

ABSTRACT VOLUME

World Water Week
in Stockholm

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Water for Development

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Workshop: Implementing the SDGs in the Post-2015 Development Agenda

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Can shared sanitation in slums be adequate sanitation?



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Keywords: sanitation, shared, sdgs

Introduction and objectives

Shared sanitation was not included as improved sanitation in the MDGs as there were concerns that the hygiene conditions were not adequate. There is an increasing body of evidence to support this. However, there is also recognition that shared sanitation is a necessary step on the pathway to improving access to sanitation, particularly where space is a limitation such as in informal settlements. The objective of this paper is to inform policies on how to improve adequacy of shared sanitation, including public sanitation.

Methodology approach

This work is based on a 3-year study in 8 informal settlements in Kenya, Rwanda and Uganda. Quantitative data (from 5,500 household surveys) has been used to construct an index for adequate sanitation, based on 22 factors derived from the normative criteria for the human right to sanitation, encompassing availability, accessibility, acceptability, safety and affordability. This is triangulated with qualitative data from focus group discussions (n=83), interviews with local residents and stakeholders (n=99) and deliberative forums (n=3).

Analysis, results, conclusions and recommendation

Shared and public sanitation facilities provided access to sanitation for the majority of the population in the informal settlements studied: in Kigali and Kisumu 73% and 98% respectively used shared sanitation, in Kampala 46% relied on shared sanitation with a further 42% relying on public latrines. The average number of households sharing ranged from 4.3 in Kigali to 6.8 in Kisumu where 90% had more than 4 households sharing. Lack of space was reported by households as a barrier to installing sanitation. Shared and public sanitation facilities will continue to be necessary in these settlements as the density of households and topographic challenges will limit the development of individual sanitation for household.

Analysis of access to adequate sanitation identified only 3% of households had access to adequate sanitation. The barriers to adequate sanitation varied by city. While shared sanitation can be considered adequate, this analysis identified it was significantly less adequate than private sanitation. Privacy and availability of shared sanitation systems were major barriers to the systems being considered adequate. These were identified in focus group discussions as leading causes of open defecation and use of flying toilets, which were present in all the settlements studied.

Unless sanitation is adequate, people will continue to resort to open defecation, flying toilets and other alternatives that contaminate the environment. This contamination can lead to diarrhoea, stunting and other poor health outcomes. This paper will present analysis of the relative importance of drivers for open defecation (including flying toilets) in urban informal settlements in East Africa. The reconsideration of sanitation in the Sustainable Development Goals needs to consider how we can achieve adequacy of sanitation, including in shared sanitation, and measure how frequently people are resorting to open defecation.

Water for Development – Capacity Building from Plans to Practice



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Keywords: Capacity Development, IWRM, strategic transboundary planning, sustainable water management, transferability of experiences, indicators

Introduction and objectives

One of the challenges in making progress on the Millennium Development Goals (and the SDGs, their anticipated successors in the post-2015 context) has been developing capacity building mechanisms to enable countries to implement their plans to reach these goals. Water management, integrated across multiple sectors, requires capacity built and sustainably supported to ensure long-term success of national development plans. As more tools emerge to increase water use efficiency, it is critical that those who most need them know how to use them. This becomes increasingly critical in the transboundary context where encouraging harmonization and managing trade-offs are common challenges.

Methodology approach

Experiences from the Nile Basin and other transboundary river systems provide key insights on specific steps needed to build capacity to meet water related MDGs. These experiences inform the case study of the Kura River Strategic Action Plan (SAP) for Azerbaijan and Georgia. These outline specific steps and stages required to sustainably increase the capacity across multiple sectors. This focuses on integrated multi-sectoral water resources management capacity building for improved food, energy, water and environmental security. These efforts target public and governmental sectors, the private sector and civil society and are gauged by indicators to measure baselines and progress.

Analysis, results, conclusions and recommendation

The experiences presented are from the UNDP-GEF Kura Aras Project. The previous phase conducted baseline capacity building trainings in IWRM for 62 rising decision-makers across the region, with more than 72 hours of country and basin specific IWRM curriculum topics. This initial effort measured baseline pre- and post training results. The training curriculum, developed and conducted by international experts emerged from a wide range of IWRM Case studies from Europe, Africa, the Middle East, the Caribbean, and Asia, and featured national experts to increase relevance to the participants. Subsequently, UNDP-GEF supported the countries of Azerbaijan and Georgia to develop nationally based IWRM Plans that served as a foundation for the regionally agreed SAP.

The SAP implementation features increased IWRM capacity building efforts to enable those in professional and civil society positions to implement their national and regional plans. In addition to reviewing the initial IWRM trainings, this paper outlines the specific steps necessary to build in-depth capacity for sustainable water management across sectoral stakeholder groups. This includes increasing the use and understanding of technological tools, strategies for empowered awareness raising, and institutionalizing shared learning and experience exchanges. In-depth aspects for using mathematical models for water resources management, the use of decision support systems, GIS applications, ecological, social, gender, economic valuation of water services, and political approaches

for sustainable water management are applied to increase the scope and scale of stakeholder involvement and investment.

This is carefully monitored with specific indicators to gauge progress. Lessons learned are carefully tracked to benefit from successes and failures in the application of the integrated capacity building efforts. An adaptive approach is presented to continuously update and enhance the capacity building plans based on analytical assessment of the results of each phase of these plans to increase transferability of the approach used in the Kura.

Innovative sanitation financing to make Indian cities open defecation



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Keywords: Sanitation, Toilet, Open defecation, Urban, Finance

Introduction and objectives

The post-2015 development agenda includes a focus on eliminating open defecation. The Government of India has also set an ambitious goal of eliminating open defecation by 2019 reflecting importance of sanitation articulated by the new Prime Minister as “toilets first, temples later”. For cities this implies reaching out to 15 million households that do not have toilets in their homes and requires an estimated investment of over USD7.4 billion at an average cost of USD500 per toilet. Large scale surveys in two Indian states suggest that the principal reasons for lack of own toilets are lack of space and affordability.

Methodology approach

A key difference in urban sanitation is that demand for sanitation does exist. However, to achieve universal coverage in 5 years requires addressing the issues of space constraints and affordability. Our studies suggest that innovative solutions using group housing are possible to overcome space constraints. However, affordability constraint cannot be tackled simply with subsidies. Subsidies at this scale are fiscally not sustainable, and equally importantly, can distort demand and result in leakages. Thus a demand-led approach is necessary with partial incentive subsidy to unlock demand, and creating improved access to credit for households to ensure affordable access.

Analysis, results, conclusions and recommendation

Our ongoing work in cities in a highly urbanized Indian state suggests several innovative finance options: a) credit to households by commercial lenders such as housing finance institutions and microfinance institutions that see a potentially large market among urban households, b) community based systems such as self-help groups to provide toilet credit to their members, c) local government own funds to support additional assistance to weaker sections, d) funds from the corporate sector as part of the mandated 2% of profits to be used as Corporate Social Responsibility (CSR), e) new platforms for crowdfunding to attract funding for sanitation, and f) tapping the new breed of social investors willing to forgo some returns on investment to ensure social impacts.

Tapping these new sources will require several policy changes. An appropriate institutional framework will be needed to attract these new lenders and investors – possibly at two levels: a development impact fund at national /state level to mobilize debt funds for on-lending at affordable costs and a City Sanitation fund at state or city level to meet support costs for city government and to provide partial subsidies to households. We are currently working at both these levels to explore the possibility of setting up these mechanisms.

Despite the ambitious targets, government funds available for eliminating open defecation are only

20% of total investment suggesting the need for leveraging. The new resources, if used well, can also help ensure greater accountability and improved outcomes in terms of delivery and use of toilets.

For implementation, local governments will play a crucial role. Their rather limited capacities necessitate a supporting ecosystem to be developed. While innovative funding is only one part of such an ecosystem, it can play a major role in mobilising communities and unlocking demand for improved sanitation.

Building institutional capacity for water quality monitoring in Sub-Saharan Africa



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Keywords: Monitoring, water quality, institutional capacity, sub-Saharan Africa, post-2015 sustainable development goals

Introduction and objectives

Water quality monitoring is essential for ensuring the safety of drinking water supplies, verifying water treatment efforts, and measuring progress towards national and international safe drinking water goals. In almost all countries in sub-Saharan Africa, national policies (often based on WHO guidelines) legally mandate routine water quality testing; however, microbial water quality testing in low-resource settings remains limited. As a result, data are not available to guide water quality management, and waterborne disease transmission remains high. To address these issues, we explored building local institutional capacity for water testing programs to strengthen national water quality monitoring across sub-Saharan Africa.

Methodology approach

The Monitoring for Safe Water (MfSW) program is an initiative to increase access to safe drinking water in sub-Saharan Africa through improved testing and management of water quality. We first collected retrospective microbial water quality data from 72 water suppliers and public health agencies covering over 66 million people across 10 countries. We then selected 26 of these institutions to participate in the MfSW program, which provided financial incentives to build local capacity of monitoring programs. For over two years, we collected and analyzed quantitative data on institutional performance and qualitative data on the constraints and challenges to testing.

Analysis, results, conclusions and recommendation

First, we established the current status of microbial water quality testing in sub-Saharan Africa. Almost all institutions (99%, 71/72) reported some type of water quality testing and 87% (60/69) reported some microbial testing in the past year. Additionally, most of the countries (7/10) had established national drinking water standards that specified microbial testing requirements; the remaining three countries relied upon WHO Guidelines. However, despite established regulations, only 44% of institutions met their national standards for the frequency of microbial tests conducted annually. Similarly as most national standards are based on WHO guidelines, only 44% of institutions met WHO guidelines for testing frequency.

Why doesn't microbial water quality testing meet regulatory requirements? To explore this further, we then provided financial incentives and evaluated institutional testing performance. By collecting monthly data of microbial testing results from 26 institutions over two years (>25,000 data points), we observed variability in testing performance in terms of meeting institutional targets and testing frequency. This variability allowed us to compare testing performance with hypothesized constraints related to equipment, training, transport, personnel, accountability, budgeting, and other factors.

Through this evaluation, we developed an Institutional Capacity Assessment tool that uses a rigorous scoring system to evaluate institutional water quality monitoring programs.

This Institutional Capacity Assessment tool identifies five enabling factors that are essential for water quality testing, each with distinct elements for scoring on organizational capacity:

1. Institutional Accountability
2. Institutional Capacity
3. Program Structure
4. Financial Management
5. Access to Equipment and Services

Overall, we have found that adequate microbial quality testing is possible in low-resource settings sub-Saharan Africa. Institutional water quality testing programs can be evaluated and improved using the developed Institutional Capacity Assessment tool. Lastly, institutional accountability is essential for successful water quality monitoring programs.

Monitoring WASH in health centre and schools for sustainable results



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Keywords: WASH, monitoring, post-2015, SDGs

- Gender disaggregated toilets with bins with lid in girls' washrooms for WASH in schools.
- Basic drinking water service of 5 litres per day per patient and staff from a functional water source on the health centre premises.

The numerous other indicators developed for both health care facilities and schools will be described in the full paper.

Introduction and objectives

The formulation of the post-2015 SDG-agenda is in its final stage. The provision of water, sanitation and hygiene (WASH) services at household level are clearly addressed in the latest proposals, but the provision of WASH services in schools, health centres, prisons, refugee camps and at the workplace is not. Currently, 38% of health centres and 31% of schools in developing countries don't have access to an improved water source. This abstract shows a rationale for the inclusion of extra household monitoring for WASH in the post-2015 development agenda, and includes a number of suggested indicators.

Methodology approach

People not only live in their home, but also go to school, work, hospital, prison or other institutions. Health risks can emerge in any of these settings. However, major source of health risks are found in hospitals and health clinics.

Two example projects are chosen: one around WASH in health centres in Tanzania and one around WASH in schools in Uganda. The results of the two projects show the impact of WASH facilities on health. In both cases, random sample questionnaires have been used to gather empirical data. From the example projects, the most relevant and cost-effective indicators have been formulated.

Analysis, results, conclusions and recommendation

In central-Tanzania 100 primary health facilities are currently being upgraded with water supply and sanitation systems. This intervention is aimed to reduce the high risk of infection transmission and improve quality of care in health facilities. During the inception phase 186 health centres have been visited of which 100 centres are chosen through the FIETS sustainability model. This model includes Financial, Institutional, Environmental, Technical and Social sustainability. The 100 highest ranking health centres are assumed to be having the highest impact on society and the highest likelihood to have a sustainable hence durable outcome.

In seven districts in Uganda a random sampling of SNV primary schools was carried out by IRC. The sample size was 200 questionnaires with a focus specific target groups, namely: girl pupils, senior women teachers, and senior head teachers were administered. Based on the study, menstruating school girls are shown to be missing 10% of all school days per year. The results of the study reflect that one key means of keeping girls in primary school is the provision of better menstrual management materials and facilities. If not addressed properly menstrual hygiene management will not only lead to more girls missing school, but can potentially cause an increase in the number of girls dropping out of school altogether. Beyond showing health impact within specific recently implemented projects, several indicators have been developed that are relevant, measurable and cost-effective. These include:

Capacity Building Towards Sustainable Cotton Cultivation: Water Footprint Reduction Strategies



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Keywords: Water Footprint, Cotton, Sustainability, India, Agricultural Practises

Introduction and objectives

Cotton is a major natural fibre for human consumption and comprises approximately half of all textiles. Its production employs almost 7% of all labour in developing nations and occupies 2.5% of earth's arable land while consuming 25% of all agrochemicals. Naturally, it also has an enormous impact on freshwater resources and therefore sustainable cotton production is as critical to meeting the SDG's as it is to the textile industry. To develop a sustainable water footprint strategy for C&A's supply-chain, a Water Footprint Assessment (WFA) was conducted for cotton cultivation in three states of India: Gujarat, Maharashtra and Madhya Pradesh.

Methodology approach

India is the largest cotton producer in the world and C&A sources the majority of its cotton from these three states, which also produce nearly half of India's cotton. This study evaluated the consumptive water use (blue and green water footprints) and water pollution (grey water footprint) of three agricultural practices: conventional, organic and REEL (Responsible Environment Enhanced Livelihoods based on integrated pest management). Data on water use, fertiliser and pesticide applications in the growing seasons of 2012-2014 were collected from 1150 farms distributed across the three states.

Analysis, results, conclusions and recommendation

The results show that the water footprint of cotton cultivation varies depending on farming practices, climate and socio-economic factors. On average, conventional farms had the highest total water footprint per ton of cotton produced, whilst REEL farms had the lowest. The grey water footprint, primarily attributed to pesticide application, is the largest component of the total water footprint with the result that organic cotton has on average the lowest grey water footprint. The blue water footprint is comparatively small in all cases, as the majority of production is dependent on green water from monsoon rains. Within these categories of practices was a wide variation between states, with less developed Madhya Pradesh farms performing poorly in comparison to more advanced Gujarat.

Through this analysis of farm level data, agricultural practises were identified that could reduce the water footprint while maintaining the livelihood of farmers, such as the REEL programme, where the efficacy of capacity building among farmers was demonstrated. Both organic and REEL farms benefitted by reducing their input costs while increasing their revenue through higher market prices and increased yield.

