absorb because new residents need proper transport, decent housing, and access to water and sanitation services. This directly produces larger pollution, traffic congestion, various conflicts between people searching for a job, and to certain extent spreading of slums produced by refugees on city fringes. Urbanisation is in many ways uncontrolled, there is corruption and the whole process is under strong influence of various lobbies such as an association of constructors or builders. Direct consequences are lowering pressure in water distribution systems, failures of facilities, and difficulties to motivate population to participate in actions aimed to bring benefits for all.

A need for interventions by urban planners is rapidly growing, and their actions are required in numerous occasions. These include infrastructure dealing with access to water, sewage and transports; efforts addressing issues related to housing, urban mobility, public space organisation and urban patrimony; programmes entailing assistance to local authorities concerning public service delivery or space management; and institutional communication with regional and state authorities (such as national water directorate).

Urban development paradigm has been changed in many instances and a need for modern urban planners in Serbia is obvious. Relations between newcomers and ‘old’ residents require flexible and open-minded planners, capable to combine their multidisciplinary knowledge with an ability to adapt to different contexts, cope with politicised pressures and to be able to encompass elements of changing urban sociology. On larger scale, new planners must be versatile professionals ready to respond to complex challenges, manage ‘multidimensional growth’ and improve cities by offering solutions to the economic, social, environmental and mobility issues faced by the urbanisation, and especially water related services essential for peoples living.

One of the most urgent tasks for city planners in Serbia is resolving inequities in urban basic service provision, damaged or outdated facilities, and poorly organized and inadequate taxation of large water consumers and polluters. For example, water purification facilities require permanent maintenance and renovation on regular temporal basis and the provision of funds to meet these requirements is left to the responsibility of the low-income families representing majority of city population. Faced with decreasing family incomes due to economic crisis, and in the same time decreasing quality of drinking water, frequent failures of service and permanent increase of water costs, citisens are aware of this situation which directly affects their health and finances, and expect actions of local authorities to improve the situation.

In this paper we present results of on-going research on identifying real priorities in urban planning for major Serbian cities, primarily related to improvements in water distribution systems infrastructure, provision of stable services, and fair costing and taxation of urban consumers (with emphasis on justified balance between small and large consumers).

Urban Water Supply in India: Responsibility of Urban Local Bodies in Providing Equitable Service Delivery and Social Development

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Keywords: urban water supply, urban local bodies, equity in service delivery, public private partnership, social development

Introduction/Problem Identification

India has large number of urban population. The demand for water is increasing every day in urban areas. The Municipalities and Corporations are the urban local bodies and play the role of service providers. The Per Capita demand for water in urban area is estimated from 250 to 300 litres. The urban populations reside in towns, cities and Metropolitan areas. Majority of the population reside in urban slums. In urban areas the people are discriminated on the ground of class and status. The poor who live in urban slums are mostly denied of basic infrastructure facilities; one among them is drinking water. The class disparity results in inequality and becomes hindrance to social development. Thus the local bodies play must play crucial role in providing equitable water supply to the urban population by re-framing polices and guidelines, public Private Partnership and Community participation.

Analysis/Results and Implications for Policy and/or Research

The class disparity among the urban population results in unreliable access to safe water supply. Moreover, the drinking water is supplied through lorry and pipeline to the urban population. Most of the time the water is wasted due to leakages in the service systems and gets contaminated due to rusts in the pipes. Poor become victims of water borne diseases. The rich and elite can afford to find their own arrangements at their house hold level. They can install deep tube wells, booster pumps, reverse osmosis, ion-exchange plant in their places. On the contrast the poor who live in urban slums cannot afford such a high cost of installation, moreover they are forced to purchase mineral water which is very costly for them. And there are some who cannot have the purchasing power drink the unsafe water. But water is priced same for both the rich and poor. This leads to social tensions in the urban areas. Lack of purchase power loses the identity of urban poor and becomes threat to human dignity. To overcome such issues the service providers i.e. the local bodies can change their role to facilitator by enhancing the community participation through capacity building programmes. The concept of Public Private Partnership would pave way to ensure equitable and reliable water supply to the deserving population and that in turn leads to social development. Social development is described as the process of organising human energies and activities at higher levels to achieve greater results. The concept of Public Private Partnership may be emphasised through social work intervention methods to achieve the goal of social development. The Social Workers provide interventions to individuals, groups and communities in order to assist them with their needs and issues. Interventions are intended to aid the deserving population of the society to discover better ways to develop organisational mechanisms and to apply them in alleviating problems impeding their well-being.

Bringing Tenants into the Equation for Attainment of Improved Sanitation in Urban Slum Communities: The Case of Kampala Slums, Uganda

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Keywords: tenants, improved sanitation, urban slums, Kampala, Uganda

Introduction/Problem Identification

Inadequate access to safe and clean water, improved sanitation facilities and good domestic and personal hygiene continue to create socio-economic and health problems to millions of urban dwellers living in informal settlements. While Sub-Saharan Africa tops the annual growth in slum communities, so are the increases in sanitation related diseases. For meaningful changes in improved sanitation to occur in slums, tenants ought to take a centre stage too in influencing demand and prioritisation for improved sanitation and hygiene practices.

In line with the workshop theme 7 (Urban inequities; service delivery and social development), tenants could be a force in creating change through communicative demand and building social networks among themselves to have a strong voice not only in demanding social services, but also ensuring adherence to good sanitation and hygiene practices. Most slum dwellers for example share latrine/toilet facilities for those who have access.

Analysis/Results and Implications for Policy and/or Research

In this paper, we will share findings from a baseline study conducted in 50 randomly selected urban slum zones in Kampala. This study was conducted between October and November 2010. A total of 1500 household respondents were interviewed. Currently we are still analysing the data. Urban slums constitute over 60 percent of the over all population in Kampala city. The focus of this paper will analyse the role of tenants in influencing attainment of improved sanitation and hygiene in slums and provide lessons on how to get them more involved for significant impact to be achieved. Findings from this study will inform my intervenes too as it is part of my PhD project on user driven sanitation in urban slum communities. The findings are hoped to contribute to the on going international debates and researches to finding lasting solutions to sanitation and hygiene challenge in urban slums.

Opportunities and Strategies for Promoting Better Service and Social Development in the Urban Systems – A Sri Lankan Experience

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Keywords: opportunities, strategies, complementarities, service prowiders, formal sector

Introduction/Problem Identification

This poster illustrates, how current inequities in urban basic service provision affect urban areas after natural purification and filtration of a river was disrupted during dry seasons. The impact of poor facilities, interrupted service for drinking and sanitation, poor families face serious risks with the non potable water due to high content of bacteria results in disease outbreaks. There are many opportunities for forging closer links between the formal and informal service providers by promoting partnership and dialogue, and positive motivation changes for interventions, regarding their responsibilities for the reduction of the inequities that exist to effectively channel urban development in a positive way. Better information is essential to enable proper planning of infrastructure provision, ensuring interventions targeted to the most needy, where the well functioning institutional arrangements will facilitate smooth, effective, fair production and distribution system.

Analysis/Results and Implications for Policy and/or Research

The aim of this poster is to illustrate in general, how current inequities in urban basic service provision affect Ambalantota urban area after natural purification and filtration of Walawe River was disrupted during dry seasons. The impact of poor facilities, interrupted service for drinking and sanitation, poor families faces serious risks with the water provided by the municipal system is non potable due to high content of bacteria in unsafe water, results in disease outbreaks which have significant impacts on economic and social development. Study says, there are many opportunities for forging closer links between the formal and informal service providers by promoting improved partnership and dialogue between them and positive motivation changes for interventions, regarding their responsibilities for the reduction of the inequities that exist to effectively channel urban development in a positive way. Better information on urban inequities is essential to enable proper planning of infrastructure provision, ensuring interventions targeted to the most needy, where the well functioning institutional arrangements with the stakeholder participation will facilitate smooth, effective, fair production and distribution system to the whole municipal area.

Introduction This paper is the reflection of the author after being involved in the water sector comparative study of the middle scale town development joint project funded by the Southern IRDP and the Muslim Commercial Bank. The project aims to form the basis for an overdue reform of the water sector where the low-income groups often pay more than the rich for services. The MCB finances the recovery and extension of water supply in ten middle sized towns. Advised the National Authority with their structural reform plans and improvements in their management capacities by providing financial resources for technically advanced infrastructure development. With the major investment in safe drinking water and improved sanitation, district values indicates that access to safe drinking water in the walawe basin ranges 73 to 83 percent.

Ambalantota small urban area is the main city of the Ridiyagama Land Settlement Project. Basic drinking water supply is provided by the river purification complex. According to the Ministry of

Agriculture approximately 0.5 billion m^3 per year of drainage water from agricultural fields, about 60 million m^3 per year of industrial effluents, and 43 million m^3 per year of urban sewage are being discharged into the river in 2008. In the dry season in the river lost its natural services and become a health hazard and aesthetic nuisance. The study says that better information is essential to enable proper planning of infrastructure provision and a comprehensive environmental impact study should carried out prior to the implementation of such plans. After the study the project initiated river restoration project (WRP) under the River Authority. The project was implemented by the MCB, executed by the local Municipality, with the coordination of Ministries associated with the river basin development, in collaboration with NGOs. The project is promoting people centered river system to ensure the protection of watershed providing good quality fresh water for the livelihoods and environment. They executed water safety plans, addressing land-based pollution issues with coherent at all levels. Promoted partnership and dialogue between them and positive motivation changes for interventions, regarding their responsibilities for the reduction of the inequities that exist to effectively channel urban development in a positive way.

Improvements in management capacities and the financial resources they could initiate technically advanced infrastructure development, for cost-effective delivery of water, sanitation and other basic services. These also address other difficult urban development issues, related to small town planning, slum upgrading, drainage system rehabilitation.

Positive motivation changes for interventions, regarding their responsibilities for the reduction of the inequities and interrupted service through many awareness and workshops and training camps mainly for most needy people, directly results in reducing the disease outbreaks which have significant impacts on economic and social development. According to the UNDPHD Report 2008, with this programmes and water resource development has helped reduced poverty levels recently.

The urban management system sanctioned their policies and decisions by introducing new well functioning institutional arrangements (Peoples Water Councils) with the stakeholder participation, through NGOs and CBOs, in order to facilitate smooth, effective, fair production and distribution system to the whole municipal area. These PWC were contributed to improving basic service provision. The net result is improved social cohesion, livelihood development.

GIS as a Tool in Improving the Quality of Life through CLUP and CBMS

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Keywords: comprehensive land use plan, geographic information system, poverty diagnosis, publice service delivery, improved quality of life

Introduction/Problem Identification

With the rapid increase in population, urbanisation, and industrialisation there is a reduced quality of Philippine waters, especially in densely populated areas and regions of industrial and agricultural activities.In order to regulate the use of the land, the Local Government Units should prepare their Comprehensive Land Use Plans (CLUP) to direct and manage the growth and harmonise the use of land and water. However, majority of the CLUPs needs to be Updated.