Responding to the grey water footprint's large share of the total water footprint, training farmers in alternatives to conventional pesticides is a critical step toward improving water quality. This shift, together with better soil and crop management, more efficient irrigation technologies, mulching

and timing of planting, cotton farmers can improve their livelihood, while contributing to more sustainable water use. Water Footprint Assessment highlights the transitions needed and this study demonstrated the need to increase the capacity of cotton farmers in India to use water efficiently and to have improved income, thus directly working towards the SDG's.

National strategies for Water Sector Capacity Development: Colombia, Indonesia, Uganda



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Keywords: capacity development, national strategy, leadership, action research

Introduction and objectives

The proposed Sustainable Development Goals present a paradigmatic shift in their attention to implementation considerations, with capacity development at their core. In order to overcome a 'patch work' of capacity development efforts, national strategies for water sector capacity development are emerging as a coordinating framework. Some countries have already embarked on developing and implementing such strategies, while others are only at the beginning, deliberating their necessity. How can national strategies for water sector capacity development be developed and implemented, with high-level political buy-in and involvement from multiple actors in order to ensure sustained, adequate human, organisational and institutional capacity?

Methodology approach

Drawing on policy and strategy development theories in combination with insights from leadership literature, we developed a draft conceptual framework to verify on the basis of empirical research. For that purpose, three countries from three different continents (Asia, Africa and Latin America) were selected for action research, namely Indonesia, Uganda and Colombia. In-country events with a broad range of national stakeholders were held in 2014 and 2015 for supporting, and reflecting upon, the national processes of developing and/or implementing strategies targeted at water (and environment) sector capacity development. The resulting findings were complemented by desk research of historical strategy developments.

Analysis, results, conclusions and recommendation

Each of the three cases has its own set of physical (geographic conditions and water resources, exposure to climate change risks), socio-economic (% and growth rural/urban population, economic growth, GDP per capita, education system performance, etc.) and political parameters. Within and cross-case analyses revealed the stage of strategy development as well as the local dynamics of each case that lead to the current progress. With respect to the development and implementation of a capacity development (CD) strategy, Uganda is at the most advanced stage, with a completed strategy and pilot implementations already taking place in selected sub-sectors; this is followed by Indonesia's draft strategy development (at ministerial level) and up-scaling efforts; finally, although a comprehensive policy for Integrated Water Resources Management is in place in Colombia that pays attention to institutional capacity, the development of an all-embracing CD strategy is still in a deliberation phase. Progress towards national CD strategies seems to be strongly related to the countries' dependence on foreign aid and technical assistance, putting the least developed among this sample (Uganda) in the lead.

Careful deliberation (and strategic CD efforts!) will be required to ensure longer term leadership for the national CD strategy within the country, as well as its sustainable implementation and updating.

Moreover, local culture seems to play a very influential role in defining the type of capacity 'gap' that is most salient and the extent to which this can be addressed by a national CD strategy. Based on our findings, we propose guidelines for the development and implementation of water sector CD strategies that are intended as a means to help develop capacity at various levels (individual, organisational, enabling environment, civil society) and among all stakeholders (private and public sector, non-governmental, civil) in a concerted and sustainable way, for the water sector and beyond.

Implementing, monitoring and financing the SDG in rural Africa



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Keywords: rural water services, handpumps, sustainable development, monitoring, mobile payments

Introduction and objectives

Implementing the SDG for universal rural water services in Africa requires linking institutional, operational and financial transformations. We report on a study in Kitui County, Kenya, that has operationally tested a new model based on an innovative monitoring system. This has produced dramatic improvements in water service delivery. The model focuses on improving the performance of rural handpumps that serve around 200 million rural Africans. The feasible transition from a pilot study to a viable business model is illustrated in changes in user payment behaviours contingent on operational efficiency. The model is replicable and we illustrate wider uptake across Kenya.

Methodology approach

In 2012, handpumps in Kitui County, Kenya, were fitted with transmitters which automatically send daily usage data. Baseline surveys, focus groups, workshops and interviews were conducted with government, donors, private sector and communities to design and monitor the pilot. In 2013, a professionalised maintenance system was introduced using the data to trigger maintenance responses. In 2014, a mobile payment system for maintenance services was designed to reflect handpump users' payment preferences. New indicators have been designed based on data flows to monitor service reliability, water demand, unit cost of water production and revenue collection rates.

Analysis, results, conclusions and recommendation

Results of this study provide new evidence suggesting that institutional, operational and financial challenges in rural water provision may be addressed through data-driven professionalised maintenance services. The findings of this study include (a) a ten-fold reduction in handpump downtime to under three days; (b) a fairer and more flexible payment model contingent on service delivery; (c) new and objective indicators to guide rural water infrastructure investments and regulatory reform.

Following the 2013 pilot, communities were consulted on a variable tariff based on observed usage or priority use (schools, clinics). Handpump committees agreed to a rolling, one-year maintenance contract with a new and locally-based maintenance service company. The contract between communities and the maintenance service provider requires monthly payments based on long-term handpump usage levels that are paid through the mobile payment platform, M-Pesa. The maintenance service provider guarantees to repair breakdowns within three days with penalties for under-performance.

The model reduces operational and financial risks through institutional innovations. Communities benefit from lower average repair costs and avoidance of unpredictable, high-cost repair events. The latter can leave handpumps unrepaired for many months, or abandoned, wasting capital investments and forcing people to search for more distant and less safe water sources. A long-term financial system is being developed using results-based financing mechanisms linked to the transparent and regular flow

of performance metrics. Government and donors can monitor their investments to promote value for money and social inclusivity.

New indicators for rural water service delivery are informing national water services regulation in Kenya. This offers a pathway to regulate and improve water service delivery for the majority rural population, who have the lowest levels of improved water access. A larger programme in Kwale County now reaches over 40,000 people with similar or better results.

Improved Water Use Efficiency in Irrigation: Role of Water User Associations



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Keywords: Water User associations, Water Usage Efficiencies, Participatory Irrigation Management, Data Envelopment Analysis

Introduction and objectives

The Agriculture Sector remains the largest consumer of water globally. Sustainable food productions depend on irrigation, and hence, improved water usage is critical in the sector. However, efficiencies of water usage in Irrigation sector are not determined and remain unknown in India.

Large Irrigation projects in India are now promoting formations of Water Users Associations (WUAs) to encourage Participatory Irrigation Management. However, benefits to WUAs are not linked with their water usage efficiencies, and hence improved water usage is not on the agenda of farmers. This paper evolves a framework to measure efficiencies of WUAs taking a real-life case study.

Methodology approach

The paper establishes the need for measuring water usage efficiencies in Irrigation Sector, and develops a Data Envelopment Analysis (DEA) based framework for exploring irrigation efficiencies based on identified indicators. This approach is applied to a major Irrigation project by employing DEA based framework across a number of WUAs which helps identify the best practices within any project and estimates the quantum of possible savings of water. By linking water usage efficiency results to the incentives of farmers including their subsidies and water tariffs applicable to their respective WUAs, competition can be generated amongst WUAs to become progressively water effective.

Analysis, results, conclusions and recommendation

Agriculture water usage is vital in developing economies like India where more than a billion people need improved food security. Efficient usage water would imply that irrigation projects be assessed for water usage effectivities, something that is non-existent in India so that the inefficiencies have become systemic and deep-rooted.

In large Indian irrigation schemes, Water User Associations are constituted to encourage participatory management in securing equitable water distributions. Constituted over populations of 100-1000 users, WUA General Body includes farmers and their wives as members. Demographic area covered by a WUA is a hydrological boundary, normally 100-2000 ha.

DEA study conducted at WUA level for Tawa Irrigation Project in Madhya Pradesh State showed that two-thirds of the WUAs were performing poorly, thereby highlighting necessity of identifying best practices to be replicated. DEA analysis also showed increasing returns-to-scale implying that a change of sizes of WUAs would yield greater outputs. Thus, optimal sizing of WUAs through restructuring is critical to harnessing efficiencies.

Another important finding was that cost-expenditures can be minimized by following best practices, and resultant savings may be deployed to further refine operation, resulting in incremental efficiency gains. Since, currently the tariffs are charged on per hectare basis for various crop types as fixed by the Government, the revenue has no linkage with water usage efficiencies. It is suggested that tariffs charged be linked to water usage efficiencies as a matter of policy.

The study establishes the significance of measuring efficiencies for WUAs, and shows how analysis can identify best practices and areas of improvement, set efficiency targets, etc. helping the Regulators to introduce scientific tariffs and enable restructuring of WUAs. It is expected that the work will be of significance to various stakeholders including policy makers, regulatory authorities, funding Institutions, and the WUAs.

Do global monitoring frameworks reflect water quality in sub-Saharan Africa?



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Keywords: water quality, post-2015 sustainable development goals, sub-Saharan Africa, rural water quality, urban water quality

Introduction and objectives

Public health surveillance agencies and water suppliers are institutions that are regulated to test water quality. Understanding the extent and usefulness of their water quality data can inform development of indicators of the Sustainable Development Goals. Through the Monitoring for Safe Water (MfSW) program, we have collected data from 19 water utilities and 18 public health surveillance agencies in nine countries in sub-Saharan Africa. Raw data provided directly from these institutions allows us to compare existing frameworks for understanding water safety.

Methodology approach

Through MfSW, we have collected microbial and physico-chemical data from drinking water sources from institutions regulated to perform testing. These data include: 1) retrospective data from 2011-2013 of 44,000 tests for fecal indicator bacteria (FIB), 45,000 tests for free chlorine, and 23,000 tests for turbidity; and 2) ongoing monthly data from 26 institutions between 2013-2014 of 27,000 tests for FIB, 11,000 tests for free chlorine, and 17,000 tests for turbidity. We define FIB as a positive fecal coliform, E. coli, or H2S test. To our knowledge, this is one of the largest datasets of water quality information for sub-Saharan Africa.

Analysis, results, conclusions and recommendation

65% of the microbial samples in the data set were collected by water suppliers and 35% by health surveillance agencies (n=65842). About three quarters of the samples (69%) in the microbial data were collected from distribution systems (including consumer taps, reservoirs, and treatment plants), while the remaining data were collected from non-piped sources, including wells, springs, household storage containers, rainwater tanks, and surface water.

From samples collected from pipe networks, 3% (n=26,068) were positive for fecal indicator bacteria. 31% (n= 23,784) of piped network samples were below the minimum guideline of 0.2 mg/L free chlorine. Free chlorine concentrations were significantly correlated with presence of fecal indicator bacteria (p<0.01, Wilcoxon rank-sum). From samples collected at non-piped sources, 33% (n= 15,867) were positive for fecal indicator bacteria.

We found that the data generally supported the JMP definitions though not always. 83% of unimproved sources (n=1,764) compared to 8% of improved sources (n=34,606) were positive for FIB; however, most (90%) of samples from improved sources represented piped water supplies. Using data from only non-piped sources, 38% of improved sources (n=3,437) were positive for fecal indicator bacteria.

These results confirm previous findings that, while improved sources are more likely to provide safe water, they do not always provide safe water.

Similarly, analysis of the water quality data confirms the hierarchy proposed in the Joint Monitoring Project's "water ladder" approach, where source types are grouped into "piped on premises", "other improved", "unimproved" and "surface water". However, while the differences between these categories are significant when aggregating data from all countries, the hierarchy is not necessarily consistent when examining data within individual institutions. These results suggest that existing frameworks for understanding access to safe water are useful on a continent- or regional-scale, however, they are not useful indicators for local agencies for planning and investment purposes.

Multi-track ‘non-subsidy’ approach for an enabling environment towards WASH sustainability



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Keywords: behaviour change, community-based sanitation, enabling environment, multi-stakeholders

Introduction and objectives

Indonesia is working towards the universal access to water and sanitation in 2019. To do this, the government issued a national policy of STBM 5 pillars. STBM is the Indonesian adaptation of CLTS (Community Led Total Sanitation), and consists of five pillars:

1. open defecation free
2. handwashing with soap and running water at critical moments
3. water treatment and safe storage
4. household solid waste management
5. household liquid waste management

Through a 5-year programme called “SHAW”, Simavi strives to create an enabling environment for the communities in nine districts of Eastern Indonesia to institutionalise the STBM 5 pillars.

Methodology approach

Simavi and five local implementing partners adopted a multi-track approach called the SHAW-Flow. We work at four different levels (district, sub-district, village, and hamlet), with government structures as well as the communities, and at all phases of the programme, in order to establish an environment which enables sustainable routines of improved behaviour.

The experience of SHAW will be presented to show how and why this approach has been successful in the targeted districts (rural and peri-urban), even without an initial subsidy. Several evidence-based results will be highlighted through beneficiaries testimonials, cost and benefit analysis, and replication strategy.

Analysis, results, conclusions and recommendation

When SHAW Programme started in 2010, the STBM 5 pillars was somehow still largely unknown, despite it being a national policy. The government and most organisations were implementing only some of the pillars – usually pillar 1 and 2. Many interpreted the policy in terms of highly subsidised physical infrastructure of building toilets to stop open defecation. However due to the lack of sanitation education, the communities often slip back to their unhealthy behaviour despite having toilet facilities and water supply.

SHAW engages the communities to practice the five STBM pillars without providing any initial subsidy, which in turn creates demand for improved WASH facilities. Parallel to this, we actively advocate the local government to ensure they respond to this demand.

At the community level, we reach out to each household and encourage them to want and maintain a

healthy living environment – including paying for services. We work with around 20,000 village volunteers who go house to house to motivate the communities and monitor the improved behaviour and practices. All these activities require no cost from SHAW. Once the communities practice an improved behaviour and demand some facilities to support this (i.e. running water for handwashing), the SHAW’s partners will then hold discussions to find an appropriate solution. This might include possibilities for some assistance from SHAW.

At the government level, we work with the local government to put STBM agenda into their strategic plan and budget for the institutionalisation of STBM in the long run. We also involve other government institutions such as the community health centres and schools to adopt STBM.

In the end the approach adopted by SHAW is an example of how a community-based non-subsidy WASH programme has successfully reached around 1.5 million people and 1,000 villages to be declared 100% STBM.

Workshop: Water as a driver for sustainable development and poverty eradication

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Water-Food-Poverty and Gender in Drought affected regions in India



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Keywords: Water, Food Insecurity, Drought, Poverty, Gender, India

Introduction and objectives

Water, livelihoods, food insecurity and poverty linkage has re-emerged as major development policy issue in less developed economies. In recent years, recurrence of drought and rising demand for water continue with unequal access to and use of water. Broad objective of the paper is to discuss nexus between water, food insecurity, poverty and gender in drought prone areas in India. Specific objectives are to highlight

- Impact of water scarcity on employment, food consumption, migration, resource use and poverty
- Household risk sharing during stress period with focus on gender (intra-household risk sharing)
- Policy suggestion to enhance water use efficiency to improve livelihood and food security and reduce poverty

Methodology approach

A three-stage approach was followed to assess household and community participation in agriculture, water use, risk coping in different regions (Odisha and Gujarat) in India. While community level water related interventions are limited and not very effective, our focus has been on analysing inter-household and intra-household across regions and social groups to argue whether impact of access to and use of water by household has been gender neutral or not, particularly during drought or scarcity period. Some local adaptations and practices relating to food and water scarcity and its impact on poverty and gender are discussed. Selection of study areas for survey was mainly on the basis of area based resources approach and on the scale of regional development. Diversities in water resources and its management are given priority with other local features such as agriculture, livestock, forest, migration etc.

Analysis, results, conclusions and recommendation

Recurrence of drought and increasing scarcity of water has affected the poor, low income groups and particularly women more in less developed agrarian economy than others. Our results substantiate it for two different regions in India with marked gender inequity in food consumption and risk sharing during the scarcity period. Inadequate access to and use of water with poor water management continue to pose formidable challenges for food insecurity and poverty. Women found share disproportionately high risks and work burden in addition to their household chore. About 50-80 percent increase in working hours and 30-67 percent decline in expenditure for the women reported in the study areas.

Consumption and expenditure reduction coping strategies found common at household level but they were not gender neutral. It has serious implication on intra-household gender relations and overall gender equity. In broader sense, low and unequal access to water and land is viewed as increasing adverse impact on women in terms of their participation and resource management and well-being. Our analysis support the argument that women in agriculture share higher work burden with little or no access to resources like land, water, credit and other inputs.

Increasing water scarcity and failure of community based water management, particularly in drought prone areas fail to improve living of the poor and women. Distress agriculture, out migration, informal borrowing, poor risk coping capability evident in the water scare regions continue to pose tough challenges for poverty reduction and gender equity.

Households as a decision making unit tend to use women members for ‘labour smoothing’ and ‘consumption smoothing’ but without adequate availability and access to resources, existing intra-household gender relations continue to be gender biased. Therefore, wider access to water, land, credit, market links by the poor women in agriculture need urgent policy attention. Strengthening local water institutions, conservation and management of local resources, ownership and effective participation of women in resource use decision making are reemphasized. Role and functioning of women in water user associations (WUAs), panipanchayat will be crucial where existing public water and irrigation system need to play the role of facilitator.

Economic gains from good water and sanitation



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Keywords: education, empowerment, efficiency, water, sanitation

Introduction and objectives

Water.org has been pushing the boundaries of microfinance with WaterCredit, a program that uses microfinance to empower the world’s poor to access water and sanitation. The primary hurdle that this program encounters is the general assumption that loans for water and sanitation are too risky because they are perceived as consumptive rather than income generating. This presentation seeks to prove that assumption wrong by using quantitative data that measures time saved as a result of improved access to these important assets and calculates the economic gains to a household based on these time savings in India.

Methodology approach

Data will be collected from interviews with current and past WaterCredit borrowers in southern India that measure time saved by construction of the WASH asset as well as data collected about how that time saved was utilized. Economic values will be extracted based on indicators such as: extra income generated from extra hours available to work per day, extra income generated from days not missed due to water-borne illness or the need to collect water, school and education-related impacts of not being sick or not missing school for water collection, and increased household income due to reduced medical bills.

Analysis, results, conclusions and recommendation

The positive correlation between water, sanitation and economic development is understood in certain circles but remains to be proven and communicated globally. The data mentioned above is under collection, with nearly all borrowers interviewed to date able to point out the economic advantages the household water connection or toilet has had upon the lives of their families. A key recommendation will be that lending institutions review this data and, based on the findings, reassess their reluctance to lend for these “consumptive” assets. Another recommendation, specific to India, will be to use this information to encourage the Reserve Bank of India to include Water and Sanitation as part of nationally-promoted “Priority Sector Lending” sectors.

Muddied waters; hidden agendas in sustainable development of transboundary rivers



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Keywords: South Asia, transboundary rivers, water governance, international donors, Ganges-Brahmaputra-Meghna basin

Introduction and objectives

This paper is an analysis of prevalent international development narratives in the governance of transboundary rivers in the Ganges-Brahmaputra-Meghna basin (GBM). This paper examines how international donors – in particular the World Bank, United Kingdom and Australia – use development discourses to justify interventions in the governance of transboundary rivers in the GBM. The sustainable development rhetoric belies political agendas of these donors.

The objective of this analysis is to illustrate that poverty alleviation and economic development through water governance is a compelling and increasingly popular discourse – but also one that can be used to mask other strategic goals.

Methodology approach

This paper was written on the basis of data gathered during six months of fieldwork conducted in India, Nepal and Bangladesh between April and November 2014. The fieldwork was based on a series of semi-structured interviews with around forty policy-makers, scholars, water governance practitioners, international donors, etc.

This paper also presents the results of a discourse analysis conducted on the strategic plans, annual reports, project evaluations, and other grey literature of the organisations involved in the governance of rivers in the GBM basin. The discourse analysis focused on the buzzwords of prevailing development and environmental management paradigms.

Analysis, results, conclusions and recommendation

International development aid has always been closely intertwined with the geopolitical strategies of donor states. The trend of ‘sustainable development’, though laudable in many ways, can also be co-opted to further political agendas. This has been illustrated in the case of transboundary water governance in the GBM. There, international initiatives rely on the rhetoric of sustainable development and poverty eradication to affect the management of rivers between India, Nepal, Bhutan and Bangladesh. The implicit objective, however, lies in donor states increasing and improving their political influence in South Asia. This paper also evaluates the effectiveness of international donors in eradicating poverty through sustainable development of transboundary water resources in the GBM. It concludes that the effect of foreign donors on improving river governance, reducing poverty and encouraging the sustainable development of the region’s water resources is difficult, if not impossible, to measure. These challenges exist in complex, dynamic contexts and require complex, dynamic, context-specific solutions that are ultimately the confluence of many factors and actors, not any one donor program.

Nonetheless, the presence and influence of international donors in the governance of transboundary waters in the GBM is not undermining or otherwise harming the goal of sustainable development and

poverty eradication. Indeed, they are part of the dynamic and complex system of water governance. Any pursuit of sustainable development and poverty alleviation, even if it has a hidden agenda, should be encouraged as long as it does no harm.

In conclusion, sustainable development and poverty eradication are currently trendy buzzwords that can be used by international donors to mask the implicit goal of increasing geopolitical influence. As such, it cannot be said that water is a driver for sustainable development and/or poverty alleviation. These are, however, noble goals that must continue to be pursued across all sectors, including water management.

Water Access and Livelihood Adaptation of Resettled Communities in Lao



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Keywords: Water access, resettlement, livelihood adaptation, hydropower development

Introduction and objectives

A major driver of change in the Mekong River Basin relates to hydropower development, and the consequent changes in landscape and access to water resources that such development induces. Previous research typically compared livelihoods before and after resettlement, reporting a sharp deterioration of living conditions and reduced income of affected households. The nature of the adaptation strategies pursued by individual households post-resettlement is rarely subjected to analysis. In this presentation, we share key findings of a longitudinal study in Lao PDR, in which the trajectories of livelihood adaptation following resettlement, and the possible determinants of that process were examined.

Methodology approach

The most common methodology used in hydropower resettlement studies is a recall method in which targeted households are asked to compare conditions before and after resettlement based on memory. This raises a number of difficulties well-noted in the literature. In this study, we conducted a series of household surveys before and 1, 2, and 3 years after resettlement, targeting the same set of households. This rich dataset allows us to examine how each and every household adapted to the change, to clearly identify trajectories of adaptation, and how these different trajectories are themselves determined by households' socio-economic characteristics.

Analysis, results, conclusions and recommendation

A factor analysis was conducted using a set of composite variables. It yielded 5 types of household clusters: (1) Diversified/ Well-off households; (2) Diversified/Worse-off households; (3) Livestock Dependent households; (4) Non-Farm Wage Dependent households; and (5) Fishing Dependent households. Clusters 1 and 2 were predominant before the resettlement.

Four main adaptation trajectories were identified. Two of the trajectories show coping strategies of families who were in Cluster 1 before the resettlement, by concentrating their investment in reservoir fishery or livestock immediately after the resettlement to maximize income in the short term, and then some shifting into non-farm income while others becoming more specialized in fishing. The two other trajectories illustrate that of Cluster 3 households and some from Cluster 1, both suffering the blunt of lost farming income after the resettlement, continuing fairly diverse activities as before with low level of investment, and some later turning to wage labor and remittances from relatives while others remained farm and forest dependent.

The livelihood strategies of the households 3 years later are clustered into 3 types: relying primarily on non-farm wage income (Cluster 4); relatively diversified livelihood portfolio similar to that before the resettlement, but with lower returns (Cluster 3); and relying on fishing (Cluster 5).

The results also show that different livelihood assets, including water resource access, financial capital, and education, play a role at different stages of trajectories, and that the adaptive capacity of households to the shock of resettlement is not homogenous. Compensation programs need to take this into account, to facilitate more smooth adaptation of households in their new environment. The analysis suggests that a more detailed understanding of this dynamic process, and the determinants of the process, is key to improving interventions for rebuilding the livelihoods of those resettled by development projects in rural areas.

Obligations Arising from the Right to Water



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Keywords: Right to water, legal obligations, comparative law, Finland, South Africa

Introduction and objectives

In July 2010, the General Assembly of the United Nations recognized the right to safe and clean drinking water and sanitation as a human right. However, it remains unclear what legal obligations, precisely, arise from the right. In order to clarify the obligations of the right to water (excluding sanitation) in developed and developing countries, our presentation investigates and compares the constitutional frameworks of Finland and South Africa. Through transnational lessons it is possible to distil comparatively the various legal obligations that flow from the right to water as it is entrenched constitutionally and statutorily in the two countries.

Methodology approach

The study follows the methods of a doctrinal study of law with a special emphasis on legal comparison, including an assessment of the legal implications of the sources of the right to water such as human rights treaties and national constitutions. In addition to the well-accepted State obligations to respect, protect and fulfil human rights, we apply a more specific framework to determine and compare the obligations of the right to water in Finland and South Africa.

Analysis, results, conclusions and recommendation

While both Finland and South Africa follow the constitutional approach to the right to water, they provide different constitutional frameworks to regulate the issue. In Finland water is not mentioned in the Constitution but is related to many constitutional rights, whereas the South African Constitution provides everyone the right of access to sufficient water. In Finland everyone has access to water whereas South Africa still faces challenges in its provision.

Largely following the generic classification of Tuori and Kotkas (2008) of the legal implications arising from economic, social and cultural rights we distil several generic legal obligations that could arise in the context of the right to water and apply these to the legal frameworks of Finland and South Africa to determine to what extent the obligations appear in them. The right to water may obligate a State and public authorities:

1. to fulfil the actionable rights of an individual,
2. to implement the right,
3. not to lower the level achieved in the realisation of the right,
4. to take the right into account in the interpretation of law, and
5. not to apply a legal provision in contradiction with the right.

In addition, the right to water may obligate third parties such as private water companies, which means that all or some of these obligations could apply to non-state parties as well.

The examples of Finland and South Africa illustrate that the right to water first and foremost obligates

public authorities to realise the right in the highest possible degree and not to lower the level achieved, while it very seldom grants actionable rights or provides non-state parties obligations. As well, the obligations of the right to water are realised differently in the two jurisdictions as a result of legal design, socio-economic and environmental considerations and governance design.

Right to water in West Africa requires secure land rights



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Keywords: Africa, Agriculture, Land, Human rights, IWRM

Introduction and objectives

In West Africa there is an increasing trend from governments and donors to attract large scale agricultural investment to improve productivity and reduce the investment burden in agricultural development on the State. In negotiating these land deals, governments have allocated secure long term water rights to companies wishing to invest but are only slowly giving similar secure rights to small scale farmers.

Objectives:

a) analyse current trends in West Africa concerning land and water rights in large scale rice irrigation schemes and the pros and cons of different approaches; b) explore how evolving rights-based approaches may affect future resource management.

Methodology approach

The authors have participated in the design of schemes to secure land rights in large-scale irrigation systems in partnership with the government departments responsible for these systems, irrigation scheme managers and farmer organisations.

Analysis, results, conclusions and recommendation

The notion of secure rights on land for which the agronomic value depends on collective action for its management and maintenance, is complex. The process raises issues such as how to organise payment of collective water fees, whether secure private title will lead to land being “sold off” to speculators, and how “secure” rights can be given to families where land is traditionally held collectively.

Water consumption for irrigation remains relatively low in relation to available resources but in the longer term, as demands increase, allocation between users and application of “user pays” principles will require farmers to hold, and manage, secure rights to water.

This can only occur when farmers have secure rights to land and this is a slow ongoing process in the region. Linking rights to water to rights to land has implications for other water users (cities, pastoralists, fishermen etc). At the farmer level, secure rights to land will increase a sense of stewardship of scarce resources that is currently lacking. Some large-scale irrigation schemes consume three times more water than is agronomically needed, and this hampers irrigation expansion efforts.

Issues surrounding rights to water for other users will be discussed.

More thought is needed to address the pros and cons of specifically linking water (and water fees) to land for both large and small farmers; how such linkage can be used as a mechanism to increase water use efficiency; and what this means for other water users.

Perspectives of small-scale water enterprises: Motivations, drivers and barriers



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Keywords: water, enterprise, private sector, social entrepreneurship

Introduction and objectives

Poor functionality of water systems in rural areas observed globally has led to questions about the most appropriate management models to provide reliable services. Within many countries, more professionalised approaches to service delivery for the poor are being sought, including through involvement of private sector, or through formalising community-based organisations. This is the case in Vietnam and Indonesia, the relevant sites in this research. Critical questions concerning enterprise motivations must be asked, given that access to water is a human right. Equally, more must be learnt about the barriers such enterprises face, if they are to play useful, on-going roles.

Methodology approach

The Institute for Sustainable Futures (University of Technology, Sydney) is leading this research in partnership with local civil society and university partners. Literature on small-scale enterprise development and social entrepreneurship in the context of Vietnam and Indonesia informed a mixed method - quantitative and qualitative - tool to examine enterprise perspectives concerning their motivations, drivers and common challenges. Structured interviews were undertaken with formalised water enterprises, including 20 private enterprises in Vietnam, and 21 private enterprises, cooperatives and village-owned enterprises in Indonesia. These covered a range of ages, sizes and operating locations, as well as successful and less successful enterprises.

Analysis, results, conclusions and recommendation

Findings confirmed that profit was not always the only or main motivation underlying enterprises' involvement in water service provision. Other types of motivations such as social goals, reputation and respect, new knowledge and skills, and socialising and camaraderie were also apparent. For instance one interviewee noted how his business was formed with a social goal in mind: “this venture started from social-environment concern, [rather] than profit”. Recognising these multiple motivations and drivers opens up new pathways to consider how to attract potential entrepreneurs to develop services for the poor, and reduces concerns that enterprises are likely to always focus on maximising profit, to the detriment of equitable outcomes.

The complexity of balancing a social entrepreneurship role whilst ensuring business financial sustainability was also evident. Commonly reported barriers included limited access to capital and to capacity building opportunities, as well as limitations resulting from the regulatory environment.

In Indonesia, for instance, obstacles were faced due to unclear government legislation concerning asset ownership, high fixed operational expenses, high interest rates for loans and lack of business skills. In Vietnam small private enterprises demonstrated varied levels of success, and varied attention to serving the poor, with poor customers comprising from 15% up to 60% of the customer base and potential for

connection fees to be reduced or waived. Challenges were met in negotiating tariffs, gaining sufficient management skills, and variable implementation of national policy by different provincial governments. These challenges in each country limit the ability of enterprises to expand their services, in particular, to the poorest.

Attention from the public sector is needed to assist in addressing these challenges, however this may only come with increased policy and institutional recognition of the important role formalised enterprises can play in contributing to improving access to this basic human right.