To implement the CLUP, corresponding programmes and projects should be targeted and prioritised to realise the goals and objectives. Therefore, the need to know the location of the target population is crucial in order to ensure the success of said projects. A good information system is a good tool for prioritising where the very limited resources of the LGUs shall be directed. Although there is a dearth of data in the LGUs, they claim that they have no technical capacity on how and when to use these data.

Analysis/Results and Implications for Policy and/or Research

GIS Technology in combination with other tools can facilitate the preparation of the CLUPs and determining target beneficiaries to prioritise in implementing the programmes and projects. It is likewise a useful tool to improve the provision of efficient service delivery.

Applications of GIS technology:

1. A Geographic Information System is a good tool for preparing the Comprehensive Land Use Plan of municipalities. GIS is likewise used to determine where the suitable areas are for locating communities in safe places. The areas suitable for future urban development based on the set conditions can be generated by overlaying the geohazard maps. This can be called risk sensitive land use planning. With an approved CLUP, municipalities are able to harmonise the different land uses and to be able to plan for the direction of growth for the urban areas.
2. The use of a Geographic information system is a useful tool to determine the location of areas with no access to safe water. In combination with the Community Based Monitoring System, this identifies the households who have no access to safe water and those who are poor. By overlaying these information: households who have no access to safe water and the barangay basemap, you can identify the priority barangays which needs to be provided with the basic services:
    - There is a need for reliable updated baseline data
    - CBMS is a planning tool for annual investment programming
    - Tool for Poverty diagnosis
    - It is an appropriate LGU intervention to address poverty because you know the location of the poor people to prioritise
    - Used for planning

- Good tool for implementation of poverty alleviation and intervention.
- It strengthens linkages with civil society

3. Safe access to water is closely linked to Health. Unhealthy population induces inequality. Thus, it is important that the LGUs be able to deliver the basic service of providing safe water to those with no access.

An Example of how an private company (Manila Water) improved efficiency in providing water through the Use of GIS:

The use of GIS was used by one of the concessioners to provide an improved and efficient service. The use of GIS made it possible to expand service coverage, improve service delivery and increase operating efficiency.

By using GIS, Manila Water, one of the private concessionaire, was able to increase the supply from 26% to 99%, and reduce the water loss from 63% to 11%.

The water loss is attributed to the leaks in the pipes. GIS was used to map out the location of leaks by digitising the areas and coming up with the map, thus making the repairs or installation of new pipes efficient.

Currently underway is the use of GIS to map out the service customers. Each customer has a unique identification number. When a complaint is filed, the account number is asked and linked to the exact location of customer in the map. In this manner it makes it more efficient to address the complaint of the customers and repair the leaks which contributes to the water loss.

Workshop 8: Regulatory and Social Contexts for Institutional

Water Supply and Institutional Changes in Ukraine: Recent Experience and Perspectives

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Keywords: water sector reform, institutional strengthening, river basin, water resources, water environment

Introduction/Problem Identification

Discussed in the paper are measures taken in Ukraine on creation of river basin authorities which is viewed as one of the principal tasks of water sector reform in Ukraine. It includes – carrying out a number of measure, including, at the first stage (2006-2009) – reorganisation of management structure, including creation of new river basin authorities; development and implementation of pilot projects for economical and practical elaboration of the water resource management model based on the basin principle. At the second stage (2010-2012) it is envisaged to elaborate the set of legislation and regulations regulating implementation of the basin principle in Ukraine. Third stage (2013-2015) – completion phase – creation of legislative base and new institutional structures of river basin management, realisation water policy in accordance with integrated approaches to water resources management and the EU requirements.

Analysis/Results and Implications for Policy and/or Research

Ukraine is a country with limited water resources and they are unevenly distributed throughout its territory. The quality of water in most surface water bodies is assessed as catastrophic, although about 80% of drinking water supply comes from the surface sources. There exists an excessive anthropogenic pressure on catchment areas of the most rivers of the country. Therefore, there is undoable an urgent need for certain changes in management of water resources of the country, including changes of formal and non-formal institutions.

Today in Ukraine one can find a number of factors confirming the process of transformation of water sector and they include: changes in water-related legislative and regulatory framework; redistribution of administrative functions between executive bodies concerning issues of water resources management, creation of new executive bodies dealing with management of water resources on river basin principle, establishment of structures responsible for the reproduction of water resources, development targeted programmes for reconstruction and upgrading of water supply networks, implementation of environmental monitoring etc.

Water Code of Ukraine and the Law “On the State programme of development of water resources” stipulated the need to shift the water resources management practices to the principle of river basin water resources management. Accordingly, created in Ukraine are 6 river basin authorities – RBAs (Western Bug, Dnipro, Dniester-Prut, South Bug, Seversky Donetsk, and Crimea). The main purpose of RBAs is not only to improve general water quality, but also to improve ecological condition of these river basins as a whole. Formally, the principle of river basin water management was introduced in 2005, but during the first stages of introduction of the river basin principle of water resources management in Ukraine relevant activities were initiated and carried out under the framework of the international projects that were not always quite successful. The primary task of RBAs is to coordinate and control activities of different stakeholders, and to provide an overall management of water resources use and protection activities in the relevant river basin.

Some changes in the activity of the RBAs are currently taking place in a context of administrative reform in Ukraine, under which restructuring of some central executive bodies is being currently carried out, including creation of new institutions and elimination of some existing ones. In particular, the Ministry of Environmental Protection of Ukraine was transformed into the Ministry of Environment and Natural Resources of Ukraine which incorporated State Environmental Inspection of Ukraine and State geological and mineral resources service of Ukraine. Also was created a number of other institutions dealing with management of natural resources and the environment, including State Water Resources Agency of Ukraine (instead of the reorganised State Committee of Ukraine for Water Management).

Ukraine moves forward to water sector reform: the Ukrainian government is adapting its legislation and regulations to meet EU water directives. Once successful, the next step requires tremendous investment in water and wastewater infrastructure (Water Sector Reform). Long-awaited economic growth in Ukraine brings hope and prosperity, but also new risks to its outdated, inadequate water and wastewater infrastructure. Experts forecast that the country's water supply and sewage infrastructure will reach its peak by 2015 and requires tremendous investment in rehabilitation and wastewater reuse to increase water supply, improve drinking water quality and meet growing wastewater treatment demands.

The fact is that most of the Ukrainian water supply and sewage cannot meet existing water regulations without rehabilitating their water and wastewater treatment facilities this major effort will require a mixed approach involving national water reforms, private capital and international financial assistance and investments. In Europe, Ukraine is one of the poorest countries in water resources, yet its population consumes more per capita than most Countries in the: region. Daily average water consumption in Ukraine per capita totals 320 litres per day, while in the European cities it is only 100 to 200 litres per capita.

Water resource is important factor which determines and provides sustainable economical and social development of a country and its environmental safety. At the present time dependence of the society on water resources increases and the level of demands to its quality and quantity raises as well. Rational use, protection and water resources renovation are the top priorities for Ukraine. The main goals of state water policy are to provide water supply to economy and population and to solve existing problems of the water sector and water ecology problems.

Regulation by Incentive: Innovative Regulation of Commercial Utilities in Zambia

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Keywords: regulation, incentive schemes, human resource management, commercial utilities, Zambia

Introduction/Problem Identification

In 1990, Zambia introduced substantial reforms of the water sector, including the commercialisation of utility providers (CUs). The reforms included the establishment of an independent regulator, the National Water Supply and Sanitation Council (NWASCO). The functions of NWASCO includes licensing of all CUs, developing guidelines, establishing and enforcing standards, setting tariffs and advising on water supply and sanitation related issues. In 2008, in order to incentivise staff to improve financial efficiency and overall CU performance, NWASCO introduced Regulation by Incentive (RBI) which links individual staff performance targets with overall institutional goals.

Analysis/Results and Implications for Policy and/or Research

Regulation by Incentive(RBI)involves NWASCO and CUs jointly identifying three or four institutional performance targets that could be reached over six months. Each CU then translates these targets into individual staff incentives which should contribute towards achieving the overall institutional target. A financial institutional incentive is paid out from NWASCO at the end of the period as a factor of the performance achieved. Each staff member is also paid a bonus, according to whether they achieve their individually agreed performance targets.

In 2008, RBI was piloted in four CUs: Southern Water and Sewage Company, Chambeshi (CHWSC), Kafubu WSC (KWSC) and North Western WSC (NWWSC). The results of the first cycle of the programme saw NWWSC obtaining 100% of their possible incentive, SWSC receiving 75%, CHWSC achieving 50% and KWSC receiving 0%. At the end of the first phase of the programme interviews were conducted with staff at all levels across two of the four CUs involved in the programme. The results found that all staff member were aware of RBI and were highly supportive of it. The RBI pilot scheme was described as a success by both NWASCO and CUs, and the scheme has been expanded to other CUs. The initial phases of the scheme were financed by NWASCO and other donor partners with future phases planned to be funded directly by the CUs.

RBI was seen as a success because it included all staff and helped to build collective action around a common set of goals. The findings of this research are consistent with other research on pay for performance schemes in the public sector. Matkinson (2000) stated that well operated schemes successfully clarify objectives and engage employees directly in the goals of the organisation, motivate and reward employees by linking compensation to targets and "foster a culture based on teamwork and fairness" (Makinson, 2000, p.2). The RBI schemes was successful in that it acted as a catalyst for more substantial managerial and organisational changes within the utilities.
However, the long-term sustainability of RBI presents a challenge as CU's struggle to find additional financing to support ongoing phases of the scheme. A lack of on-going financial support could see

termination of the scheme and this may make it harder for managers to use non-financial means to motivate improved staff performance. Further research is required to assess the effectiveness of performance contracts for staff who work in areas such as customer service, marketing and community engagement. Research elsewhere shows that quantitative assessment of these actives may reduce the overall quality of the services (Munro, 2004; Bowerman et al, 2000). Other areas which require further research relate to whether the RBI targets will eventually result in the CUs focusing too much attention on a limited number of targets and thereby neglecting other important service level agreements (Bevan and Hamblin, 2009).

Institutional Change for Sustainable Urban Water Management in India: Adaptation to Changing Environment

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Keywords: India, urbanisation, water supply, urban water management, institutional change

Introduction/Problem Identification

Rise in population coupled with rapid economic growth is seen as a major factor resulting in higher rate of water resources depletion globally. The problem of water scarcity is more acute in cities and towns of the developing world, where most of the challenges of water supply, sanitation and environmental sustainability are still unanswered. Rapid urbanisation and climate change will further weaken the already poor urban water management systems. These systems are troubled with: 1) inefficient water pricing; 2) heavy leakage of water from old distribution systems and unaccounted for losses resulting from faulty meters, unbilled consumption, illegal tapping etc; 3) contamination of the supplied water and; 4) lack of political will, and institutional and financial capability for carrying out reforms. Thus there is an urgent need for planned action to manage urban water resources in developing countries effectively and efficiently, especially in Asia.

Analysis/Results and Implications for Policy and/or Research

Our analysis from the data on 301 Indian cities and towns confirms that the fast urbanisation and population pressure have greatly impacted water supply systems in Indian towns. Also the distribution of population in different size class of settlements has become highly skewed over the years. It was observed that the share of Class I towns or cities, with population size of 1 lac or more, has gone up significantly from 26 per cent in 1901 to 65 per cent in 1991. The percentage share of class IV, V and VI towns, with less than 20,000 people, on the other hand, has gone down drastically from 47 to 10 only. However, these developments have not been supported with the improvements in the basic water amenities in the urban areas.

Water supply in most of the Indian cities exhibits insufficient water pricing; high distribution and unaccounted for water (UFW) losses; and sub-standard water quality. Analysis shows that in regions of natural water scarcity (which also experience physical scarcity), the cost of production and supply of water is far higher (ranging from 1.47 to 3.69 Rs/m^3 of water) than that of naturally water-rich regions (ranging from 0.05 to 0.88 Rs/m^3 of water). However, domestic water supply is highly subsidised in several of these water scarce Indian cities.

On another hand, distribution and UFW losses have emerged as the most important factors impacting urban water resources management. In Indian urban cities, distribution losses alone are in the order of 30-50 per cent and the total unaccounted for water (UFW) losses accounts to 45 per cent of the total water supplied and further increasing). The condition is even worse for the informal settlements and slums in these urban areas where basic water and sanitation infrastructure is completely non-existent. The main reason for the distribution losses is poorly maintained infrastructure, whereas for UFW losses, unbilled and illegal connections are the biggest causes.

From water quality point of view, eighty-five per cent of urban population in India has access to drinking water but only 20 per cent of the available drinking water meets the health and quality standards set by the world health organization (WHO). Analysis of data from 109 Class I and 65 Class II cities show that 13% of Class I and 17% of Class II cities even lack presence of any water treatment plants. Water quality monitoring is even worse for the selected Class I and Class II cities. Almost 63%, 35% and 22% of the class II cities do not monitor the quality of raw water, quality of water at treatment plant and water quality at distribution network respectively. Further most of the Indian cities have intermittent supply of water leading to high levels of contamination.

Considering these growing urban water management challenges, there is need for paradigm shift, i.e., shift in focus from supply augmentation to demand management and increase in overall accountability on the part of the utility and the consumer. With these findings, the research paper has suggested the institutional change framework for sustainable urban water management in India. The institutional change will involve: 1) one or combination of organisational change measures comprising decentralisation, private sector participation and, community-based management; 2) directive reforms and; 3) human resource development.

At present, the institutional change process in India's urban water supply sector is in various stages of development. Some reforms are in advance stage (decentralisation, HRD but only in comparative terms) and some in infant stage (PSP, Community Participation, Directive Reforms). But all are in need of political and legal support to make them much more desired, effective and relevant. Improving urban water services will therefore require greater attention towards institutional restructuring, arrangements and reforms that can be sustained over the long run.

Further, given the wide range of local and regional requirements in India, a "one size fits all" approach in implementing the recommended institutional change framework may not be appropriate. The finer aspects of implementing the framework will depend upon the physical and socio-economic environment, political situation and administrative set up that exist in the urban area. It is considered that the institutional change process will be more so important for small urban towns where public utilities lack technical competence and are financially and managerially weak and so far have received little attention. All these reforms together can equip Indian cities better for averting risk, in the face of rapid urbanisation, climate change and water scarcity.

Water Partnerships in Areas of Limited Statehood – Conditions for Success

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Keywords: Partnership, Limited Statehood, Performance, Management, Institutional Design

Introduction/Problem Identification

The General Comment No. 15 confirms that governments have obligations to ensure access to safe drinking water and sanitation under international human rights law. But the Comment also recognises that some states may not be able to ensure instant realisation of the right to water, for example in areas of weak or failing states. Cooperation with other public or private partners is seen as an option to provide for better water governance. Transnational public-private water partnerships aim at contributing to realising the water-related MDGs. The Partnership approach rhetorically proves to hold innovative promises for effective service delivery and long-term development. However water partnerships are still contested – an in-depth analysis of their performance on transnational, regional and local levels of implementation and a better understanding of conditions for their success would help to further develop their potential.

Analysis/Results and Implications for Policy and/or Research

Urban development and services to the poor are considered as major challenges, especially in so-called "areas of limited statehood", i.e. areas where the state monopoly on the use of force and the authoritative decision-making and -implementing competence by the state are only partially effective. Transnational public-private water partnerships pursue to provide services in such areas which serve as a role model for local authorities and local governance institutions and aim at being a baseline tool to transfer into different contextual settings of urban slum areas. These water partnerships claim to provide an innovative concept: on the one hand by approaching local problems and challenges with bottom-up and demand driven concepts and solutions paired on the other hand with the additional asset of pooling together international expertise and resources from academia, civil society and private sector. Our research explores the complex interplay between the challenges posed by the lack of security and effective regulatory frameworks in areas of limited statehood on the one side and the opportunities in terms of the specific resources and activities of partnership projects on the other side. It aims to answer the question how a public-private partnership should be set up to best handle difficult regulatory and social contexts. We find that institutional design and management matters.

Our research is based on 21 cases of transnational partnerships that are active in areas of limited statehood, among them the GWP, BDP, WSUP and others. Given the focus of this year's Water Week on "Water in an Urbanising World", our presentation (oral or poster) will concentrate on evaluating and comparing partnership projects of "Water and Sanitation for the Urban Poor" in India, Bangladesh, and Kenya. Starting with insights of the institutional design and management qualities of these partnerships on transnational level, we link this aspect and its relevancy for successful outcomes to the local context settings. Starting with an account of the challenges in urban slum areas, we will present best practice in dealing with such problems.

Our analytical framework asks for the relevance good project design and management, i.e. of resources and resource management, internal and external communication, contracts and change management, monitoring and evaluation, capacity development and coordination with project implementation units. Moreover, our research sheds a light on rule of law and security aspects as being relevant to project success in local context settings. So far the role of rule of law and its link to formal and informal institutional arrangements can be singled out to be a significant contribution to project performance. Last not least, our research also investigates reasons for social acceptance or rejection of these projects on community level of the beneficiaries and target groups as well as on administration level of targeted authorities and municipal corporations which are targeted to provide long term development by transferring and up-scaling these approaches. We find that procedures to support local stakeholder participation in planning and implementing programmes matter.

Therefore this contribution/paper will provide insights into a multilevel context of governance making to provide the urban poor with basic water and sanitation services and considers internal project elements as well as external context factors as relevant explanations. From the empirical evidence we will derive implications for institutional arrangements on the service provider side of these multilevel actor consortiums as well as insights in how far bottom-up elements and demand driven approaches contribute to the performance of these projects. Moreover, first insights can be given from comparison of transnational partnership service delivery with conventional actor consortiums in developing aid.

Enabling and Promoting Change in Public Water Policy as Sustainability Concepts Evolve

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Keywords: policy, sustainability, triple bottom line, regulations, future scenario

Introduction/Problem Identification

Public policy related to drinking water is not keeping pace with the evolving concepts of sustainability. Policy development should consider sustainability as a defining principle. It is suboptimal or even counterproductive to develop and implement a policy that does not apply this principle. For water systems (consisting of the complete hydrologic cycle) policy development should apply the same sustainability rigor as being promoted/required by many political and public organisations for specific applications such as constructing a new treatment plant or conveyance facility. However, due to the complexity and specialise interests of our diverse water community, a holistic approach by policy makers is not normally being considered as thoroughly as it could or should be. This presentation illustrates how different approaches to achieve a policy outcome can result in substantially different sustainability results and support the concept of sustainable policy in the water industry.

Analysis/Results and Implications for Policy and/or Research

The evolution of environmental policy needs to keep pace with the changing concepts of sustainability. Public policy, related to water, should consider sustainability as a defining principle. It is suboptimal or even counterproductive to develop and implement a policy that does not apply the sustainability process.

A definition of sustainability is necessary for this paper to establish a common point of reference. Sustainability will be referred to as the process of determining sustainability, not an end-point. This definition can be agreed to in principle by most organisations and practitioners. Sustainability as an end-point (e.g., amount of water conserved, tons of GHG produced) is often controversial and does not server-well policymakers or policy implementers. Sustainability as a process can be approach in a commonly acceptable method, such as balancing triple bottom line (TBL) criteria; with the added stipulation that future evolution or scenario concepts must be applied to the analysis to assure that TBL is applied with reasonable flexibility or foresight and can be melded into alternative sustainable futures. We all can appreciate that today's sustainability will not be tomorrows. However, the sustainability process can be used for the foreseeable future as a means of introducing evolving sustainability principles into policy development.

One of the major hindrances to applying sustainability approaches is the complexity and specialise interests of our diverse water community. Our policy makers often are segregated (or stovepiped) or are advised by experts that are segregated into specialties such as environmental water quality, drinking water quality, atmospheric concerns, economic development and more. As such, there is a tendency to create policy that unduly weights the specialties in which they have their expertise. This presentation illustrates how different approaches to achieve a sustainable policy outcome can result in substantially different sustainability results.

For different locations in the world and different circumstance, the sustainability process can remain the same but the use and number of criteria and measures use to implement the process can and will vary. The recognised relationship among sustainability criteria and measures (e.g. energy, GHGs, public health, non-renewable resources, life cycle costs) creates a basis for decision-making and so policy development. While the issues seem to be well framed, the implications and answers are not always well understood by politicians, regulators, utilities, academia, and water engineers. Consequently, we need to have a flexible framework to address today's policy development requirements while allowing for tomorrow's needs.

This presentation provides analytical results and discussion of the factors that influence policy decisions as impacted by TBL considerations such as energy, GHGs, costs, and stakeholder concerns over drinking water quality and the environment. Different outcomes result as the consequence (i.e. weighting) of each of the TBL criteria are varied in importance. For example, if GHG is weighted highly, a low energy outcome or application of renewable energy will result. By reducing a MCL, GHG, residuals, and cost will likely increase. The examples in this presentation indicate the type of criteria that could be considered when setting policy. These criteria and the resultant change in outcomes are quantified and contrasted for different alternatives for a nominal 77 MLD water treatment plant. The following are examples of the alternatives:

Multiple analyses are presented that demonstrate the need for a sustainable approach to policy. For example, the analysis of a policy that is being applied in many areas of the world for indirect potable reuse, which requires reverse osmosis as part of the treatment process. The analysis shows that GAC treatment options have significantly less equivalent CO_2 emissions compared to the RO alternatives, from 4 to 18 times less CO_2 compared to RO. Both provide acceptable water quality for indirect potable reuse. Life cycle costs are reduced by approximately 30 percent. In a second example, a water policy in Australia set the nitrate value for indirect potable reuse water at 0.04 mg/l. A study that considered a change to 0.5 mg/L, demonstrated a decrease \$60 million, reduction of 26,000 tons GHG per year, with less than 2 ton per year increase in nitrogen, which was acceptable for discharge into the receiving waters. Additional examples suggest how planned policy changes in water quality regulations could impact the environment and societies ability to pay.

The presentation concludes with a description of how these results support policy development using sustainability principles that are applicable to complex problems.