Pump-priming payments for sustainable water services in rural Africa



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Keywords: sustainable development, handpumps, drinking water security, payment behaviour, Kenya

Introduction and objectives

Sustainable development depends on reliable water services for households and economic actors. However, 273 million rural Africans still lack improved water access, and one in three handpumps are non-functional at any time. Using unique data gained through innovative mobile monitoring and focus groups, we evaluate how dramatic improvements in maintenance services in rural Kenya influence payment preferences across institutional, operational and geographic factors. By understanding the payment preferences of rural water users we see how an equitable rights-based approach can be reconciled with economic incentives for small entrepreneurs engaged in rural water service delivery.

Methodology approach

Applying public goods theory, this study examines how user preferences are reflected in demand (as expressed by willingness-to-pay) for a reliable supra-communal handpump maintenance service with implications for a devolving water sector. We explore how water users' preferences are shaped by institutional, geographic and management factors (service delivery, institutional factors, handpump density, abstraction quantities). For this purpose focus group discussions were conducted with 639 rural water users at all 66 handpumps of Kyuso District, Kitui County, Kenya. Semi-structured interviews with the Water User Committees, the District Water Officer and County stakeholders were integrated into the analysis.

Analysis, results, conclusions and recommendation

The institutional design of rural water governance, synchronising user demand with inclusive service delivery, is critical for more equitable and sustainable development outcomes. Kenya's decentralisation of the water sector offers institutional opportunities as water services are devolved to the 47 new county water ministries. Concurrently, new technologies have been introduced to remotely and transparently monitor community water supplies.

This has enabled a recentralised model of maintenance services at scale, a pilot of which has decreased handpump downtimes by a factor of ten. This improvement has significantly increased the value rural water users attribute to water services, which translates into an increased willingness-to-pay for these services. This has important social and financial implications, and contributes to the access, reliability and affordability criteria of the human right to water.

The research arrives at five conclusions: (1) water user payments are contingent on service delivery: three times more handpump users are willing to make regular monthly payments after experiencing the maintenance service; (2) with an improved service willingness-to-pay increases by a factor of five; (3) the institutional design of the user group and its level of exclusivity is an expression of collective

preferences regarding payments; (4) handpump density influences the management and performance of handpumps; and (5) mobile monitoring and mobile payments have the potential to significantly improve institutional oversight for a devolving water sector.

Drawing on these findings, the study suggests that handpump sustainability depends on rapid, reliable and inclusive services, which can strengthen the institutional stability of user groups through aligning demand and supply, and securing payment incentives for the users. Users recognise that improved water supply not only ensures their access to safe water but has wider implications for their overall welfare and local development, thus translating the rights-based approach into a practical, participatory and sustainable solution for poor rural communities.

Operationalising rights to water and sanitation in Nepal

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Keywords: Nepal, rural, WASH, GESI, HRBA

Introduction and objectives

This paper explains how the principles of human rights based approach (HRBA) and gender equality and social inclusion (GESI) are mainstreamed and operationalized through two bi-lateral rural water projects in Nepal. The Finland and Nepal-funded Rural Water Supply and Sanitation Project in Western Nepal and the Rural Village Water Resources Management Project are operated under the Ministry for Federal Affairs and Local Development in 24 districts out of a total of 75. Given that the projects operate through the local government systems and at scale, the good practices contribute to the water sector policy dialogue in Nepal at large.

Methodology approach

The projects utilised participatory action research to develop the HRBA and GESI strategy and its operational tools. The projects took their existing GESI Strategy and Action Plan as the point of entry. A barrier analysis was done to explore legal, institutional, administrative, physical, geographic, economic, linguistic and cultural barriers. The approach was a multi-disciplinary, iterative, cyclic approach that aimed to translate the principles and ideas on how to address barriers, into tangible action and measurable indicators at the local government and community level. This was linked to developing simultaneously the contents of the capacity building programmes and planning practices.

Analysis, results, conclusions and recommendation

The projects contribute to achieving universal access to water and sanitation for all, empowering rights-holders to claim their rights and enabling duty-bearers to meet their obligations. They build the capacities of local government level duty bearers and raise awareness at all levels regarding rights to water and sanitation. The projects use three main strategies:

- Mainstreaming HRBA and GESI principles by integrating these at all levels into policies, planning, implementation, monitoring and evaluation. For example GESI and HRBA aspects are taken into account when preparing local government level five year master plans, and when planning individual schemes; all training events have integrated HRBA and GESI aspects within the existing curricula; monitoring at all levels and related reporting have HRBA and GESI indicators, reminding all involved of these principles. Both normative and cross-cutting criteria are considered.
- Undertaking targeted actions to supplement the above where mainstreaming alone would not suffice. Gender-specific interventions will sometimes need to target women exclusively, men and women together or only men, to enable all groups to participate in and benefit equally. Disadvantaged groups will need specific attention. An example is adding a confidence building workshop prior to the main local government level planning workshop to encourage the disadvantaged groups and women to participate and to get their voice heard. Positive discrimination in terms of quotas for participation is also practiced.

- Policy dialogue, integrating the objectives into discussions at all levels, and communications. The HRBA & GESI Strategy document and its supporting materials take national GESI dialogue one step further.

Inclusive targeting is required if women, the poor and other disadvantaged groups (including people with disabilities) are to gain equitable access to resources and opportunities. This is necessary also to avoid elite capture, and ‘business as usual’. Hands-on technical assistance and monitoring support implementation for results.

Commercial financing of utility investments for the urban poor



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Keywords: Commercial financing, Commercial banks, urban water

Introduction and objectives

USAID through its six year regional program the Sustainable Water and Sanitation in Africa (SUWASA) supported an initiative to shift from a purely donor-based investment strategy by water utilities to one that integrates commercially financed investments that adhere to the core business principles of market responsiveness, service delivery and return on investment. It assisted in institutionalizing this commercial approach among utilities, commercial banks, and the Kenyan government and building their capacity to continue the program after the end of SUWASA. The program aligns the financial incentives, bank and consumer to drive a financially sustainable model that increases access to water, reduces the cost of water to the end user, and increases profitability of the utilities and the banks.

Methodology approach

Identify the key issues relating to why utility not getting needed investment, provided capacity building to banks on legal framework for lending to state owned utilities, Undertake a market assessment to determine ability and willingness to pay. Development of a business plan taking into account the commercial loan. Support the utility in developing an application letter for a loan to a bank submit the application for the bank.

Analysis, results, conclusions and recommendation

The USAID/SUWASA program supports a shift from a purely donor-based investment strategy by water utilities to one that integrates commercially financed investments that adhere to the core business principles of market responsiveness, service delivery and return on investment. SUWASA Kenya is institutionalizing this commercial approach among utilities, commercial banks, and the Kenyan government, building their capacity to continue the program after the end of the SUWASA program. Ultimately, the program aligns the financial incentives of the utility, bank and consumer to drive a financially sustainable model that increases first time and improved access to water, reduces the cost of water to the end user, and increases profitability of the utilities and the banks.

The program does this by:

1. Supporting utilities in identifying commercially viable investments and developing bankable financing proposals.
2. Advising commercial banks in developing new water financing products and appropriate lending methodologies for utilities.
3. Assessing market demand and affordability for water and sanitation services among the poor, and supporting community outreach and education programs related to utility investments.

SUWASA Kenya has had a transformational impact on the country’s water sector by successfully unlocking commercial financing and allowing utilities to tap into a host of government, international, and multilateral funding resources. The program’s technical assistance to bank partners and utilities is an ideal complement to the successful USAID Development Credit Authority (DCA) guarantee

program, which has USD 9 million in water financing guarantees with three Kenyan banks, Kenya Commercial Bank (KCB), Housing Finance and K-Rep Bank. SUWASA Kenya is also partnering with the Government of Kenya (GoK) Water Services Trust Fund, complementing and supporting their management of Output Based Aid (OBA) and Aid on Delivery (AOD) subsidies to incentivize commercially financed projects. SUWASA helped nine WSPs develop investment proposals for projects valued at approximately \$4.6 million. SUWASA technical assistance to utilities and commercial banks resulted in bank loans of approximately \$3.5 million for projects, such as water supply network rehabilitation, pipeline extensions, household connections and the upgrade of a water treatment plant.

SMART Centre's Tanzania and Malawi - Capacity building for marketbased WASH technologies



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Keywords: Rural WASH, Capacity building, Market-based technologies.
Smart Water Solutions, Innovative water technologies

Introduction and objectives

One option to increase access to water and sanitation is reducing cost of products and services. In the past 20 years a number of conventional technologies have been improved and new options were developed. A range of innovative options are so called Smart Water Solutions (SWS) including Sanitation. Examples are manual drilled boreholes of 100-1500 USD, EMAS and Rope pumps of 50-120USD, drip-irrigation, Household water filters of 20USD, zero cement latrines etc. These and 20 other options have in common that they are produced with local materials and by local private sector resulting in a "Profit based sustainability".

Methodology approach

Innovative and affordable options are in place; a challenge now is scaling up the dissemination. An example of centres for dissemination of SWS are so called SMART Centres in Tanzania and Malawi*. Activities of these Centre's include;

- Creating awareness. Demonstration of SWS, information on water fora, field visits, etc.
- Build up Supply chains; Train local private sector in production, maintenance, marketing, business skills.
- Other activities; WASH policy advice, quality control, certification of drilling and pump companies, making maps of manual "drillability" at regional or national level and linking producers and users with micro credits.

Analysis, results, conclusions and recommendation

Smart Water Solutions are smart because they are effective, affordable, available and most options can be produced locally "profit-based sustainability".

SWS can reduce cost of Communal rural water supply, increase Self-supply and can help to reach the yet unserved where conventional technologies like machine drilled boreholes, are too expensive. Water quality can be improved by treatment at the household level as an intermediate step Water quantity can be increased and distances to water points be reduced with scaling up Self-supply

Results:

Results of the training by SMART Centre's in Tanzanian and Malawi are:

- A supply chain of innovative and affordable WASH technologies
- 35 drilling and pump companies trained and functioning
- 10.000 Rope pumps installed, of which 35% purchased by families so Self-supply
- Cost reduction of rural water points from 40 to 15 USD per capita

Examples of SWS are 70.000 Rope pumps in Nicaragua and 40.000 in Africa, 30.000 EMAS pumps

in Bolivia, 1 million Treadle pumps in Bangladesh, Millions of hand drilled wells in Asia.

Conclusions:

- To scale up the use of SWS, large scale capacity building is needed
- An effective way for capacity building is the SMART Centre concept

Recommendations:

- In each country one or more WASH innovation centres like a SMART Centre, where both conventional and new relevant WASH knowledge for that country or region is concentrated.
- The products promoted by these centres should be proven, Market-based, and include options that are also affordable for the poor.
- Activities should focus on scaling up Self-supply since this results in economic development needed to sustain rural communal supply in the longer term.
- Bring knowledge of SWS in the national vocational education like in Tanzania

* SMART Stands for; Sustainable, Market-based, Affordable, Reliable Technologies
SMART Centres are member of the RWSN (Rural Water Supply Network) network..

Social values embedded in an Australian water allocation plan



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Keywords: Water allocation, social sustainability, Australia, irrigation, forestry

Introduction and objectives

Sustainable development and its Australian translation in natural resources management, Environmental Sustainable Development, are widely recognised as having three interlinked dimensions: economic, environmental and social sustainability. However, in the Australian context of water management where water markets and environmental flows have been introduced in the last decades, the social dimension has been less examined than its economic and environmental counterparts. This paper fills this gap in exploring which social considerations water planning process encompasses.

Methodology approach

The Lower Limestone Coast water allocation plan under revision since June 2004 served as a longitudinal case study, on which the following data were collected: i) 180 local newspaper articles on the planning process for the length of its revision, ii) 65 submission forms filled in by the community during a public consultation on the draft water plan and iii) 20 face-to-face interviews of keys stakeholders involved in the planning process conducted two years after the last community consultation on a draft groundwater plan.

Analysis, results, conclusions and recommendation

A review of the evolution of the Australian water planning approaches indicates that best practices progressively include community engagement, adaptive management, fairness and social assessment, matching therefore some of the social sustainability principles. Water plans, in being the main implementing tool of the reform, are thus an appropriate tool to reconcile the currently overlooked social sustainability with its economic and environmental dimensions.

The key findings suggest that social values associated with water are multiple in the region: water as a common good, food security, basic human need, regional identity, drought-proof community, carbon stores, aesthetic value, aboriginal cultural water access, cultural & spiritual identity and recreational value. However, despite these multiple social values, the water allocation planning process does not define any social objectives. In contrast, clearly set environmental goals place unbalanced emphasis on environmental sustainability.

The study found nonetheless that the Lower Limestone Coast water allocation planning process achieved relatively good, although inconsistent, results in addressing social sustainability. However, it does so only through indirect, inconsistent and incomplete approaches to consideration of the social aspects of sustainability in protecting social values associated with consumptive uses. This calls for more coherent and dedicated attention to be paid to social sustainability in water planning through a shift from mitigation of social impacts to adaptation and integration of social objectives in water plans is needed to balance the reallocation impacts; as well as integration of social values requiring, in particular, some form of protection such as the licensing of cultural and non-consumptive uses of water.

Workshop: Managing change – strengthening resilience to climate and disaster risks

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Resilience to Climate and Disaster Risk: Bangladesh Context



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Keywords: resilience, adaptation, climate change, disaster risk, Bangladesh

Introduction and objectives

Bangladesh with its geophysical position, very dense population, limited resources and dependence on nature, is one of the most disaster prone countries that are facing added challenges due to climate change. But with the vision of a nation ensuring safe lives and livelihood of its people, with past several decades of experience from disasters, the country is now able to shift from a culture of relief and response to more comprehensive disaster risk reduction. This paper is aimed to present case studies that will help to develop measures for strengthening resilience to climate and disaster risks for sustainable development.

Methodology approach

Collections of relevant information for assessing the past experience of different disaster management approaches and also present practices, which were applied during and after disasters. The preferred options would assist the entire community to engage in comprehensive interventions that will not only ensure the protection of the settlement but also provide self-sustaining livelihood and service delivery options for its population. These include identification and validation of number of selected climate change adaptation options through field demonstration. The identification and validation processes involved series of workshops. Transforming this scientific information both to communities and the policy makers through social mobilization programs.

Analysis, results, conclusions and recommendation

Bangladesh experiences the impacts of climate change through irregular rainfall pattern, water logging, floods, cyclone, saline intrusion, drought, sea level rise and tidal surge. The poor communities in the disaster prone areas of Bangladesh are the most vulnerable to the impacts of climate.

Perpetuating the spirit and vision for disaster risk reduction and climate change adaptation, Bangladesh has adopted a holistic process to integrate disaster and climate risks into development planning and processes. Many aspects of climate change and variability are already having a profound effect on the livelihoods of poor rural communities and enough is known about the future impacts of climate change for action to be taken. But the challenges for disaster risk reduction and climate change adaptation also remain alarming and also are increasing in intensity and complexity - some are persistent and recurring and the others are emerging. Overcoming these challenges will require scaling up our efforts through cooperation and collaboration among nations and communities – exchanging knowledge, information and technology for a common vision of a resilient future.