Special Cabinet on Water: Water Resources Political and Institutional Framework in Guatemala

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Keywords: water policies, water governance, institutional framework, water planning, Guatemala

Introduction/Problem Identification

Making water management part of key development issues needs a strong and robust public and social capacity, based on a legal and institutional framework. nevertheless, in countries like Guatemala that do not have such framework but do face hugh water problems is urgent to seek alternative ways to manage this vital and complex natural asset. defining national and general water goals that contribute to reach social, economic and environmental targets of sectoral policies already institutionalised, is proving to be a point of entry for a better management of this vital resource and a mean to generated better governance conditions that in the future could end in a real modernisation of the legal and institutional water framework.

Analysis/Results and Implications for Policy and/or Research

"There is no road, built it while walking" Machado, spanish writer

Water is recognise as a vital, economic and environmental asset by the government, as well as a security matter, so the government has to act accordingly even though when it lacks of legal and institutional water framework and has to deal with many other structural problems – poverty, low GDP, low fiscal revenue, environmental deterioration, multicultural practices, lack of confidence in the public institutions due to historical circumstances, etc.

Having "enough" natural water availability does not assure water supply for human, economic and environmental needs where the management capacities and the seasonal storage index are very low.

Putting a high level political mechanism for policy making and programme coordination, can give an alternative solution to move forward in water management issues initially giving added value to sectoral water approaches. the programmes are as fallows:

a) "Safe Drinking Water and Adequate Sanitation for Human Development": under the responsibility of the Ministry of Public Health and Social Assistance (MSPAS);
b) "Governance and Water Planning and Management": under the responsibility of the SCW given the fact that the country does not have an specific water legal and institutional framework;
c) "Forest, Soil and Water Quality Management in Watersheds": under the responsibility of the Ministry of the Environment and Natural Resources (MARN); and
d) "International Watercourses": under the responsibility of the Ministry of Foreign Affairs (MINEX).

Translate the national water policy in specific sectoral programmes, with objectives and priorities that target goals of other policies can be the entry point for the modernisation of the administrative structure of water resources management once is proven that this water programmes certainly contribute to meet sectoral and general goals

Finally, all programmes are based on the "integrated water resources approach"; its objectives are meant to be achieved based on effective water governance and with the adoption of modern concepts of planning and water management. All stakeholders – public, social and private – participation most be onboard where indigenous communities, women and youth are listen, proposed, compromise and are part of the solution.

The common link among sectoral programmes is the need to make an integrated water resources management where the diverse activities meet in the ground and target both sectoral and general goals.

Signposting Progress for Water Security: Diagnosing Determinants of Regulatory Performance and Exploring the Promise of Social Accountability Monitoring

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Keywords: institutions, performance, water, accountability, Tanzania

Introduction/Problem Identification

The complex water management challenges facing Dar es Salaam are common to most cities in the developing world. Rapid growth places increasing pressures on water resources against a difficult backdrop of poverty and inequity, inadequate infrastructure and a highly variable and changing climate. Urban water security is threatened by resource degradation, depletion and conflict with significant implications for human well-being, economic growth, and ecosystem functioning. Despite legal reforms and considerable donor investments in water resource regulation in Tanzania over the past decade, progress in improving institutional performance to meet these challenges has been limited.

This paper documents a two stage research process which a) identified barriers to improved regulatory performance in Dar es Salaam, and b) followed this with targeted civil society advocacy to address them.

Analysis/Results and Implications for Policy and/or Research

Results provide insights for how external support can be better focussed in such contexts, and indicate that the social accountability monitoring pioneered here has promise in strengthening institutional incentives and government delivery for water security.

The first phase of the research applied an innovative interdisciplinary methodology to diagnose the implications and controlling factors, or determinants, of institutional performance. Multiple case studies, organisational observation and novel stakeholder discussion aids were used to compare regulatory specifications against the realities of water resource use by municipal water supply and sanitation providers and industry. Interviews and questionnaires conducted with regulatory cadres validated a root cause analysis which characterised the determinants of observed performance. Empirical results highlight the negative outcomes of the observed, unregulated water use and the many formidable constraints to performance within the 'low specificity' task of water resource regulation in developing countries. Alongside explicit capacity constraints, a set of tacit problems such as a lack of legitimacy, overlapping mandates, ambiguous authority and manipulation by powerful interests were found to be pervasive, and to undermine institutional incentives and performance. Autocratic management, corruption, and the way that development assistance is delivered were also found to be problematic. Low accountability and an absence of publicly articulated demand for improved delivery of water management were overarching problems.

A second phase of action research responded to these findings through a collaboration between WaterAid and Tanzanian NGOs who undertook social accountability monitoring of water resource management. Regulation of water abstraction, pollution control and conflict resolution were assessed and poor performance across these functions imposed impacts felt disproprtionately by poor communities, in particular through elevated health risks and erosion of livelihoods. This poor institutional performance was traced to insufficient budgets and late transfer of funds for regulatory operations, and inequitable representation within stakeholder forums set up to provide regulatory oversight.

This first ever exploration of the value of social accountability monitoring in improving institutional performance in the regulation of water resources generated promising results. On presentation of the work at the annual Joint Water Sector Review, formal commitments were made to take corrective action, with the Director of Water Resources labelling the research as 'a welcome wake up call'. The World Bank sponsors of water sector reform in Tanzania agreed the work was an essential oversight mechanism. A repeat of the exercise is planned for 2011 to track impact.

Public Private Partnership in Wastewater Management: Lessons from Australia

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Keywords: wastewater reuse, public private partnership (PP, Critical Success Factors (CSFs, sustainability, irrigation

Introduction/Problem Identification

Poor water governance regimes and the ever increasing demand for freshwater supply have resulted in severe water scarcity. Water management authorities across the world face the challenge to ensure that quantity, quality, distribution, and allocation of water among the various uses are sustainable. Consequently, wastewater reuse is gaining importance as a reliable alternative source of water. But successful expansion and integration of this idea into future sustainable water management plans encounter various obstacles including public acceptance and private sector involvement. In this context, this paper discusses two wastewater reuse projects in South Australia and highlight the critical success factors (CSFs – social, institutional, regulatory and policy, financial, technical, and risk – for public private partnership in wastewater management. The paper also discusses the activities supporting these set of factors, thereby leading to sustainable wastewater management.

Analysis/Results and Implications for Policy and/or Research

Water scarcity is a serious issue mostly resulting from poor water governance regimes and the imbalance caused by the increasing demand for water and diminishing supply of water. But developing additional surface water supplies is expensive; So, 'source substitution' (development and use of new and/or alternative sources of supply) is the solution to address perceived new demands. Accordingly concepts such as water reclamation, recycling and reuse are now being incorporated in most water and wastewater management policies around the world. Furthermore, there is general agreement that non-potable use of urban wastewater (treated and/or untreated) can augment traditional water supplies and thus prove to be a reliable substitute for reduced freshwater supplies. But successful integration of these concepts into future sustainable water management plans is easier said than done. Water planners and policy makers encounter various impediments such as costs compared to other water sources, acceptance by the public, minimisation of environmental and health impacts, and technology to treat water to an appropriate standard while implementing wastewater reuse projects. But does private-public (community) partnership ease the implementation of a successful and sustainable water reuse scheme? This paper tries to find answer to this question by selecting two case studies in Adelaide, South Australia, and discusses the Critical Success Factors (CSFs) to implement a sustainable water reuse scheme through public private participation.

The two projects: Virginia Pipeline Scheme (VPS) and Willunga Pipeline Scheme (WPS) were selected for the study because the schemes were unique in their own right and had different organisational setups and both schemes have performed well since their inception.

The VPS is built on the build-own-operate-transfer (BOOT) model, and is the largest of its type in the whole of Australia. The scheme is a co-operative undertaking of the Virginia Irrigators Association (VIA) – representing market gardeners and other irrigators; SA Water Corporation (public sector) and Water Reticulation Services Virginia (WRSV) (a private company). On the other hand, the WPS is the result of a licensing agreement negotiated between the Willunga Basin Water Company (WBWC) and the SA Water Corporation to access reclaimed water from the Christies Beach wastewater treatment plant for 40 years. The WBWC is a joint venture company formed by a consortium of grape growers and winemakers, which owns the pipeline and is responsible for its operation and maintenance. All the costs were met by the WBWC. Since its inception in 1999, the scheme has expanded and today supplies Class B water to around 80 beneficiaries. A second wave of users, as a third party, was required to sign water supply agreements with the WBWC.

Experience from these two projects suggests that Social Capital and Community Social Infrastructure are essential ingredients in implementing water reuse project as they link the physical infrastructure to individual leadership. The Virginia pipeline scheme demonstrates that it is possible to achieve increased social capital even with heterogeneous or diverse groups. The Willunga pipeline scheme on the other hand demonstrates what can be achieved when people come together to tackle water scarcity challenges on their own. Further, confidence in the associated agencies to deliver and perform their duties effectively is also crucial in implementing a reuse project. In addition, these projects exemplify the benefits of involving all the stakeholders through effective partnerships which include: utilising the experience of the private sector to improve service delivery, shifting the role of government from being a service provider to a facilitator for service provision, and improve the relationships between public and private sector and the community to work in partnership for mutual benefit and the general public good. These projects also identify six factors namely social, institutional, financial, and regulatory and policy, risk allocation, and technical are the Critical Success Factors for public private partnership and through appropriate "project alliances" it is possible to address these challenges and establish and manage the relationships between all stakeholders involved as well as successfully manage the risks associated with implementing wastewater reuse schemes. Thus, with considerable innovation and collective efforts of a motivated group of individuals, positive results are yielded.

The "DLIST Approach" – Engage with Stakeholders on All Levels of Society to Achieve Fair and Equitable Development for All

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Keywords: stakeholders, community planning, information sharing, communication, participation

Introduction/Problem Identification

Local communities are easily overlooked in large projects and conservation processes. To avoid this, they are involved already in the planning phase of the Agulhas and Somali Current Large Marine Ecosystem Project, through the deployment of a tried and tested community empowerment and outreach tool; the Distance Learning and Information Sharing Tool (DLIST).

Analysis/Results and Implications for Policy and/or Research

The website, www.dlist-asclme.org, provides information sharing opportunities, including discussion forums, an online library, targeted courses, travelling environmental film festivals and newsletters. To assist stakeholders without access to internet to actively participate, each country that is part of the ASCLME Project has a "DLIST demonstration site". In these carefully selected communities, the DLIST team works closely with local stakeholders to formulate their input to the planning process. At the same time, mechanisms are established for improved communication between grassroots communities and higher-level structures. The demonstration sites also provide opportunity to apply targeted funding to address issues identified by local communities.

The DLIST approach has led to the formation of an active and growing Community of Practice (CoP) consisting of members from all sectors and levels of society. The members of the CoP can share knowledge, perspectives and assist a coherent voice from the ground to inform the project. The DLIST web-based platform functions as a mechanism for exchanging views across the region while being a user-friendly depository of valuable information related to marine and coastal conservation. The DLIST approach can be applied in both urban and rural settings and focus on issues related to environment, sanitation, over-all development and policy.

The Human Right to Sanitation: Bridging the Urban/Rural Divide

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Keywords: right to sanitation, human right to water, governance, procedural rules, due process rights

Introduction/Problem Identification

The human right to sanitation is inseparable from the concept of the human right to water, universally regarded as essential for realisation of the right to health and the right to an adequate standard of living, two rights expressly included in the 1966 International Covenant on Economic, Social and Cultural Rights, which has been ratified by 160 States. As with the right to water, the right to sanitation implies a range of rights and obligations, including individual substantive rights, collective substantive rights, and procedural rights. However, progress in respect of the provision of sanitation lags behind that made in respect of the provision of drinking water. One reason for this may be related to the fact that the requirements of health and dignity, which dictate the normative content of any appropriate understanding of the human right to sanitation, differ as between urban and rural settings. The requirements of the right must be understood in each context.

Analysis/Results and Implications for Policy and/or Research

Although many States, international and regional organisations, NGOs and academic commentators have now endorsed or recognised the human right to sanitation as creating entitlements and obligations under international law, either as a stand-alone right or as one ancillary to the human right to water, uncertainty continues to surround the concept. Though the right to sanitation has received notable endorsement in 2010 from, inter alia, the UN General Assembly, the UN Human Rights Council, and the UN Committee on Economic, Social and Cultural Rights, there exists no authoritative document outlining the normative content of such a right or suggesting how it might be implemented in practice. While it is possible to infer certain aspects of the right to sanitation, particularly its procedural elements, from the guidance provided in 2002 by means of General Comment No. 15, further guidance is required, especially as its implications may differ significantly as between urban and rural areas.

For example, whereas the implications of a failiure to provide for the right to sanitation for the enjoyment of the primary right to health are more obvious and immediate in an urban setting, in a rural setting the impacts in respect of human dignity and thus, often in respect of the participation of girls and women in education or the work force, are likely to feature prominently. Of course, the provision of public infrastructure for sanitation services might often be more straightforward in engineering terms and more affordable in rural areas, but the social awareness and political will required may often be lacking. Recognising the different approaches required to the financing of urban and rural sanitation services the African Development Bank, for example, has recently adopted separate guidelines for user fees and cost recovery for rural, non-networked water and sanitation delivery and for urban, networked water and sanitation delivery.

Given the considerable disparity between the normative requirements of the right to sanitation in urban and rural contexts, and the lack of clear details on the steps required of all actors by this right, it is clear that the procedural elements inherent to the concept take on added meaning. Only a truely participative approach based on the availability of all relevant information and access to all decision-making processes can ensure that the conditions objectively required for protection of health and dignity are achieved in all contexts. In addition, the principle of non-discrimination takes on paramount importance, for ensuring the full participation of all sectors of the community and the full enjoyment by all of the benefits of adequate sanitation.

The Implementation of Successful Social Programmes in the Provision of Water Servicies in the City of Buenos Aires, Argentina

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Keywords: water, services, urban, programmes, social

Introduction/Problem Identification

The aim of this paper is to describe some Social Programmes connected with the provision of water services in the City of Buenos Aires, and in other 17 areas around which are included in the same concession agreement.

In this case "Aysa" (Argentinean Water and Drainage Services) is a mixed (with both public and private capitals) company, which since 2006 has the concession to provide these services to the mentioned area.

It is important to say that before 2006, two foreign companies (Suez and Aguas de Barcelona) owned the private company called "Aguas Argentinas" and its concession agreement was terminated by the Argentine National Government, by the creation of "Aysa".

All along this article, we will describe a successful Participative Management Programme currently performed by Aysa, which collaborate with a better provision of water services but also creates a positive linkage with the local community.

Analysis/Results and Implications for Policy and/or Research

All along several years of study, we found out several interconnected indicators focused in environmental, social, legal and economic aspects for the provision of the water service developed by Aysa.

In this sence, the adequate application of local and international administrative and environmental laws, policies, and quality controls, are very important in order to achieve a sustainable urban water service provision to the city of Buenos Aires and for the other 17 areas around it.

In the present case, this "new" company has different social and environmental programmes which are functioning in a very successful way.

In the first place, there is one named "Water + Jobs". It functions through local cooperatives for the training of the community, in order to work there and contribute to the improvement of water services in the area.

Usually, the cooperatives work on the installation of water resources infrastructure in poor areas of the city, but they are always supervised by some technicians from Aysa.

And in the second place, this company implemented several rational water use campaigns in different neighborhoods of the city of Buenos Aires. Their main activities were performed in schools, universities and NGO´s, explaining several ways in which any person could save water (in the garden, bathrooms, and in their houses in general).

Also, Aysa organised media campaigns in some newspapers and television, with the aim to educate the whole community in environmental issues connected with water resources protection.

In the third place, we must add that the “Social Fare” implemented since 2002 (in the middle or Argentinean economic crisis) was a key issue which is still functioning in an excellent way. It was created to help people with low incomes (unemployed or any other social problem) allowing them to pay a reduced fare, in order to have water and drainage services as any other person who is paying the full fare.

In conclusion, existing local “weak” legislation surely provides an inefficient water supply service, if no social programmes are implemented.

In this regard, the valid and existing laws should be rigorously applied by the corresponding public authorities (administrative and judicial), because if not applied, its mere existence is useless.

Also, the Government should prepare and apply policies to guarantee the transparency in the water supply area, which collaborates in the provision of better services for all the citizens in the region.

Including the Excluded: Institutional Incentives for Overcoming Path Dependencies of Urban Water Supply in sub-Saharan Africa

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Keywords: water supply, institutions, path dependency, informal settlements, Africa

Introduction/Problem Identification

Over the past forty years, social transformation in Africa south of the Sahara has led to an extremely high urbanisation rate with almost two thirds of the urban population in sub-Saharan Africa living in informal settlements or 'slums'. Over the decades there has been a number of initiatives to improve water and sanitation, but the poorest are in many countries still excluded from public water services. In this paper I argue that a key to understanding why this situation has occurred is to be found in history. The historical development of urban water supplies has created 'path dependencies', resulting in institutional and economic barriers for public service expansion in informal areas. To create effective policies, institutions and technological solutions that can bring about more inclusive and sustainable public water service, first we need to understand how these barriers came about.

Analysis/Results and Implications for Policy and/or Research

This presentation is based on case studies from two countries in East Africa: Kenya and Uganda. First I look at the historical development of urban water supplies at the national policy level in these two countries. I demonstrate why, at a systems level, urban water supply has been resistant to radical change and why it tends to develop along conservative lines. Choices that were made early on – even at the time of the establishment of the first urban water systems in the colonial period – can be seen to exert a constraining force on these systems for a very long time. Political initiatives and policy shifts that came later – such as the Kenyan Government's goal from 1970 of providing water for all Kenyans by the year 2000, or the UN 'Water Decade' of the 1980s – did not sufficiently acknowledge the historically defined resistance to change. Instead these processes yielded what the economist Paul A. David has called 'path dependent outcomes'. Institutions such as law and regulation are important factors contributing to path dependency, but also knowledge production and engineering practice, attitudes among leaders and the political economy of the country.

Secondly, I analyse what is the effect of this path dependency in relation to the urban water systems' ability to expand into and provide services in informal settlements. What did it mean for poor people in informal areas that urban water systems developed along conservative lines? Of particular importance here is the institutional 'mismatch' between a large-scale water utility and the informality of low-income settlements with regards to property rights, land use, and modalities of payments. In essence, large-scale urban water supplies face multiple transaction costs for providing services in informal areas that create barriers for expansion of services in these areas. Interestingly, the barriers identified also provide some clues on how to improve services in informal areas.

Thirdly, I present some promising real-life examples that can offer a model for overcoming the barriers identified. In Kisumu in Kenya, the water utility provides water services in collaboration with local private actors in the informal settlement of Nyalenda through a novel institutional interface and organisational model called 'delegated management model'. In Kampala the water utility is experimenting with a system for pre-paid water services in informal areas using electronic tokens.

Both examples are analysed in the light of the barriers identified. This serves to demonstrate that there are models of institutions, organisation and technology that can be configured in such a way that the institutional and economic barriers can be overcome.

Finally, I look at the recent water sector reforms in these two countries and analyse to what extent they provide incentives for utilising good examples such as those presented. Do the reforms facilitate to break off from the path dependent trajectory and to effectively expanded services in informal areas? Or do reforms merely perpetuate a system of excluding the poor? This section closes with some clear recommendations to reformers in sub-Saharan Africa; on how to create more effective incentives in the sector so that public water systems can adapt better to today's reality and to eventually include the excluded.

Jakarta Water Governance Post Public Private Partnership: The Role of Regulatory Body

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Keywords: water services, public policy, privatisation, regulatory body, good water governance

Introduction/Problem Identification

Jakarta is the capital city of Indonesia. The city has the modern water system supply since Dutch colonisation in 1940s. After independence in 1945, the service has transferred to the local government owned company (LGOC), a Jakarta's special purpose vehicle to develop a widely-coverage piped-water-supply of the metropolis. In 1998 Jakarta water was being privatised through Public Private Partnership (PPP) methods to two private investors: Thames of UK and Suez of France. Both of them had their local partners. The challenge was how to develop good water governance post PPP. Therefore, Jakarta founded the Jakarta Water Provision Regulatory Body with the main task is to develop good governance in the water services in Jakarta to assure that privatisation perform excellently.

Analysis/Results and Implications for Policy and/or Research

In 2002, government founded the Regulatory Body of Jakarta Water Provision (nicknamed as JWRB). The institutions served as oversight body to the cooperation agreement among public-private-partnership parties. Therefore, the premier and first responsibility of JWRB is to assure that the cooperation between PAM and the operators was conducted in regard to the Letter of Agreement.

The first arrangement of the JWRB was political appointee of the Governor. The second arrangement of the JWRB (2005-2008 and 2008-today) was through public selection. JWRB organisational structure developed formally as the hierarchical institutions. In practice, the model was enhanced from the hierarchical management toward the "centre-less management model" or "doughnut organisation" (handy)or "circular model of organisation" (Hesselbein).

In the centre was the ultimate governance, Board Meeting. At the first layer, it is the board member who worked based on its complement expertise of the technical, financial, legal, and customer and public relation expertise. At the outer side, it is the assistant to the Board Member and secretariat, and at the outset side is parties (Jakarta Authorities, PAM Jakarta, and private operators), partners (KPAM, FKPM, and other stakeholders), consultant (the part time base hired professionals), and donors (such as The World Bank and other non-obligatory support form organisation other than parties).

This centre-less micro governance has develop to the macro Jakarta water governance, as the player of the water governance are: Governor of Jakarta, Parliament of Jakarta, PAM Jakarta, Private operators, Customer (Jakarta Water Consumer Committee or Komite Pelanggan Air Minum, or KPAM), Public (Jakarta Water Drinking Communication's Forum or Forum Komunikasi Air Minum Jakarta or FKPM).

JWRB plays as the platform of the governance system and process to manage the policy process of water in Jakarta under deliberate model, which means involving public participants, combine with the rational model, which means to take in all the rational indicators of the policy input. The policy formulation model has replaced the incremental model which dominated the preceding policy decision in water service and tariff.