The field testing results from the comprehensive disaster management programs in Bainpara and Gazipara, two cyclone affected villages of Sutarkhali Union under Dacope Upazila in Khulna District reveal 60 climate change adaptation options out of 90 options that were identified and validated in the programs. Success and lessons from these pilot interventions will help build communities in south western part of Bangladesh that can with stand reoccurring disasters, fight back climate change impacts and achieve sustainable growth.

This study presents case studies that engage technology, physical and social infrastructure, local knowledge and social capital to complement the available resources to promote resilience through better living. These mostly include structural safety, adaptive interventions, social protection, sustainable development, early warning, natural resource management for sustainability, community – managed system.

Building Climate Resilience: Adaptive responses to urban flooding across scales



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Keywords: Resilience, Climate, Flood, Urban, Vulnerability

Introduction and objectives

Many factors that influence vulnerability and resilience to flooding and climate change in urban areas emerge as a consequence of interactions that cross scales from the regional to the urban neighborhood and household. While, development actors focus on flood management possibilities at relatively large scales, responses within households, businesses and neighborhoods are widespread. These emergent responses influence and are influenced by actions at higher scales. This presentation provides evidence on the role of such responses and their relationship to higher-level interventions in responding to floods and protecting assets of vulnerable populations as urbanization and climate change proceed.

Methodology approach

The presentation will draw on an extensive suite of studies of flood related disaster resilience conducted by ISET-International and our partners across urban areas in South and South East Asia and in the U.S. under programs supported by the Rockefeller Foundation, DFID, CDKN, the Red Cross and other organizations. These studies all utilized a common resilience/systems framework to guide data collection and analysis. As a result they provide a unified narrative for interpreting the factors and cross-scale linkages that contribute to climate and disaster resilience in different contexts.

Analysis, results, conclusions and recommendation

Using an engaging and interactive multi-media-based approach, the presentation will share and interpret evidence on adaptive responses to floods occurring at the household and neighborhood level and their relationship to the higher-level factors that enable or constrain such behavior and the contribution it makes to resilience. Tangible examples involving shelter design, community-based drainage, the role of informal networks, early warning, urban disaster planning and other initiatives will be used to illustrate more general principles. These will document specific adaptive responses and their relationship to programs, institutions and policies at municipal and national levels. It will also explore how the benefits from adaptive responses are distributed across society with particular attention to poor and vulnerable groups.

Key conclusions include: (1) the central role of diverse behavioral responses at the household, business and neighborhood level in building resilience and supporting adaptation to climate change and flooding in urban areas; and (2) the importance of recognizing, enabling, and guiding such responses in higher level strategies and implementation activities. The presentation will also present key concluding insights on the degree to which flood and larger patterns of climate resilience are context-dependent and benefit the most vulnerable populations. Overall, the presentation will argue that far more attention needs to be devoted to the drivers of behavior, the diversity and context-dependence of responses, and the nature of relationships at very local levels along with their interactions with water, disaster risk and development interventions at higher urban or regional scales in order to meet the needs of poor and vulnerable populations. Processes that support sustained engagement and shared learning are essential for this to occur.

Flood and drought risk: Differences, similarities and strategic management



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Keywords: drought, flood, ecosystem, risk, strategic

Introduction and objectives

Floods and droughts are of increasing global concern. The inadequacy of current practice (as observed through the continued impacts of floods and droughts) underpins the consensus that both flood and drought management approaches must improve and that a transformational change in approach is required; away from a reactive, episodic, process based on emergency response towards a proactive, continuous, process of risk management.

This paper draws upon an international review of the common challenges floods and droughts pose and presents the shared principles and concepts needed to transition towards a more strategic management approach that is both risk and ecosystem based.

Methodology approach

The findings presented here are based upon a research collaboration between WWF and GIWP (General Institute of Water and Hydropower, People's Republic of China) to develop a new strategic approach to flood and drought risk management. This highly productive collaboration has included (i) a review of international practice (from Australia, North Africa, Europe, North America and Latin America), (ii) analysis of lessons from historical floods and droughts, and (iii) face-to-face expert working sessions involving leading specialists in China and international experts from Australia, South Africa, US and Europe.

Analysis, results, conclusions and recommendation

The analysis presented in this paper confirms that there is a significant opportunity to manage floods and droughts more strategically to deliver better social, economic and ecological outcomes. This does not imply the need for a single comprehensive and integrated approach but context-specific approaches based on a common strategic framework that deliver resilience (not simply resistance).

In particular this paper will outline a strategic framework which defines:

- (i) The purpose of modern drought and flood risk management; and
- (ii) Characteristics that underpin a strategic flood and drought risk management approach including (a) Understanding the whole system behaviour (including the relationships between human and ecosystems); (b) Using knowledge of risk and uncertainty to inform decisions; (c) Implementing a portfolio of measures and instruments (including capitalising on the benefits that good ecosystem management can bring to reducing flood and drought risks); (d) Embedding flexibility to enable evidence based adaptation.

The paper will expand upon how this framework supports building long term resilience through three inter-related phases: (a) Preparedness phase, that takes a long term view and taking actions to reduce the risks associated with future floods and droughts; (b) Response phase, where the focus becomes increasingly

centred on actions to minimise impacts; (c) Recovery phase, where the focus moves to promoting rapid recovery of the human and freshwater systems.

Conclusions:

Through synthesising lessons and best practice from past drought experiences it is clear that significant opportunity exists to manage floods and droughts better. The paper will conclude with a series of golden rules that have been identified to guide the transition from traditional approaches to a more strategic risk based management.

Lake Cyohoha catchment: Enhancing climate resilience of communities and ecosystems



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Keywords: Climate resilience, trans-boundary, water security, stakeholders' participation

Introduction and objectives

Lake Cyohoha transboundary catchment, located in the Bugesera region between Burundi and Rwanda, falls within the Kagera sub-basin of the Lake Victoria basin, which is part of the Nile Basin. Food insecurity is the major problem in the catchment, mainly due to: small sized farming plots, poor agricultural practices, population pressure and land degradation. Access to basic services is very low. Moreover, climate change trends pose a growing threat (floods, droughts) in the catchment. The main objective of the paper is to share experience from demonstrating local actions that will enhance climate resilience of communities and ecosystems.

Methodology approach

In Lake Cyohoha catchment, communities were supported through demonstrating some climate change adaptation actions. A catchment/ecosystem approach is being used to promote integrated management of water and related resources in a transboundary catchment setting. Strengthening partnerships and developing capacities of stakeholders for water security and climate resilience are also included. The overall approach has been a participatory and community-owned process using water partnerships as platforms for participation at different levels. The Burundi and Rwanda country water partnerships (CWPs) are providing important platforms to facilitate coordination and dialogue among various stakeholders, and among different programs/initiatives.

Analysis, results, conclusions and recommendation

The most suitable options for water security and building climate resilience were evaluated in a multi-stakeholders participatory approach. Actual implementation of appropriate measures for climate change adaptation and for water security is at an advanced level.

Main results so far include:

- Awareness raising about sustainable water resources management and climate change adaptation
- Participatory catchment-wide assessments
- Identification of priority interventions to enhance water security and climate resilience
- Catchment Plan preparation for integrated water resources management and climate change adaptation
- Catchment management structures (and broader stakeholder platforms)
- Support to communities in taking local adaptation actions comprising:
 1. demarcated and managed the buffer zone along the lake shorelines (60 ha), planting conservation and fruit trees (60ha),
 2. demonstrated biogas facilities as energy sources (12 units),
 3. extended water supply systems (for about 3000 people)

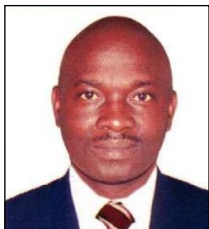
4. introducing improved cooking stoves (1000 households), rain water harvesting (12 households), and rehabilitated upper catchment areas (on-going).
5. strengthened partnerships between local government, local implementing actors and communities

The lessons being learnt from such interventions will be used to influence policies and practices in Burundi, Rwanda and the entire eastern Africa sub-region. Moreover, as Lake Cyohoha catchment is transboundary, the experiences from its management will inform management of bigger transboundary basins.

The following are recommended based on the lessons from the project:

- Water resources are shared resources within a hydrological boundary. Use catchment/basin as a unit of management/cooperation
- Communities need water for various uses. Demands are integrated and thus approaches
- Early participation and ownership by all stakeholders is useful for sustainability
- Community catchment management structures enhances empowerment and ownership
- Linking policies with practice useful in promoting water security and climate resilience

Enhancing Drought Resilience in the Horn of Africa



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Keywords: Drought, Innovation, Partnership, Policy, Resilience

Introduction and objectives

The Horn of Africa region comprising of Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda is prone to recurrent droughts making it one of the most vulnerable regions on the African continent to climate variability and change. Droughts affect nations with dramatic impacts on socio-economic and environmental stability. The Integrated Drought Management Program in the Horn of Africa (IDMP HOA) focus is to increase drought resilience. The objectives are:

- Influence policies and programs towards sustainable drought management
- Develop and support innovative demonstrations that address water security challenges
- Develop knowledge and build capacity for enhancing drought management
- Enhance partnership and collaboration in drought management

Methodology approach

- Using participatory approaches to identify policy gaps, support and influence action of policy, plans and strategies at country and regional levels
- Demonstrating and document successful innovative initiatives that address water security and enhance stakeholders in uptake and up scaling drought related solutions
- Knowledge development and capacitating institutions and local actors in water security and drought resilience as well as documenting and sharing lessons and best practices
- Support partnership and collaboration at regional, national and community levels for sustainable water management in dry lands

Analysis, results, conclusions and recommendation

The HOA region is highly vulnerable to drought. This is due to its dependence on primary production, unsustainable natural resource use, weak institutional capacity, limited and poor infrastructure, inadequate equipment for disaster management, limited financial resources and heavy reliance on rain-fed agriculture. Agriculture, Water, Energy and Biodiversity/ wildlife/Forestry/ tourism are the most vulnerable sectors.

Most countries in the HOA region have given priority to reducing vulnerabilities to drought, responding to drought incidences. They have developed policies, strategies, plans related to drought and putting in place institutions for drought management. Past actions by governments to respond to drought were focused mainly on relief and rehabilitation.

With regard to institutional mechanisms on drought management, all HOA countries have a responsible government institution to lead and coordinate the implementation of disaster risk management. However, the form and structure of coordination arrangements varies from country to country. Kenya has a dedicated National Drought Management Authority. South Sudan has a Ministry for Humanitarian Affairs and Disaster Management. While, Ethiopia has established Disaster Risk Management and Food Security Sector being led by a State Minister under the Ministry of Agriculture. Uganda and Somalia have higher levels of coordination being coordinated from the Offices of the Prime Ministers. In conclusion, the status of national frameworks for drought risk management in the HOA countries clearly showed that countries are at different stages in terms of establishing national frameworks for managing drought resilience. However, with regard to capacity for implementation and other soft components, the HOA countries share similar priority areas of intervention.

It's recommended that all countries in the HOA region engage in key priority areas to building drought resilience such as capacity & partnerships building, early warning systems, mainstreaming drought resilience in government plans and regional cooperation for drought management.

Enhancing Community Resilience to Climate Change: Models, Approach and Practices.



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Keywords: Risk & Vulnerabilities, Community participation, Integration of indigenous & scientific knowledge, Adaptation models, Resilience

Introduction and objectives

Coastal areas of Bay of Bengal are highly prone to disasters, which are mainly induced by the phenomenon of climate change impact in the region. Most of the studies show an increasing trend in temperature and rainfall variable and increase in the frequency & intensity of disasters. The issues has been also subjected due to heavy dependence on natural resources which are regularly dwindled and degraded by the impacts of both disasters & climate change as the major factors contributing to vulnerabilities of people living in poverty traps. This paper's objective is to present best practices and share learning.

Methodology approach

This documentation has been done reviewing secondary information regarding the bio-physical and socio-economic context of coastal areas, collecting local knowledge found to practices by coastal communities as local level adaptation. Besides, more emphasis was given to keep out detail data on inputs and outputs from different pilot options, taking beneficiary and community perceptions, learning's, recommendation to make these more resilient, acceptable and profitable for the community. So, both qualitative data on inputs and outputs and qualitative data on learning and perceptions have been analyzed to prepare the document.

Analysis, results, conclusions and recommendation

“Paribartan” is a multi-country climate change adaptation project has been aimed to increase resilience of the coastal community in the Bay of Bengal is being implemented by Shushilan and Jagrata Juba Sangha (JJS) over four coastal districts of Bangladesh. The project is a generous support of European Union through Concern Worldwide Bangladesh. Community Risk and Vulnerability Assessment (CRVA), a participatory vulnerability assessment tools was followed by Shushilan through engagement of communities and union disaster management committee (UDMC) to analyze risk associated with different hazards. Accordingly individual community level climate change adaptation and disaster risk reductions action plan was prepared from the identified options.

Upon taking support from the scientific bodies and different sectors of the government and by the guidance of Concern Worldwide Paribartan team, Shushilan team conducted feasibility studies, prepared guidelines on different adaptive options and are being implemented in the fields. These pilot models are- composite agriculture; resilient house-rain water harvesting system-vegetable gardening; energy saving stove-fuel wood plantation-nutrition gardening; homestead and char plantation for protection etc.

Besides, some innovative approaches adopted by the project that have helped reaching the communities more easily in building capacity and preparedness works. These are mobilization of Gram Paribartan Team (GPT), 100 HHs initiatives for preparedness campaign, Women Forum at different level and Paribartan Student Forum (PSF) for youth mobilization. The outputs, impacts and effectiveness of

these innovative pilot options and approaches have been recorded, analyzed and documented following longitudinal process. This paper will present that best practices in promoting community based adaptation to combat climate change.

The Role of Infrastructure and Governance in Adaptation



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Keywords: infrastructure, storage, governance, climate, resilience

Introduction and objectives

The World Water Council has undertaken with the Government of Mexico a study to understand the effect of storage reservoirs, and the criteria by which they are managed and operated, on the resilience capacity for climate change. The initial results are meant to promote improved policy and decision making among a variety of stakeholders.

The study will analyze systematically and objectively, through a series of case studies, the roles storage and water management systems can play in the future in order to mitigate and adapt to the potential adverse impacts of climate change, as well as policy implications and governance.

Methodology approach

Ten case studies will serve the basis for a framework analysis demonstrating the roles of storage for adaptation to climate change and variability as well as their policy implications for water management, within the framework of sustainable development.

The case studies will evoke:

- Potential impacts (both positive and negative) of climatic and non-climatic factors on a variety of reservoirs;
- Policy frameworks, management, governance structures and implementation instruments;
- Challenges faced and lessons learned on construction and operation of reservoirs;
- Adaptation and mitigation mechanisms for socio-economic and environmental challenges;
- Drivers for water resources policy, management and development.

Analysis, results, conclusions and recommendation

The project and its framework analysis, which is currently in progress, should aim to find new ways of approaching reservoir design and operation in a variety of circumstances in order to maximize the mitigation and adaptation effects on specific social, environmental and (green) economic targets. It should also study new long-term allocation mechanisms and short-term reallocation or temporary restrictions (during droughts or for ecological crises), as well as adaptive approaches to old and new reservoir operation in the context of unprecedented changes in the intensity and variability of extreme events.

The study is global in scope, with illustrative case studies from each continent, that will encourage the formulation of recommendations in different contexts.