The deliberate policy making model was developed by involving two key institutions: Jakarta Water Voice (JWV) and Jakarta Water Stakeholder (JWS). The JWV is an organisation of customer representatives named Jakarta Water Consumer Committee (Komite Pelanggan Air Minum, or KPAM). The forum was founded in 2003 by the Jakarta's Kampong Legislature or Dewan Kelurahan (Dekel) who represents the community of the Kampongs in Jakarta.

Adjacent to JWRB key partners to develop policy on water, KPAM also works as actively partner of the water operator to assure the service quality improvement. Private operators work with KPAM to perform regular meeting with customer in Sub-Kampong –weekly to two-weekly, depend on the need of the operators and public demand. JWRB then promoted to found the multi-stakeholders forum named The Jakarta Water Drinking Communication's Forum(FKPM), which consist of the public organisations, NGOs –included Indonesia Customer Association and Indonesia Water Dialogue – KPAM, academicians, the PPP parties and their partners such as Jati-Luhur Authority (raw water supplier), Jakarta Authority, Ministry of Public Works, and Ministry of Environment. The FKPM meets twice in a year.

The second responsibility of JWRB is to propose tariff to the Jakarta Authority. The prior model of tariff setting was involving PAM Jakarta and Government of Jakarta only. Before PPP, water tariff was determined solely by PAM Jakarta and Jakarta authority. Post PPP, the mechanism was private partners propose the new tariff to PAM Jakarta, then PAM Jakarta propose to the Governor, than Governor decided. The problem was: Jakarta Administration had neither sufficient of expertise to decide whether the proposal was fit or not; neither extra time to assess and exercise the policy tariff before decided. The problem then Government has been under-fire of criticism –by the public concern of anti-corruption clause.

The second accountability of JWRB is acted as the "filter" for tariff increase or noted as new tariff. Therefore, JWRB receive the new tariff proposal from the parties, represent by the first party, PAM Jakarta. Instead of to "channel" the proposal to the Jakarta authority, JWRB conduct two-sides of assessment: to the operators in regard of their performance achievement and financial requirement, and to the public in regard of service quality improvement and affordability. The result of the assessment, then pass to the Governor as Jakarta authority representation. Governor can decide to accept JWRB's proposal or to reject. The prior system was Governor rely upon PAM Jakarta and private operators proposal, the present system is that Governor's decision will be very much rely on RB recommendations.

The Matanza – Riachuelo Basin in Argentina: Regulatory and Social Contexts for Institutional Performance

Author: **Dr. Claudio Palos**, Federacion Argentina de Colegios de Abogados

Keywords: law, administration, management, regulations, policy

Introduction/Problem Identification

The Matanza–Riachuelo River, in Buenos Aires, Argentina, is among the most polluted courses of water in Latin America. Running through one of the largest urban areas in the world, the contaminated waters have direct and indirect impact on several million people. For several decades, there has been a standstill and inaction regarding river management, pollution control and clean–up. One of the major justifications from policy–makers has been the jurisdictional quagmire involving basin management, with nearly 20 different jurisdictions involved. Nevertheless, recently a court case heard by the Argentine Supreme Court has created a regulatory and social context that presents new opportunities for institutional performance in water management. This work glances at these circumstances and policy framework, paying attention especially to the role of the judiciary in water-related environmental governance, the relation with civil society input and impulse, and the opportunities this presents

Analysis/Results and Implications for Policy and/or Research

As indicated in the introduction, river management (including pollution control and clean – up) for the Matanza – Riachuelo Basin in Argentina has not been carried out due to, inter alia, jurisdictional impasse among and between several different institutions with fragmented authority over the river. This abstract summarises an analysis of what are the main factors in the impulse for management, control, and clean up that is taking place in recent times from a regulatory and social context that activates lagging institutional performance.

The river's immediate area of influence is characterised by high levels of pollution of the watercourse as well as in the surrounding soil and air, lack of adequate waste collection and disposal systems, flooding, as well as exposure to risk and vulnerability due to industrial activities in the immediacy. A few years ago, new developments have taken place after people affected by the pollution levels present (in particular as to health impacts) in the watercourse brought a lawsuit to the Argentine Supreme court. The Supreme Court admitted and heard the plea and passed judgment in the case known as "Mendoza, B. and others against the National State and others over damages" and ordered the clean – up of the Basin and ordered the recently formed Basin Authority to draw, and fulfil, an environmental restoration plan of the river and surrounding areas. The Court emphasised and asserted that restoration and prevention of future damage to the watercourse needs rapid, effective and definitive resolutions.

The analysis of this Supreme Court ruling (in and of itself a pioneering ruling given that the Argentine Supreme Court has been remiss in dealing with water pollution cases), brings forth several different overtones related to this case reflecting how complex and competing demands over the access to safe water resources in a large urban setting can be brought forth and resolved. Furthermore, the impulse to well-functioning institutional arrangement conveying court mandated action to a workable clean – up plan in this case is analysed. Lastly, the role of the judiciary (in this case in its highest level) in water – related environmental governance is to be debated.

First, a central aspect is that affected people brought forth the lawsuit. This is significant in the analysis, given that the community's initiative is the driver in the hearing in order to bring forth this case and expresses joint efforts by civil society organisations. Community participation, joint efforts between organisations, as well other proactive roles by affected people's organisations and their supporters has brought to fruition the Matanza Riachuelo case where the legal and policy context have, to date, been amiss.

Second, the court ruling has given a clear mandate to the relevant authorities, indicating in its judgment that there is a need to draw a clean-up plan and furthermore specifying what are the key steps as well as deadlines to fulfil the different stages in said plan. The ruling is quite specific on the steps, and goes beyond usual policy rhetoric to include environmental and social specific guidelines for clean-up programme. Some court – ordered steps not only deal with court order clean-up plan for the basin's authority but also, includes aspects of transparency, access to information, inspections of polluting companies and identification of contaminating industries, urbanisation plans, clean-up of riverbanks, provision of water and sanitation services, as well as the implementation of an emergency sanitation strategy.

The role of the judiciary (in this case in its highest level) in water – related environmental governance is to be debated. With this case and with this ruling, new aspects of how the judiciary acts in environmental governance (in this instance, specifically related to water regulatory and institutional performance) in Argentina are set. That is, the role of the judiciary is re – shaped regarding water and environment issues.

In conclusion, the ruling by the Argentine Federal Supreme Court ordering clean up and restoration of the Matanza – Riachuelo Basin is the one of the most important environmental lawsuits in Argentina, issuing a final decision in relation to environmental damage remediation and prevention. The ruling not only is a policy rhetoric, but it also has contains a very specific mandate to the River Basin authority, surpassing jurisdictional wrangling and lack of clear action by relevant authorities. The practical fulfilment of the ruling has begun to be implemented and its legal provisions have begun to be enforced, and is a process to follow due to its innovation and importance regarding water issues in Argentina.

Nepal's Experience with Public-Private Partnership in Drinking Water Supply and Need of Alternative Approach

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Keywords: water, Kathmandu, public, private, community

Introduction/Problem Identification

Kathmandu, the Capital of Nepal, is becoming one of the fastest-growing cities in South Asia. This is also becoming as the only city in Nepal consuming most of public resources and development budgets. It has put other regional cities in shadow by leading itself towards the most unsustainable city in near future. The scarcity of water and poor institutional performance is one main reason behind its uncertain future. Just over two decades, Kathmandu's population has increased by 3 fold from about 1 million to some 4 millions with the level of basic water supply and infrastructure remaining virtually the same. It is now a metropolitan city of 5 municipalities.

Till 2008 water management and supply had remained under Nepal Water Supply Corporation (NWSC),a public utility. It was later replaced by Kathmandu Upatyaka Khanepani Limited-KUKL (Kathmandu Drinking Water Limited) as per the lending conditionality of Asian Development Bank (ADB). The loan is for Melamchi Water Supply Project.

Analysis/Results and Implications for Policy and/or Research

Huge public asset transferred from NWSC has been a big burden for consumers and taxpayers. It also has reduced heavily the financial and institutional capacity of NWSC in managing and supplying drinking water in the rest of Nepal, including regional cities, district headquarters, and most severely the rural areas. Private management and supply of water in the Capital through KUKL has proved to be a disaster with huge investment in one basket at the cost of poor. Although, KUKL Board consists of Kathmandu Valley municipalities and other public bodies under a scheme of public-private partnership, the result has been profit for private and loss for public combined with improper division of power, sharing of responsibility and ensuring public accountability with transparency.

What is more problematic is that traditional systems of water management within Kathmandu Valley practiced by the Newari ethnic community are also disappearing. As a result, the community management of huge amount of water collected and distributed from natural streams, ponds, lakes and stone taps have also been neglected, displaced and destroyed. The 5 municipalities and other local government bodies such as the Village Development Committees and District Development Committees have also been displaced from their community-based public duties to promote commercialisation of water management and supply through privatisation.

As a result, the scarcity of water has become chronic as more people from rural areas are fleeing to Kathmandu – the only place for business and employment opportunity as well as personal safety and security from ongoing conflict and violence. People also migrate to Kathmandu believing that the government will flood them Melamchi water soon.

Another main problem behind the increasing collapse of Kathmandu's water management and supply system is that it lacks clear definition about ownership of local water resources which is in high quantity – but largely ignored to (mis)justify the monster Melamchi project. There are conflicts between private tank-water suppliers and communities from where their common water is taken away virtually at free of cost but at the cost of water scarcity for drinking, irrigation and maintaining local ecosystem. It also has given rise to inter-community, inter-village and inter-municipality conflicts over access and use of existing water availability.

The author is currently undertaking a research on what went wrong in the publicly owned previous water supply system and community involvement at local level. This research covers the areas of weak and overlapping legal provisions relating to water right and institutional arrangement.

Additionally, it carries out a comparative analysis between public and private and public-private management of water in big cities with Kathmandu as the latest case study. It looks into the shortcoming created by the absence of communities in decision-making and effects of corporate approach to mega water supply through mega project resulting to poor delivery of quality water supply in an adequate and affordable manner, particularly for urban poor. Further, it analyses the huge financial, social and ecological burden created by such costly river diversion project, inefficient private management, inadequate regulatory bodies such as the KUKL and rooms for reform.

This research further explores the possibility and practice of how human rights, environmental and climate change-related issues can be brought into harmonisation. The framework suggested by the World Commission on Dams will also be analysed in the regulatory and social contexts of Kathmandu water management and supply system. The conclusions and recommendations of five different scoping and thematic study reports of Nepal's national dialogue on dams and development will also be discussed briefly so as to propose a new democratic and sustainable framework for reforms in existing water regulatory system as relevant to the above-mentioned social contexts, for example rich people getting easy access to water but the poor with no land for water-pipe connection and no income to pay high rate of tariff in the absence of any social security system or protection measure for them.

Likewise, the existing constitutional provision provided under the Interim Constitution on the right to health and environment will also be discussed in the context of what sorts of water management and supply systems will have to be created under the new federal system of governance that the country is going through at the moment. So this research clearly reflects the constitutional spirit and provisions to be provided under the new constitution-in-the-making in the proposed regulatory institutions relating to drinking water.

Maharashtra Water Resources Regulatory Authority – A Case Study of Regulatory Mechanism in India

Author: **Mr. Suresh Vithal Sodal,** Maharashtra Water Resources Regulatory, India

Keywords: affordability, accessibility, equity, economic regulation, sustainability

Introduction/Problem Identification

Water scarcity is an ever-growing global problem. Increased population pressures, improved living standards, and growing demand for environmental quality have all prompted governments to find better ways to manage their available water resources. In declaration at the Bonn 2001 International Fresh Water Conference and again at the 2002 World Summit on Sustainable Development in Johannesburg, ministries expressed concerned at the 1.1 billion people in the world who, at the beginning of 21st Century, live without access to safe drinking water, and 2.4 billion without access to proper sanitation.

Maharashtra State, which is 3rd largest state in India. However, the water sector has been affected badly by various problems viz. conflict within various categories of users and unsatisfactory levels of water use efficiency and cost recovery. There was thus a pressing need to tackle the situation from consideration of productivity, equity and sustainability.

Analysis/Results and Implications for Policy and/or Research

Management of water is an economic, social and political issue encompassing all sectors of an economy. Water resources are increasingly becoming a limiting factor for economic growth and human development. A holistic approach has there, been adopted by the state involving policy reforms, legal enactment, capacity building and stakeholder participation. Subsequent to framing of a State Water Policy in 2003, an important legal measure was taken in 2005 by enacting the Water Resources Regulatory Authority Act.

A social issue in the provision of water services has to be considered from the perspective of impact of policies on different income and consumer groups. Water pricing policies can contribute to environmental and economic goals but may face social resistance. However social concepts in water service provision include access and affordability. “Affordability” is social aspect of water service provision that is most clearly and closely linked to pricing policies. Affordability of water services may not be distributed equally across income groups or neighborhoods – a lower income household will inevitably pay a higher proportion of their income for water services than a higher income household does.

Charging water pricing structures to better reflect environmental externalities and resource cost will always entail social acceptability issues. Social water pricing can often contribute simultaneously to economic efficiency, resources conservation, and equity goals. Improving access to water services and filling water infrastructure investment gaps have cost implication, and the distribution of these costs is important for policy implementation.

Appropriate water pricing is an important incentive for water conservation and a disincentive for water pollution. Also, optimal levels of service in water supply and sanitation have both human health and environmental implications. Lack of access to good water is a key element of poverty, but pricing water in a way that reflects environmental and efficiency concerns can sometimes be controversial due to social consideration (especially affordability for low–income households).

The question is often framed as one of efficiency versus equity. However, these two approaches do not necessarily have to result in conflicting policy options. Under certain conditions, water pricing systems can promote efficiency while addressing equity goals. One such approach would define the basic needs part of water demand, access to which should be guaranteed for all (especially low–income) households, and beyond which the prices for water services should reflect economic and environmental policy objectives.

The Authority is the first of its kind in the country and criteria based water tariff taxation by a third party regulator has never been attempted anywhere else to date. Thus developing criteria for bulk water tariffs, based on sound economic principles and informed economic choices, was a challenging task before the Authority.

The proposed allocation of O&M costs to the 3 categories of users, considering 3 factors viz. affordability, accessibility and quantity and timeliness of supply. As per the Maharashtra Water Resource Regulatory Authority Act, bulk water tariffs in the state are required to recover the O&M costs of the irrigation system. The criteria for fixing tariffs for this purpose are to be determined in consultation with the beneficiary public.

Today every industry is expected to treat effluent and bring its discharge to the desired standard before release into the natural water course. In such case, basic rate can be charged. If effluent is not treated to revised MPCB standards a rate equal to twice the basic rate can be charged.

Users are however not absolved from the responsibility of ensuring efficient use of water and are charging, after use, water of prescribed quality. These objectives are to be enforcing through a system of penalties and incentives in the tariff structure.

Water pricing remains a complex process and is required to meet diverging financial, economic, environmental and social objectives. A major challenge therefore is designing tariffs in a way that strikes an appropriate balance among competing objectives.

After an elaborate public consultation process, the Authority has finalised the Criteria for Determination of Bulk Water Tariff. The State govt. is preparing the tariff proposal as per the Criteria. The first tariff order is expected to be issued by April 2011. The Criteria has a number of incentives to promote water use efficiency and incentives and disincentives for water quality improvement.

The characteristics of present tariff plan are simplicity (tariff plan is understandable and straight forward) and transparent (tariff plan evolved through a consultative process) and aims to achieve its multiple objectives.

Redesigning of Water Institutions in Developing Cities of the Developing World: Policy Choices for Urban Water Reforms in National Capital, Delhi

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Keywords: institutions, water reforms, choice and preference, preference heterogeneity, governance

Introduction/Problem Identification

Water crisis is a manifestation of crisis in governance and institutional failure in the developing world. Institutional arrangements governing water sector are undergoing remarkable changes in developing countries. Private sector participation (PSP) is being recommended to solve the huge challenges facing water supply services in the developing world. The focus has shifted to questions relating to optimal choice of various forms of PSP, its ex-ante impact assessment, and regulation. Policy sciences are characterised by complexities and fuzziness as facts are uncertain, values in dispute, stakes are high and decisions are urgent (Funtowicz and Ravetz, 1991, 1994). Customer preferences and choice for institutional forms of delivery including PSP has not been addressed adequately in developing country context. Planners need to aggregate opinion of experts, stakeholders and customers in the policy design.This presentation tries to explore answers to these questions in the discourse.

Analysis/Results and Implications for Policy and/or Research

The research has reviewed the empirical evidence generated by expert opinion, stakeholder consultation and household surveys across Delhi, the main hub of reforms in electricity, telecom, roads and water through stated preference technique. The data analysis had helped in statistically testing of the need assessment of consumers; criteria option decision by experts and the consensus evolving solution through a coalition analysis of all stakeholders. It has produced two basic realms of analysis:

- Broad Public Perception of Reforms.
- Specific Public Preferences between Competing institutions in urban water systems.

Planning hierarchy and preference of water delivery institutions: Preferences for water supply institutions vary with planning hierarchy and the socio-economic strata of the city. People have different preference structure for choice of institutions based on service attribute specifications, the consequent price and socio economic characteristics. The consensus social choice depicts preference heterogeneity due to spatial typology defined by socio economic characteristics of the sample population. Differing customer class and end use rejects the notion of a centralised service provision mechanism of PSP (Concession And Divestiture), as it will leave majority of the customer classes dissatisfied. The delivery mode therefore has to be based on spatial typology of the settlement. Price increases are also acceptable to people in the Corporatisation mode if quantity and quality of water improves without increase in prices.

Preference reversal due to Price increase: Given the choices these urban houses mainly slums and unplanned areas indicate preference in ordering these choices in increasing level of attribute quality but while using prices order differently. The results are thus an indication of preference reversal (Tveresky et al 1999). The introduction of price attribute alters the choice selection option by the household in terms of preference reversals both positive and negative.

The broad contours of reforms in urban water delivery sector can be outlined based on the emerging empirical realities in the developing city of Delhi:

1. Social choice reflects preference heterogeneity and needs to be captured in policy design: The finding reinforces the observations that the expert and city specific stakeholder consultations are influenced by the motivation and the thrust of perceived institutional change of private sector participation.
2. Private Sector participation may work in a developing city: The change of public perception and preference of institution is partially in response to the felt needs in the water sector and realisation that privatisation in areas of essential services of electricity, telecom and roads has shown improvement.
3. Customer's preference for reform through private sector participation is sensitive to differences in their scope for provision.
4. Institutional and governance reforms should precede pricing reforms: The results confirm that iinstitutional choice is not only about specifying decisions based on different actors, but also determining the rules that govern the way that these choices are adopted in policy design. The results are providing limited support for the hypothesis that poor services may force respondents to select private sector as the choice. These are good or at best plausible explanations for the introduction of reforms via increasing PSP route in spatial context. All customer class and experts support the importance of reforms in the water delivery. The effective demand for radical reforms through complete privatisation is limited as revealed in the empirical results. People have limited willingness to change and negative attitude towards privatisation due to apprehension of drastic price rise. The tariff structure for each user type must therefore reflect distributional fairness in tune with allocative efficiency. Measures need to be designed for the concept of universal service obligations.
5. One institutional model does not fit for all and romancing of state and market through governance reforms is vital. The empirical evidence indicates that the public sector reforms can be reconstructed by institutional and governance reforms combining state water utilities and market oriented private sector for delivery of water services. This change of direction is in response to the realisation to the opposition of privatisation indicated in the results. The state in the emerging governance framework can maintain an overall control of the delivery institution but must allow scope for PSP at a spatial decentralised level by introducing progressive but gradual commercialisation of services. The results are an indication that state does have a social and merit obligation of providing water. This feeling is quite dominant in a developing city with huge slum population. There is a need to redefine the role of the state.

A Compilation by Engineering Professionals of Capacity Building Experience

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Keywords: guidebook, capacity building, engineering, WFEO, UNESCO

Introduction/Problem Identification

The World Federation of Engineering Organisations (WFEO) in October 2010 launched the first edition of a guidebook setting out its understanding of the complexities facing the engineering community regarding capacity and sustainability issues. The guidebook suggests approaches to the building of human resources and capability, and presents a collection of philosophies, programmes, initiatives and good practices collated from experience.

Both UNESCO (WFEO's partner in this initiative) and WFEO are of the view that given the strong relation between economic and social development and a critical mass of practitioners skilled in engineering and science, stronger efforts should be made to develop and build this capacity in developing countries. However they are also of the view that the decline in recognition of the role of engineering in many developed countries necessitates that similar effort should be made in all countries.

Analysis/Results and Implications for Policy and/or Research

The principles and ideas proposed in the guidebook (at http://www.civils.org.za/Publications/tabid/81/Default.aspx) are not position papers or policies of either UNESCO or WFEO, but represent a collection of philosophies, programmes, initiatives and good practices collated from the experiences of a range of engineering organisations and engineering professionals. The following is only an outline, indicating how this "collection" is assembled in the guidebook.

Success in capacity building will only be achieved through a systematic approach, taking into account the following "pillars" of capacity building:

- Individual – to ensure that the needs of the individual are met.
- Institutional – to ensure there are educational, professional, technical, governance and statutory institutions, systems and support structures in place. The institutions to be both public and private sector, including stable, viable and responsible businesses, commercial enterprises and financial institutions that can support the provision, operation and maintaining of infrastructure and services.
- Technical – to ensure there are technical standards, codes of practice, technical literature and guidance material and so forth to underpin and support ethical and appropriate engineering, technological and procurement practices.
- Decision-making – to ensure decision makers have sufficient information and understanding as well as access to knowledge and skills to enable them to make logical and rational decisions.
- Finance – to ensure that adequate and affordable finance is available to enable sustainable solutions, and that financial practice is at all times responsible.
- Resources, tools and supplies – to ensure that there is access to appropriate, affordable and suitable materials, tools and supplies for the building, operating and maintaining of infrastructure.