Smart Solutions for Climate ready Water Utilities



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Keywords: climate change, water, utilities, water and climate, Nigeria

Introduction and objectives

The Africa Adaptation Programme (AAP), Nigeria office; with the support of Federal Ministry of Environment, the UNDP Nigeria, and Govt. of Japan recently commissioned the Bread of Life Development Foundation to conduct an assessment study on the 'Impacts of Climate change on Water Supply and Sanitation in Nigeria'.

The study investigated the correlates between climate change, and sustainable delivery of water supply and sanitation services in Nigeria, exploring the real and potential effects of climate variability on access to safe Water supply, as well as how it affects capacity of service providers to guarantee this access.

Methodology approach

Review of secondary data surveys, participatory meetings and field visits. Existing literature relevant to the theme of the study were consulted and reviewed. Quantitative survey- Questionnaires were administered on 39 water supply and sanitation utilities, and water users in the four focal states for this study- Lagos, Anambra, Osun and the Federal Capital Territory; as well as online to other stakeholders in Nigeria.

Participatory meetings were held with key stakeholders in four states. Qualitative surveys- Study team undertook assessment visits - A total of 20 case studies are contained in this report arising from spot observations and analysis of secondary data.

Analysis, results, conclusions and recommendation

Analysis

Climate is a threat more than an opportunity as it is negatively affecting water service delivery. Nigeria WSS sector lacks the appropriate policy, legal, and institutional framework to respond to climate change impacts. Nigeria's IWRM plan is yet to be finalised.

Results

Eighty four per cent (84%) of the 39 agencies surveyed have observed drastic changes in stream flows, seventy eight (78%) have observed contamination of groundwater due to weather changes, ninety per cent 90% are experiencing leakages in distribution system due to infrastructural damage caused by extreme flooding. 86% of WSS utilities have experienced increase cost of raw water treatment caused by increased contamination of water bodies.

Sixty seven (67%) per cent of the WSS sector agencies surveyed have not set up a desk office on climate change; and (73%) are yet to research into climate resilient water supply and sanitation technologies and systems. A high (76%) of WSS utilities said they have never conducted in house training for

relevant staff on climate change; (61%) said their staff have never attended seminars/workshops/conferences on climate change and (74%) said they have never conducted studies/researches on climate change as it affects their agency.

Recommendation

Water supply agencies should undertake vulnerability studies of existing water supply and sanitation system and ensure that new systems are built to reduce vulnerability; Incorporate climate change effects into the design considerations for major infrastructure; Maintain accurate record of water flow fluctuation in intakes including streams, rivers, and dams to enable them predict climate variability; and Modify existing infrastructure and operations to cope safely with and perform in more variable and extreme conditions.

Conclusion

National Governments should commission a study to assess the safety of dams and water schemes, and their vulnerability to weather extremes

Strengthening resilience through collaborative research and open information systems



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Keywords: Niger River basin, Africa, floods, droughts, climate change

Introduction and objectives

The population of the Niger River basin largely depends on climate-sensitive livelihoods, such as rain-fed agriculture and livestock rearing. Substantial rainfall fluctuations in the Sahel have led to major disasters such as the droughts and famines of the 1970s and 1980s, and the more recent flooding events in 2008, 2009 and 2012. In this research, we explore how collaborative research using open information systems can strengthen the resilience toward such disasters in a changing climate.

Methodology approach

We established a collaborative partnership between Swedish and West African scientists. This involved regular interaction to build mutual capacity regarding (i) dominating hydrological processes in the Niger River basin and (ii) open-source computational tools to assess disaster risks. By combining our expertise, we adapted the process representations in the HYPE model to better match the hydrology of the basin, e.g. with a routine for simulating the floodplain dynamics of the Inland Niger Delta. Subsequently, we used climate model data to assess what effect climate change may have on floods and droughts in the region, and published the results online.

Analysis, results, conclusions and recommendation

The collaborative research enabled us to substantially improve the HYPE model, particularly along the main branch where simulated river flows better matched observations in many locations. This made the model more appropriate for analyzing floods and droughts in a changing climate.

The climate projections indicate that temperature is likely to increase steadily in the basin in the future. Precipitation is also projected to increase, but perhaps more significantly to become more severe at the extremes. Floods are expected to increase in magnitude for most parts of the basin. Agricultural drought events are projected to become more intense and of longer duration in most locations, which may impact the livelihoods of many inhabitants. Substantial uncertainties and spatio-temporal variability remain in these conclusions.

The open nature of the HYPE model and the practical training enabled scientists at technical institutions with a disaster response mandate in the region to further adapt the model, and to start exploring the utility of the tool for additional purposes such as operational flood forecasting. Furthermore, the open publication of climate change impacts on floods and droughts at <http://hypeweb.smhi.se/nigerhype/climate-change/> enabled other institutions in the region with appropriate training to use the results in their adaptation and mitigation efforts. Hence, this collaborative learning approach contributed to strengthening the resilience of the society – through its technical institutions – to present and future disaster challenges.

The encouraging results from the Niger River basin and the generality of our approach suggests that our interactive feedback-driven process of incremental improvement could be valuable for building resilience and sustainable institutions also in other parts of Africa. Realizing this potential faces both opportunities and challenges, which we will further discuss in the presentation.

Riparian Relations Over Time on Indus



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Keywords: Cross-scale, transboundary water governance, institutional adequacy

Introduction and objectives

In adjusting for water resources management to better address challenges posed by climate change, the dynamics of cross-scales and their influence on institutions and decisions could provide important insights for managing complex systems. The case of Indus River is examined here to provide an example of the way institutional arrangements and legal and policy frameworks for transboundary water governance are shaped as a result of cross-scale interactions. The key question asked is whether there are specific indicators that could best judge adequacy of management practices in face of climate change.

Methodology approach

Secondary data analysis to capture an overview of the institutions created for Indus to implement two key agreements – namely the 1960 Indus Waters Treaty and 1991 Water Apportionment Accord. Analysis is provided on key challenges that directly result from climate changes in the region and impact on the Indus basin. Description of riparian relationships on Indus over time through the use of Transboundary Water Interaction Nexus (TWINS) is provided to complement the analysis.

Analysis, results, conclusions and recommendation

The research asks following questions:

1. Are the institutions created to manage Indus River remain adequate in face of evolving conditions as a result of challenges posed by climate change?
2. What changes, if any, have taken place in the institutional framework to directly respond to climate related variations?
3. What specific indicators can be identified to assess adequacy of institutional arrangements currently in place?

Using TWINS framework, the paper presents the interactions that are influenced by cross-scales interactions in shaping the institutions and their validity over time. The overarching questions being asked is whether a dramatic shift is still needed to incorporate new realities of climate change impacts in the region and by extension to the Indus River management practices.

The paper articulates some recommendations for the policy makers, researchers, civil society advocates, and user groups to consider. The paper differentiates these recommendations by degrees of influence that various stakeholders may have at international, national and sub-national scale.

Is the Sankh-South Koel-Subarnarekha link resilient to projected climate change?



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Keywords: Inter-basin water transfer, resilience, climate change, hydrological modelling, Sankh-South Koel-Subarnarekha
Introduction and objectives

Sankh-South Koel-Subarnarekha link is part of ambitious Inter-linking of Rivers (ILR) project proposed by the Central Government of India. It is an Inter-basin water transfer (IBWT) project planned by the State Government of Jharkhand, India. IBWT projects are engineering oriented and propose to transfer excess water available in water-surplus basin to water-deficit basin. Proponents claim IBWT will resolve water scarcity issues; however critics raise several concerns regarding environmental impacts and practicality of these projects. Feasibility studies are being carried out by the National Water Development Agency and some early results are available on its website.

Methodology approach

These studies are questioned by scholars on the basis of lacking transparency in the data, methodology and techniques used (Prabhu 2008). In particular the NWDA studies have overlooked resilience of IBWT projects to projected climate change in the region (Bharati et al. 2011). Gupta & Zaag (2008) advocated for independent research on IBWT projects by highlighting the 'engineering, science and politics interlock' (p.31). The present study is part of such independent research (an on-going PhD) and makes an effort to determine if the Sankh-South Koel-Subarnarekha link is resilient to projected climate change under a range of emission scenarios.

Analysis, results, conclusions and recommendation

The research study area covers two basins of Sankh-South Koel-Subarnarekha link, the Brahmani basin (donor) and the Subarnarekha basin (receiver) in Jharkhand, India. The study makes effort to use publically available datasets and models (either free or with minimal cost). The analysis is based on rainfall, temperature and catchment data. The research examines, catchment hydrology at a range of scales using historical information and models water availability for the two basins without and with the proposed Sankh-South Koel-Subarnarekha link. This modelling work produces two base-lines- Catchments with and without IBWT link. The results facilitate the analysis and comparison of consumptive and non-consumptive water use in the basins under present climate conditions. It enables the analysis of the impact of IBWT link on catchments. Then model incorporates regional climate model (RCM) outputs to predict the performance of the Sankh-South Koel-Subarnarekha link on the water users within the catchments.

The percentage change in baseline scenarios both with and without the link in place is useful to assess the resilience of the proposed link. The research enables guidelines and recommendations for the Sankh-South Koel-Subarnarekha link to be developed. These guidelines and recommendations could also be considered for other such proposed IBWT schemes in similar regions. As the link is in planning stage, these recommendations could be accommodated to enable sustainable development rather than damaging water resources in the region.

Global umbrella for local rains: Assessing Hyogo Framework implementation, Brazil



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Keywords: Disaster Risk Reduction, policy implementation, post-Hyogo Framework for Action, vulnerability, interdisciplinary research

Introduction and objectives

Two significant agreements targeting international development and disaster risk reduction (DRR) – the Millennium Development Goals (MDGs) and Hyogo Framework for Action (HFA) – are due to end in 2015. Thus, the debate on “next steps forward” has been on the rise to jointly address different development goals. This research assessed to what extent was the implementation of HFA in Brazil successful. The case study in Rio de Janeiro showed that disaster infrastructure reconstruction projects, policy changes, information, network and investments were success indicators. This study contributes to the debate through identifying potential challenges to implement HFA in Brazil.

Methodology approach

The information to assess implementation was obtained through a literature review of documents from the UN/ISDR, the Brazilian government and private institutions. In particular, the national progress report on the implementation of the Hyogo Framework provided important information. To compare and validate the information from the documents revised, semi-structured interviews were held with the main authorities working on the DRR sector of Rio de Janeiro: Inea, DRM, CPRM, SEDEC and CE-MADEN. A matrix was developed to compare all indicators of every priority of action of the HFA with actions observed in the case study.

Analysis, results, conclusions and recommendation

This case study identified gaps in the implementation of the HFA; a point of concern for the present post-HFA debate. This study highlighted the importance of local level implementation and capacity building to both Brazil's decision makers and the international community (e.g. UN/ISDR).

Brazil has been remarkable in establishing the legal environment, setting designated institutions for DRR actions, and bringing DRR at the national agenda. However, in the case of Rio de Janeiro, there weren't enough financial resources, communications networks, and long-term goals for DRR to be rooted at the local community level. The current HFAPA fell short on guiding local governments to set appropriate administrative actions for DRR. These issues could have negative impacts on the livelihoods of vulnerable sectors of the population. Gaps were found in technological capacity and resources' use issues across all HFA actions. More gaps were identified on implementation at the local level than at the state level regarding communication and education.

Policy design was found to be the fastest and least expensive step forward within the national policy process of DRR. The time investment and financial costs deemed to hold back the transition into policy implementation at the state and local levels. Strengthening disaster preparedness at all levels, and reducing underlying

factors (fourth and fifth HFApa), were harder to realize since it is difficult to reach local levels in Brazil. In addition to understanding of barriers and enablers of implementation, more research is needed to assess outcomes brought by the implementation of the global initiative such as the HFA. This will efficiently and effectively focus efforts to avoid vulnerable situations for both society and ecosystem. Further, it will offer some solutions to achieve a long-term vision of DRR from policy makers; thus securing a sustainable development that accounts for DRR.

Disaster Resilient Water & Food Solutions by Bangladeshi Poor Communities



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Keywords: Livelihood, Innovation, Solution, Water, Foods

Introduction and objectives

Effects of climate change badly affect the drinking water sources and foods that lead in severe water and food crisis. Children and women become the main victims of adverse impacts of climate change. Numbers of poor people migrate to urban areas for livelihood purposes leaving their native lands. Despite millions of people still live in climate vulnerable disaster prone coastal zones, semi-arid and flood prone areas adapting themselves with the changing situations. This paper clearly describes how these people have overcome emerging problems; manage the changing situations and effects of changes in their social, economic, environment and health aspects.

Methodology approach

SPACE, a local NGO conducted participatory situational analysis, organized people, strengthened their capacities and facilitated in developing disaster resilient mechanism based on emerging needs and changing situations. SPACE facilitated in community mobilization and imparting orientation and training to leading people, installing disaster resilient low-cost rainwater collection system, dry toilets, vermin-compost, water saving washing units and groundwater recharger at household level followed by Community Approach. SPACE ensured expected use, maintenance and management of the facilities through community-based monitoring mechanism, undertaking immediate and corrective measures on identified gaps involving community leaders, owners and children in monitoring process and documenting the findings.

Analysis, results, conclusions, and recommendation

Bangladesh is a disaster prone country due to its vulnerable geographic location. Adverse impacts of climate change badly expose its safe water and sanitation situations into vulnerable and challenging. Droughts, groundwater declining, increasing flood, heavy rainfall, water-logging, river erosion, flash floods and saline intrusion led severe drinking water crisis. Over densely population, low lying and agriculture base, low economic strength, inadequate infrastructure, slow development, inadequate institutional capacity, higher dependency on natural resource make the country more vulnerable to climate stimuli. These unwanted situations have led poor people not only safe water scarcity; also food insecurity, unemployment, diseases, environmental degradation etc.

Realizing the needs of poor communities, SPACE facilitates the community in strengthening capacities for combating the emerging problems through innovating affordable and local solution of water and foods. Installation of dry toilets, groundwater recharger and water-saving washing units in semi-arid areas, rainwater harvesting system in coastal zones, flood prone and arsenic affected areas, the poor people have made a sustainable water solution. They also produce organic fertilizers through kitchen waste management, recycling human faces and urines for food facilities at their homestead. Conse-

quently, 80% households have safe water access from rainwater and wells round the year; adequate food facilities at home and clean environment. Field report further reveals diarrheal incidences and malnutrition among children and women decreased, medical cost significantly reduced. Major challenges include storage of year round rainwater and sustainability of achievements by the people as those are low-cost, no hi-tech and scientific systems are not involved.

However, the learning involves as people are capable to solve local problems and make them adaptive to the changing situations if they are properly facilitated. Key-Actors and development partners should extend cooperation to replicate the learning among climate threatened poor communities who suffer from water and foods crisis.

Workshop: Freshwater Ecosystems and Human Development

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Reducing Nutrient Loads from Agriculture Using Pay-for-Performance Conservation



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Keywords: Nutrients, Agriculture, Eutrophication, Incentives, Market Mechanisms

Introduction and objectives

Agriculture remains one of the leading contributors of nonpoint source (NPS) pollution to ground and surface waters around the world.

Eutrophication and hypoxic zones cost billions of dollars annually and impair the use of surface water for millions of people.

Objectives:

- Present innovative approaches to address agricultural nutrient loads to water
- Display cutting edge applications of information technology to reduce nutrient loss from farm land
- Discuss economic incentives to motivate farmers to take action to reduce nutrient losses

Methodology approach

The most challenging aspect to pay-for-performance conservation is accurately quantifying field-specific nutrient losses. Nutrient losses cannot be practically measured from each field. Using a constant coefficient for N or P loss reduction from a given BMP is useless, given the huge variability nutrient source and transport factors in each field, and would undermine the value of a pay-for-performance system. Our pilot-testing of pay-for-performance conservation has led us to the solution of modeling nutrient losses at the farm-level, which triggers a primary incentive payment, and water quality measurement at the watershed-level, which triggers a secondary incentive payment to participating farmers.

Analysis, results, conclusions, and recommendation

The results from this pilot-testing work in Vermont indicate that an average of 0.24 lbs. of P loss can be reduced per acre per year from the simple actions that are good business decisions with a \$25 per lb. incentive payment. The results from identical work in Iowa were much more striking; a \$10 per lb. incentive payment was able to induce a 0.88 lbs. per acre per year reduction in P loss. These reductions are an average from across all of the participating farms' acres, not just the acres on which changes were made.

Assuming that the Vermont result is representative across the larger Missisquoi River watershed, pay-for-performance conservation, using a \$25 per lb. payment, would be able to reduce over 9 metric tons of P loss per year. This represents over 37% of the reduction required by agriculture in the watershed under its P TMDL. The initial evidence indicates that pay-for-performance conservation has the ability to motivate more farmers to implement conservation in an effective manner and to reduce nutrient losses from agricultural land in a much greater way than has been previously seen.

With pay-for-performance conservation, farmers profit from finding and implementing the most appropriate and cost-effective actions specific to their farm and fields. This profit motive induces innovation by farmers to use their knowledge and creativity to develop solutions that work well at the least cost. This same motivation to capture profits is the single most important aspect of a market economy

and what drives continual advancements in productivity. Unfortunately, this has been completely lacking in the delivery of our current conservation programs. Pay-for-performance conservation turns this around by harnessing the power of farmer ingenuity to solve problems through the profit motive.

The contribution of wetlands to sustainable urban development



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Keywords: climate change, freshwater ecosystems, human development, SDGs, urban wetlands

Introduction and objectives

Projections for 2025 suggest urban settlements will house 70% of the world's population, with large cities in developing countries accounting for more than 90% of future population growth. This will increase pollution loads and physical encroachment on urban and peri-urban wetlands, affecting ecosystem integrity, public health, and flood and climate resilience. The opportunities that wetlands provide for sustainable cities are, however, frequently overlooked or overwhelmed by the rapidity of changes. Better understanding and quantification of wetland ecosystem services in urban areas and dissemination of this knowledge is urgently needed to develop policy and its integration into urban planning.

Methodology approach

“Wetlands and Urbanization” pilot projects implemented by the Ramsar Convention and UN-Habitat assessed the ecological and social impacts of urbanisation in Ghana, Senegal and Togo, providing an evidence-based framework for integrating wetland management into urban policy. The international Wetlands Forum in Rwanda in 2013 launched the Wetlandsforum.net initiative, as a platform for sharing knowledge on wetlands and support capacity development for their wise-use. These initiatives embrace holistic approaches connecting water, climate, biodiversity, poverty alleviation and health. Lessons learned support dialogue and integrated action on coastal and riverside urban wetlands to inform future directions for sustainable development.

Analysis, results, conclusions, and recommendation

The uncontrolled expansion of the three coastal cities of Ga Municipality in Ghana, Somone in Senegal and Aneho in Togo heavily impact forests and freshwater ecosystems, increasing water pollution and disease. Wetland loss impacts socio- and cultural well-being and exacerbates infrastructural challenges and the effects of climate change.

The wetlands benefits to local communities in the pilot cities include supporting diverse livelihoods, mitigating impacts of flooding and providing a rich habitat for biodiversity; benefits within urban and peri-urban environments that are often not fully recognized.

The pilot projects, and the Ramsar Convention resolutions on “wetlands and urbanization”, “wetlands and climate change” and “wetlands and health”, underline the need to link local governance, ecosystem services, poverty alleviation, health, education and adaptation to climate change, for wetland management. The case studies on rapid urbanisation impacts show that wetlands in urban areas provide an integral part of a sustainable future.

Human society inevitably shapes the development of towns and cities. More explicit recognition of the benefits provided by wetlands, improves urban planning, decision-making, and livelihoods and making

cities more sustainable and pleasant places to live. Preserving urban wetlands from encroachment and restoring degraded or lost wetlands will contribute to the zero-draft of the SDGs calling for a 15% increase in wetlands, which clearly identifies their importance for sustainable development.

Africa has more than 60 international river basins, covering 64 % of its land area and home to 77% of the continent's population. It is also estimated that Africa counts more than 320 coastal cities with more than 10,000 inhabitants. With this scale of importance, incorporating wetlands ecosystems into policy and plans to adapt to the inevitable expansion of cities is important for both better protection of freshwater ecosystems and the human societies that depend on them.

Restoring Lake Prespa - Common Vision to Long-term Success



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Keywords: watershed management, wetland restoration, cross-sectoral engagement, phosphorus, adaptive management

Introduction and objectives

Since 2004, the goal of UNDP's Lake Prespa Restoration Programme has been to restore the health of the ecosystem. A broad set of objectives includes strengthening the regulatory and planning base, developing scientific datasets for decision-making, prototyping new management and restoration strategies, and sharing lessons learned. The Programme is a unique partnership of local and national governments, stakeholder groups, and international partners (UNDP, GEF and Swiss Agency for Development and Cooperation). Early emphasis on cross-sectoral participatory engagement built strong support for a common vision and helped change a centralized system of water management into a decentralized system of governance.

Methodology approach

Building on initial pollution reduction successes, since 2012, the focus has been on restoration to optimize social and ecological benefits. Using social and scientific data gathered to date and ideas generated by multiple stakeholders, the approach includes design of an engineered wetland that will treat municipal waste and floodwaters, and coupled watershed and lake models that will help target a combination of additional interventions for achieving the greatest water quality benefits. The models are examining 4 primary scenarios and will be applied in concert with local considerations to help determine the mix of additional investments.

Analysis, results, conclusions and recommendation

The engineered wetland was designed after a comprehensive analysis of physical, chemical, biological, land use, and socioeconomic data. Various options were ranked using an evaluation scheme that scored according to predicted phosphorus reduction, water storage potential, ancillary benefits for biodiversity, costs, municipal priorities for land use, and social acceptability of the design on the landscape. Initially the lake and watershed models are being used to simulate the phosphorus reductions that can be achieved from combinations of wetland restoration, fertilizer application management, irrigation practice management, and orchard waste management.

These scenarios were selected based on the interests of the stakeholders and the actions with the greatest potential to meet water quality goals. The results of the modeling will be presented to the stakeholders for final selection and preparation of implementation plans. A long term lake and watershed monitoring program is gathering data that will document improvements and inform an adaptive management approach. The monitoring team and laboratory is being institutionalized as part of the municipal government and local scientists will continue to use and refine the model as new data become available.

One of the most important factors in the longevity and success of the Lake Prespa Restoration Programme has been the close involvement of the stakeholder community through several cross-sectoral

watershed management mechanisms. The Prespa Lake Watershed Management Council, for example, represents the competing interests of over 25 groups affecting or affected by water, including water users and polluters. It has provided a forum for discussing water issues, overcoming conflicting interests, creating a common vision, and prioritizing interventions, from early actions to improve best practices, to the implementation of a complex and comprehensive restoration strategy. The Lake Prespa Restoration Programme is a model for long-term adaptive management around the globe.

Hyper-Eutrophicated Reservoir and Sustainable Water Stewardship in Semi-Arid Region



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Keywords: Agricultural watershed, Ecological indicators, Invasive species, hyper-eutrophicated reservoir, sustainable water stewardship

Introduction and objectives

Krishnagiri reservoir (KR) is located in an agricultural watershed, one of the drought prone zones in Tamilnadu, India. It is the only freshwater resource in the district and it plays a vital role in supplying water to the command area. It is severely affected by soil erosion and sedimentation problems. Thus its capacity was reduced from 66.10 Mm³ to 39.26 Mm³ in the last five decades. Inflow of agricultural runoff into KR resulted in accelerated eutrophication and subsequent reduction in ecosystem services. The present study is focused on ecosystem approaches for restoration and sustainable water stewardship of KR.

Methodology approach

Water and sediments were collected and analysed from fifteen different locations of KR to study the physio-chemical parameters and nutrients for the period of 12 months. Ecological indicators chlorophyll a, phytoplanktons, fish yield data and Carlson's Trophic State Index (TSI) were selected to study the trophic status and cyanobacterial bloom. Experimental study was also carried out to find out the release rate of nutrients from the bottom sediments under present environmental conditions. PRA tools were used to collect socio-economic data from farmers, stakeholders, government officials and fisher men. Data analyses were carried out by using SPSS 16.0 software.

Analysis, results, conclusions and recommendation

Water and sediment quality at the inflow point of KR clearly revealed the inflow of high load of both suspended and dissolved phosphorus from the watershed. High organic matter at the inflow point during summer season clearly indicates the inflow of organic rich untreated sewage disposal from the upper catchment.

Overall total phosphorus concentration in sediments was very high and highest (13.6 g kg⁻¹) was observed at the dam site. Experimental study revealed that KR was acted as a sink for phosphorus in the past four to five decades and at present they are acting as a source for phosphorus. Carson's TSI was ranged between 71 and 84 and KR was ranked as hyper-eutrophic category. Reduction in crop productivity was observed due to water logging and salinity problems of KR water. There are 27 units of fishermen engaged in fishing in KR and it is the sole livelihood option for some of the fishermen in the units.

It was observed from the fish yield data that there was a greater reduction in the fish varieties and only three varieties of major carps Catla, Rohu and Mrigal and Tilapia are available at present. Invasive species includes African Tilapia fish, cyanobacteria, zebra mussels etc were identified during the study period in KR. This clearly depicts the impact of agricultural pollutants in the reservoir. To achieve

the goal of restoration of KR, the present research recommends development and implementation of numeric nutrient criteria for inflow water and enforcement of treatment of at source in the upstream side and algal harvesting. To achieve a sustainable water stewardship in KR economic instruments have to be provided in the forms of incentives and financial support to farmers in the catchment area to encourage soil conservation methods and organic farming.

Ecosystem Based Adaptation: Sustainable Water Use in Urban Area



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Keywords: Climate Change, Ecosystems, Water Scarcity, Urban Growth Impact, India

Introduction and objectives

Ecosystem Based Adaptation addresses the crucial links between climate change, biodiversity, ecosystem services and sustainable resource management. Indian cities are expected to add 440 million more people by 2050. India has a population of 1.27 billion plus, and growing. Water Availability in India total precipitation 4000 BCM, water availability 1869 BCM, utilizable water resources 1123 BCM. To accommodate rapid urbanization, the Government of India has allocated USD 1.2 billion in fiscal year 2014-15 to build 100 new smart cities, and to develop satellite towns around existing cities and failure to tackle them successfully can have national and regional implications.

Methodology approach

The analysis is the outcome of field research on linkages between the practice of Ecosystem Based Adaptation and sustainable water use in Urban Areas-to improve human living conditions and livelihoods and maintain biodiversity in urban/peri-urban areas. Need of Eco-sustainable integrated approach in water infrastructure development to achieve ecological & economic efficiency and Eco-efficient water infrastructure require shift in policies to integrated water supply, rain water harvesting, waste water treatment and recycling and flood control measures for sustainable urban planning.

Analysis, results, conclusions and recommendation

Climate change impacts such as water scarcity can influence cross cutting sectors: e.g. agriculture, forestry, natural resources, energy and the economy, climatic factors (changes in rainfall patterns) and non-climatic stressors (deforestation, inadequate agricultural practices, etc.) will negatively affect urban communities, resulting in: i) decreased food security; ii) decreased water security; iii) inadequate sanitary conditions; iv) increased health risks etc.

Our findings demonstrate that effective institutional mechanisms are essential for successful sustainable urbanization in South Asia. Ecosystem based adaptation and sustainable water use in urban areas is linked with the degree of institutionalization, political will, infrastructure and networking. The development of infrastructure for treatment and reuse of discharged water is often lagging way behind the withdrawal of fresh water raising local issue with predominantly local solutions.

Ecosystems within urban areas – including wetlands, green spaces, agricultural land, coastal areas and woodlands – provide protective, recreational, and cultural benefits while improving the aesthetics of cities. These have enormous consequences on human health and well-being, safety, the environment, economic growth and development. Water has assumed unprecedented significance in South Asian development discourse. Its availability, consumption, distribution and impact on people's lives and livelihoods is closely associated with the region's major challenges in the present and future.

Green Mission: Meghalaya, Mission is designed to give leverage to the comparative advantage that Meghalaya has in that sector, to generate livelihood opportunities for every household and to accelerate growth and Capacity-building of sector and Actor through sensitization, incentivization and galvanization; for e.g. Enhancing sustainable green cover, Adoption of green technologies, Building up a green movement etc.

Valuing Watersheds for Sustainable Development



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Keywords: ecosystem services, multiple benefits, human well-being, sustainable development, aquatic ecosystems

More predictive, quantitative models can be built on this foundation as more data become available. Early conceptual models can also be used in conjunction with hydrological models (SWAT) or ecosystem service models (INVEST) when these are available. Relatively simple yet rigorous decision frameworks can be developed, even in the absence of detailed quantitative data on ecosystem services, which allow communities and watershed managers to transparently assess the outcomes and impacts of alternative development scenarios - and make better decisions in balancing the water demands of economic development, ecosystems, and sustainable local livelihoods.

Introduction and objectives

Healthy watersheds and freshwater ecosystems provide multiple ecosystem services that underpin economic development and human well-being. One of society's biggest challenges is to sustain these ecosystems while also managing them to maintain the suite of benefits that are needed for economic development. Better tools are needed to plan and manage development so that benefits are equitably shared, and trade-offs between development and ecosystem health can be transparently assessed and managed. We present a practical approach and set of tools that can be used to evaluate multiple benefits - particularly when detailed data in a watershed are lacking.

Methodology approach

We present an approach for developing a comprehensive yet practical framework for assessing the multiple values provided by watersheds and freshwater ecosystems, using a combination of available biophysical data, scientific literature, best local knowledge - scientific and traditional, as well as through the participatory engagement of stakeholders. Inclusive categories of beneficiaries in a particular watershed are identified, beneficiary working groups define and rank a set of most valued ecosystem services. These values are linked to the landscape by identifying contributing ecosystems or land uses and ecological functions. Mapping allows areas important for service provision to be identified in development scenarios.

Analysis, results, conclusions and recommendation

Applying this approach in the context of alternative development scenarios allows benefits in terms of water-related and other services to be evaluated in several ways.

We can look at how economic benefits are shared among different groups in the watershed; how development - for example allocating water across agriculture, industry, and urban users - impacts freshwater systems and the provision of ecosystem services; who benefits the most from maintaining ecosystem services; and how watershed management choices can enhance ecosystem freshwater health and livelihoods.