One size certainly does not fit all, and in each instance where the building of capacity is deemed to be advisable, the systematic approach introduced above needs also to ascertain to what extent, and in what manner, it is necessary to address all three levels:

- the level of the enabling environment,
- the organisational level, and
- the individual level.

Each capacity building programme or initiative must:

- be preceded by:
  - identification of stakeholders;
  - assessment of requirements and identification of priorities for capacity building (that is, priorities in terms of both what capacity to be built, and whose capacity to be built);
  - identification and mobilisation of agencies that will build the capacity, and mentor and sustain this in the longer term;
- be followed by assessment of the results of capacity building; and feedback, leading to continuous improvement in capacity;
  - be iterative (i.e. a first round of capacity building might be of a basic nature only, with each round successively raising the bar).

To reiterate: capacity building –

- must be focused on the purpose of improving capacity – e.g. on improving service delivery by those in whom capacity is being built – and not be about building capacity for its own sake, since it is all too often is the case that the need to apply the capacity is lost sight of;
- must address needs according to priority.

The efficacy of capacity building must be evaluated. Part of the evaluation must be an assessment of cost-effectiveness – i.e. was the effort and cost of capacity building justified by the improvement in e.g. service delivery? If it was not, then maybe lack of capacity was not the bottleneck, and some other way to improve service delivery should rather have been undertaken. Alternatively, the capacity building needs might have been misunderstood, or the effort might have failed because of its content or inappropriateness, or even because of the way in which it was conducted and by whom.

Part of that assessment prior to deciding where and what capacity must be built, should be identification of the weak links in the service value chain. If the objective is to improve service delivery, say, should priority attention go to some other link or links that is or are weaker, rather than to capacity building?

A final chapter describes in some detail a case study that brings together all of the above.

Currently being prepared as a resource additional to the guidebook, and complementing it, is a compendium of programmes, projects, and initiatives. The compendium is however intended to be more than just a resource to be consulted. The intention also is that it will stimulate exchange of ideas, and that the best of these will be captured and added to the compendium.

Silent Violation of Human Rights to Water and Sanitation in Africa: What Miss in Policy and Regulation to Allow Effective Access to the Poor?

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Keywords: IBTs, lifeline, capacity to pay, human right to water, policy standards

Introduction/Problem Identification

African countries are making outstanding efforts in reducing water price to have a tariffs system that would allow access to services and promote human right to water and sanitation, as requested by the UN Resolution adopted by 124 countries in July 2010.

But unfortunately on the ground, the affordability for minimum water and sanitation services is never a reality, and this could demonstrate from theoretical perspective, a permanent violation of the right to water and sanitation.

They are several important questions that need to be considered for water and sanitation services pricing strategy and policy framework to better target the poor, and to easy regulation works for effective access.

Human right to water and sanitation is silently violated almost everywhere in Africa by ignorance, lack of knowledge on water governance, lack of clear standards, and lack of effective regulation.

The paper shows evidence on the ground and what miss to make it happen.

Analysis/Results and Implications for Policy and/or Research

Water is common good, human right...but also private good...

Water is a common good that must be shared and managed for present and future generations. There is enough water for all, and good solutions exist that could ensure that everyone has access to clean drinking water and adequate sanitary conditions. People have the right to a water supply that meets their basic needs. The UN High Commissioner for Human Rights has stated that all individuals have a right to water and sanitation. It is the responsibility of public utilities to ensure that this right is met.

The social burden in many African cities makes the service provision very hard for the suppliers. The provision has a financial implication for which a cost recovery needs to be achieved. That's why the nature of water as private good should also be understood.

The appropriate strategies to combine these characteristics of water remain a big challenge for the suppliers who could not escape from Government interference in the management. Indeed, what is lacking is foremost the reasonable political will to tackle this challenge in supporting water utilities management for effective social, financial and environmental sustainability of water and sanitation services provision.

IBTs as common Public utilities strategies to combine the multi-characteristics of water...

Most of the African water utilities adopted Increasing Block Tariffs (IBTs) for their water tariffs structure, as response to the social, financial, and environmental sustainability. In such a system, the population (mainly poor people) is supposed to pay less for water services respective to their capacity to pay subject to their revenue, in a way to guaranty the Lifeline (basic human need) that should define the first blocks (social blocks). Whereas the last blocks should comply with the use above the Lifeline in a way to the utility costs recovery, and with the abusive use to guaranty the environmental sustainability based on the scarcity of the resource in economic term.

The IBTs system has hence a minimum of three blocks which ultimate aim is to ensure the fair collection of the population revenue dedicated to water services. Ideal IBTs should not allow any household spending more than a certain percentage of his revenue defined as his Capacity to Pay (CTP) to the water and sanitation services.

The Lifeline and the CTP are the two most important elements to be used in setting a IBTs system, and for which clear standards need to be set and communicated at national, regional and international levels.

IBTs with a lack of clear standards to enforce policy...

In most of the cases, the reasoning of standards is not behind IBTs system in Africa, by lack of information and knowledge on the issue. The issue is not so transparent, and is too political oriented.

About the Lifeline, Gleick (1996) argued that 50 litres is a "basic water requirement" that every state must be obliged to meet. This is largely backed up by the World Health Organization (WHO) which states that 20 litres a day would represent a 'high health concern. Falkenmark (1997) argue that 100 litres is more appropriate for a 'decent and realistic quality of life in developing countries, even in the context of water scarcity, and USAID recommends 100 litres.

About the maximum household expenditures (CTP), Vodounhessi (2006) argued that less than 5% of household revenue should be dedicated to water and sanitation services, and fractioned this percentage into 3% for water services, 1% for solid waste services, and 1% for excreta services.

Capturing impact of IBTs... Case of Burkina Faso...

The real situation today is that poor are paying higher than rich people, as part of their revenue for water services. This is due to inappropriate application of the IBTs, mainly without modeling the local context of water provision, where sometimes, small scale private providers (SSPP) could intermediate in the supply chain.

In Burkina Faso, the National Water Company (ONEA) has a mandate to supply potable water to private and public sector consumers on a basis that enables the utility to fully recover its costs. Water tariffs have been amended in July 2008, where the theoretical household Lifeline of 11m^3 could fall under the two first blocks of: 0-8m^3 of 0.287€/m^3 and 9-15m^3 of 0.656€/m^3. A head of household could then buy the basic water of 11m^3 at 6.474€ per month, if he has the water network connection. If not, he will benefit from the special standpipe tariffs where the 11 m^3 cost 4.573€ without the transport cost and the time lost at the crowded standpipe. In most of the case, households referred to SSPP to whom they have to pay to end up with a real total cost of 16.007€ to purchase the lifeline water. This cost represents 32% of the minimum revenue which is about 50€, and is higher than the 3% acceptable for water. It would be 13% if there is water tap at home.

Regulation of the Discharge of Wastewater in Central America (the Model Regulation)

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Keywords: wastewater, regulation, pollution, standards, model

Introduction/Problem Identification

Central American region is conformed by Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and Dominican Republic. The ascendant growth of population in cities and their insufficient infrastructure, with its vast slums that lack basic services, collect wastewater discharges uncontrolled and inappropriate disposal of solid waste, further deteriorating the quality of supply sources. The percentages of treated wastewater in the Region are: Costa Rica 37%, Dominican Republic 20%, El Salvador 3%, Guatemala 9%, Honduras 11%, Nicaragua 50% and Panama 21%.

Analysis/Results and Implications for Policy and/or Research

One of the commitments outlined in the Alliance for Sustainable Development -ALIDES (a document signed by Central American Presidents in 1989) is to establish specific regulations for the monitoring and control of water pollution. This commitment is responsibility of the Central American Commission on Environment and Development (CCAD) and it will be implemented gradually, allowing for the establishment of decentralised mechanisms for surveillance and monitoring, promoting civil society participation in these processes.Within this context, CCAD held jointly with the Ministries of Health, a Regional Policy on Health and Environment where one of his priorities is precisely the sector of water supply and sanitation with specific lines of action such as improving the quality and coverage of the provision of potable water, sewerage and sanitary treatment and prevention, control and treatment of wastewater discharges, with particular emphasis on those sectors from tourism, chemical, mining, agro-industrial zones, residential, etc., to adopt this policy will benefit this countries by the use of concepts and regional standardisation of interoperable standards in health and environment and especially the protection of health and environment of communities.

Within this perspective, the Central American Regional Environmental Plan, PARCA, for 2005-2010 establishes a better wastewater management, as well as reference standards for water quality harmonised. In third version of PARCA for 2010-2014, it establishes and update and integrate technical standards on emissions, wastewater and waste in the region's countries. CCAD has elaborated "The Regulation of the Discharge of Wastewater" guideline which was agreed with the regional authorities of the Environment and Health, Water and Sewerage Companies and Private and Public Business Sector, this was a process that began in 2002 and it was approved by the Council of Ministers of Environment in Nicaragua, 2005. It represents an important guide taken in to consideration within the countries in the region.

As a result of the analysis of issues related to wastewater regulations in all countries, CCAD developed a set of regional regulations concerning this matter. It should be mentioned that legal instruments would have special regulations that define the procedures to follow in this matter (the case of El Salvador), as well as technical standards that establish maximum permissible levels of discharges to receiving waters and sewage discharge (as in Honduras and El Salvador) and Regulations, which provide for both issues (Guatemala, Nicaragua, Costa Rica and Panama).

For this analysis, CCAD considered at first the following needs:

- Regional common language: within the region the different regulations on sewage have technical definitions that call the same concept with different names. This points to the need of use a unified glossary of technical concepts and processes about this issue.
- Laws that identify the same problems: the 8 countries have wastewater regulations but they are so heterogeneous.
- Common codes identifying companies/industries: although standardisation of wastewater generators, according to the International Standard Industrial Classification of All Economic Activities (ISIC), has been more assimilated by Costa Rica and Panama, whereas El Salvador and Honduras are still working on the issue, it is necessary to encourage similar actions in Guatemala and Nicaragua.
- Unified parameters for the sector: it was prepared a table of comparison between the various parameters used in the wastewater regulations in the region. As a result, a total of 63 parameters were identified to define maximum permissible limits for sewer discharge and 95 parameters to define maximum allowable limits for discharge to the receiving body.
- Common sampling methods: some regulations define requirements, and some others establish the methodology according to APHA, AWWA and WEF.
- Common sampling Frequencies: in the region there are different periods for taking sampling among these regulations.
- Classification of receiving water bodies based on the use: there is no classification of the receiving bodies based on the use, although some studies base (Lempa basin-El Salvador, Tárcoles river-Costa Rica). Furthermore, Costa Rica worked a draft regulation for the assessment and classification of the quality of surface water.
- Common administrative processes: a very important element of analysis is the provision of a structured and implemented for environmental monitoring (monitoring and water analysis), which means that the tools developed on the subject, are more theoretical, with little practical application.
- Standardise discharge limits to common ranges: there is a wide range of values for the same parameter in the different national discharge regulations.

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