We illustrate the approach with applications in watersheds from different contexts - tropical Andes, coastal Mexico - and show how this approach supports the design of payments for ecosystem services that protect freshwater systems while also enhancing livelihoods. A strength of the approach is that decision frameworks can be developed at different levels of detail and quantification - depending on available data. In watersheds with little biophysical data, a general conceptual model based on stakeholder and expert knowledge can be used to make decisions - particularly in an adaptive management framework.

Cumulative biophysical impact of small and large hydropower development



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Keywords: small hydropower, ecological impact, reservoir sediment management, ecohydraulics, decentralized energy, rural electrification, Clean Development Mechanism power, water supply, cost reduction, energy management

Results of this study present evidence that further and more rigorous investigation of the cumulative effects of small hydropower and comparative effects of large and small hydropower are needed to develop coupled water and energy policies that more accurately define and support low-impact hydropower development.

Introduction and objectives

Support for low-carbon energy and opposition to new large dams encourages global development of small hydropower facilities. This support is manifested in national and international energy and development policies designed to incentivize growth in the small hydropower sector while curtailing large dam construction. However, the preference of small to large dams assumes, without justification, that small hydropower dams entail fewer and less severe environmental and social externalities than large hydropower dams. Our objective is to evaluate the relative cumulative impacts of small and large hydropower, to support discourse and policies regarding renewable energy development and mitigation of environmental effects.

Methodology approach

We investigate cumulative biophysical effects of 31 small (<50 MW) dams (totaling 417 MW installed capacity) and four large dams (totaling 10,400 MW installed capacity) in China's Nu River basin. We define potential for biophysical change according to a suite of metrics indicating absolute impact to freshwater systems, including habitat losses, catchment connectivity, conservation priority, landscape stability, change to hydrologic and sediment regimes, and water quality. We then normalize cumulative impacts of small and large dams by installed capacity to compare the cumulative impact of each megawatt of power generated by small and large dams.

Analysis, results, conclusions and recommendation

Our results indicate that small and large hydropower dams, as defined by Chinese hydropower laws, affect aquatic ecosystems in different ways. Small dams (50 MW) related to total land inundation, potential sediment transport disruption, and potential for reservoir induced seismicity. Effects to catchment connectivity vary according to the scale of reference, with effects of small dams exceeding those of large dams at a sub-basin scale and opposite trends observed at the international scale of the Salween Basin. Despite data uncertainties and variability, our results indicate differences in cumulative biophysical impact of large and small dams that exceed both modeling uncertainty and sample variability.

Rooted in the assumption that the biophysical onsequences of small hydropower dams are fewer and less severe than those associated with large hydropower, current national and international development priorities often encourage growth in the small hydropower sector while discouraging construction of large dams. These policies often define small and large hydropower dams according to a simple metric of installed capacity. Our results indicate that this definition of small hydropower is inadequate for describing the scale of potential environmental impact.

Ecosystem based approaches for Water-use efficiency development in Gaza Strip



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Keywords: Ecosystem, water harvesting, GIS DEM

Introduction and objectives

Increasing of water use efficiency should be associated with real ecosystem development.

This methodology to be used to conduct a systematic map and digital elevation model map to evaluate the best location for harvesting of water in to the ground. Several criteria have been considered in this research; urban expansion, best water quality location including chloride and Nitrate concentration and meteorological conditions.

This research provides scientific evidence indicating the effective of approaches merging between water- use efficiency and ecosystem, which save the diversity of natural resources.

Methodology approach

Water harvesting which is one of best methods to increase the water use efficiency involves the capture and storage of runoff rainwater, so that it can be channeled onto targeted land areas when needed, thereby improving agricultural productivity in Gaza Strip. Maps, based on Geographical Information Systems (GIS) and Digital elevation model, can give a clear picture of areas where rainwater can be effectively harvested at the community level based on agricultural needs and flooding control. The project methodology depends on dividing Gaza Strip by grids and cells. Each cell should be managed to collect runoff water to avoid flooding.

Analysis, results, conclusions and recommendation

A Digital Elevation Model (DEM) will be used to estimate the elevation for all locations in Gaza Strip. This project research provides a new approach to estimate flow distribution over a continuous surface. This approach is based on the analysis of topographic form of a surface facet that dictates the flow distribution. In the case of a raster Digital Elevation Model (DEM), the facet consists of a center cell and its eight neighboring cells. If the form of the facet is convex, the water flow is divergent; thus the amount of flow is distributed to all cells that have a lower elevation where stormwater catchment and harvesting can be constructed. This technique is widely used in today's commercial GIS software. This model is used to Estimate flow accumulation over the land surface in Gaza Governorates.

Information from a digital elevation model (DEM) will be spatially joined with GIS and a satellite image resolution and determining the suitable sites. This enabled the average slope across each site to be calculated. Sites with a greater slope would generate more runoff per unit area per unit of time. The DEM will be also used to define the main catchments and subcatchments in the project area (using the Arc Hydro extension).

Satellite images for Gaza Strip also be used to build the digital elevation model. Image classification

will be one of the important digital image processing tools. Erdas has been used as digital image processing software to classify rural and urban area, paved and unpaved roads etc.

GIS is an important tool to find the best locations of stormwater harvesting and infiltration points. ArcGIS10.2 will be used to analyze data collection. GIS has been used in the creation of strategic water resource plans and food security for Gaza Strip.

Groundwater Protection under New Situation in China



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Keywords: groundwater overexploitation control, strictest water management, China

Introduction and objectives

To meet water demand for rapid development of economic society, groundwater is continuously and disorderly exploited to great extent for long time in some regions in China, plus faulty operation and management, as well as insufficient emphasis on protection, which lead to severe problems of groundwater over exploitation and contamination. In recent years the Chinese government attaches great importance to groundwater protection, and has announced a series of documents with clear instructions. This paper illustrates general idea of groundwater protection in China from the aspects of overexploitation control, quality protection, water ecosystem protection, and implementation of strictest water management system.

Methodology approach

The 18th National Congress of the CPC attached great importance to ecosystem protection, which brings new challenges to water resources management in China. Based on “National Groundwater Utilization and Protection planning” and “National Water Resources Protection Planning”, which will be announced by the State Council, this paper analyzes new challenges facing groundwater in China, and according to new water management policies proposed by President Xi Jinping, “Water saving, spatial equilibrium, system management, perform functions of government and market”, this paper analyzes goal, objectives and measures of groundwater protection, as well as measures to implement the strictest water management system.

Analysis, results, conclusions and recommendation

This paper will introduce groundwater hot issues and management goals, objectives, and measures in China, based on summary analysis of “National Groundwater Utilization and Protection planning” and “National Water Resources Protection Planning”.

Firstly, the paper will illustrate hot issues of groundwater under rapid population growth, fast economic society development, industrialization and urbanization, including overexploitation, pollution, faulty management, etc.

secondly, the paper will illustrate the goal and objectives by 2020 and 2030 of groundwater management in China, including total utilization amount control, overexploitation control, pollution control and management system establishment.

Thirdly, the paper will illustrate methods and measures for groundwater protection in China from three aspects. first, implement integrated measures to control exploitation in both urban and rural areas, including water saving for industrial and domestic water use, recycling water utilization, water

transfer projects, high efficient irrigation methods, agriculture planting structure adjustment, especially reduce wheat planting in the north China plain, which is an important grain producing area and also being with severe groundwater overexploitation problem, and even irrigation land changed to dry land; Second, enhance groundwater quality protection, including control urban pollution, enhance key industries pollution prevent and control, agriculture non-point pollution control, etc., Third, groundwater ecosystem protection, especially for ecological sensitive areas, such as arid and semi-arid area, wetlands, land subsidence areas and sea water intrusion areas, groundwater table control limitation is decided and implemented;

Fourthly, the paper will illustrate groundwater management system establishment in China. In accordance to the strictest water resources management system, including water use amount control, water use efficiency control and pollution control, groundwater management and protection system will be established from aspects, such as improving supporting management legislation system, establishing technical standards system, strictly controlling water development and water use, as well as groundwater table control, and enhancing economy adjustment mechanism, etc. (e.g. extended droughts).

“Payment for Ecosystem Services” Initiative in the Cubango-Okavango River Basin



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Keywords: PES, Equitability of benefits, transboundary basin

Introduction and objectives

Freshwater is the major environmental and socio-economic resource in the Cubango Okavango River Basin (CORB), directly supporting all human activity, vegetation, wildlife habitats and their associated productivity. However, the 2012 Strategic Environmental Assessment (SEA) for the Okavango Delta Ramsar Site and the Transboundary Diagnostic Analysis (2011) for the CORB found that the system is under substantial threats.

The study aims at exploring the conversion of the CORB's bio-capital into a business model that expands the scope of business opportunities to improve the livelihoods of the CORB population while ensuring its ecosystem integrity.

Methodology approach

A PES approach for the Cubango-Okavango River Basin will aid in bringing together communities across boundaries, between those in Angola, Botswana, and Namibia that rely on the river for its provision of freshwater, sustenance, and income opportunities. With the support of OKACOM, UNEP, SAREP and GRID-Arendal are working and involving local communities, government ministries and the private sector in order to value and prioritize the ecosystem services in the basin, tackle the threats and protect the CORB basin for the future.

Analysis, results, conclusions and recommendation

The Okavango Delta provides a staging area for birds migrating to southern Africa during the boreal winter and is a storehouse of globally significant biodiversity, as well as a popular international tourism destination.

The productivity associated with freshwater use and its related aquatic ecosystems is estimated at approximately 25% of GDP in the basin, with considerable inter-country variability. Freshwater sources are the natural resource component most at risk since there is no substitute for the basin's watercourses and associated aquifers. Following the business as usual model, the system will be driven to surpass unacceptable thresholds for the maintenance of its ecological integrity.

Payments for ecosystem services (PES) are ways to financially internalize externalities, providing land managers with incentives to adopt land use practices that maintain or enhance ecosystem services. They can facilitate the transfer of financial resources from the users of ecosystem services (often downstream stakeholders) to those stakeholders who live in localities where the ecosystem services are produced and maintained (often upstream stakeholders), so that the users become the buyers of the services and the producers become the sellers, thereby optimizing the flow and equitability of

benefits derived from these services.

A PES scheme can be suited for the CORB and will create incentives for local communities to conserve and improve resource management, with the potential for:

- Secure livelihoods, by ensuring the delivery of critical ecosystem services throughout the basin and safeguarding both the environment and the people who rely on the river for economic opportunity;
- Achieve a thriving tourism industry, by safeguarding wildlife and fish populations that support safari travel, one of the key economic activities in the region; and
- Ensuring ecological sustainability, thus increasing resilience to climate change and reducing threats from development.

Watershed Management for Sustainable Water Sector Development Projects in Ethiopia



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Keywords: Sedimentation, Watershed Management, Projects, Livelihood, Sustainability

Introduction and objectives

Water is vital for life, development and the environment. If water development projects are properly managed, it can be an instrument for economic growth, social development and environmental conservation. But inadequate quantity and quality due to poor management limits poverty reduction and national development, resulting in poor health, food insecurity and reduce energy production. Water resources protection needs appropriate mechanisms of reducing pollution caused by point and non-point sources. Sustainable use of water depends on the functionality of the whole ecosystem. The objective of is paper to integrated watershed management ,livelihood and reduction of sedimentation in reservoirs.

Methodology approach

The methodology was based on dam projects in Ethiopia including water supply, irrigation and hydro power focusing on soil erosion and sedimentation in the reservoirs and its impact on the water quality and quantity. Both primary and secondary data including review of literature, study documents, field observations, and consultation with different stakeholders have been made to assess the problem. During the field observation existing conditions include the development projects activities, the natural environment, and the socioeconomic condition of the people living in and around the watershed areas was critically assessed for to identify solutions.

Analysis, results, conclusions and recommendation

Analyses of the water development dam projects show that sedimentation is the major problem in the reservoir caused by poor water and land management. Lack of integrated planning and implementation of projects has a negative impact on the conservation and utilization of natural resources. Wise land and water resources utilization needs knowledge from the perceptive of multidisciplinary view and the full involvement of the stakeholders. Equitable benefit sharing of the community by creating incentive mechanisms in soil and water conservation activities in the watershed areas of the development projects. Multiple benefit including reduction of sedimentation in the reservoir, water quality improvement in general, increase in agricultural productivity, energy production and improving the livelihood of the watershed communities can be achieved.

The major problems caused by high rate of sedimentation in the reservoirs:

- Increases in turbidity and algae bloom in the reservoir of water supply dams increase the cost of water purification ;
- The cost of silt removal from irrigation canals;
- Reduce the water holding capacity and life of the dam;
- Reduce the energy production;
- Increase maintains cost of hydropower equipments and structures.

Water development projects planning and implementation is complex and requires adequate coordination efforts of various stakeholder and user groups. An integrated watershed management in holistic

approach must be considered to solve the problem of sedimentation in the reservoir and maximize the benefits from the integrated watershed management. The implementation of future Sustainable Developments Goal (SDG) should give priority for the conservation of watershed areas and freshwater ecosystem in general. Regular environmental impact assessment (EIA) is necessary to reduce the rate of sedimentation, to increase the life of the dam, for dam safety, water quality and quantity and improvement of livelihood of community in and around the watershed area.

Workshop: Managing water resources for green growth and equity

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Negative impact of intensive farming on groundwater soil and land



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Keywords: Intensive farming, negative impact, groundwater-soil-land

Introduction and objectives

Intensified agricultural inputs during first two decades of Green Revolution (1970-1990) changed the face of Haryana State in terms of surplus food grain production reinforcing India's Food Security. However, subsequent decades (1991-2000) witnessed stagnation in production, diminishing farmland returns and surmounting stress on its small (<2ha) and medium (<10ha) farmers constituting >85% of the community. A remarkable decline in production of beans, pulses and coarse food grains alongside an awful degradation of its basic georesources like groundwater, soil and land are some of the negative impacts needing redressment (Lunkad and Sharma, 2007,2008).

Methodology approach

Proposed presentation is based on analysis of groundwater and soil samples obtained from 55 locations in 5 blocks of Kurukshetra, a leading district of eastern Haryana having come under negative impact of intensive farming during Green Revolution. Major ions including NO₃;⁻ pH, TDS, TSS, SOC, CEC, available N-P-K and granulometry were estimated using standard laboratory methods. For impact assessment data have been drawn from published and unpublished sources relevant to rainfall, canal irrigation, groundwater extraction, water-table recession, input of chemical fertilizers, degrading groundwater quality, soil salinization, land use change, urbanization, depleting pastures and cultivated land.

Analysis, results, conclusions and recommendation

Presentation focuses Kurukshetra district (1530 km²), a part of Haryana's eastern agroclimatic zone growing wheat, rice and sugarcane as principal crops over 1444 km² (94.4%) land. About 82% irrigation is from groundwater and 18% by surface water canals. Haryana fulfils 53% of its irrigation demand from groundwater and 47% from surface water. Groundwater is overexploited. Number of tubewells doubled from 35,725 in 1973 to 71,910 in 2010 and their density increased from 10 to 40 per km². Groundwater extraction is 166% of potential rainfall recharge (negative budgeting). Water table has been declining over past 30-35 years at average rate of 0.3 m/year affecting farmers' bill (electricity/diesel for pumpsets). N-fertilizer application has increased over past 4 decades from negligible to 382 kg/ha, it is 3 times standard dose (120 kg/ha).

This is root cause of nitrate pollution of groundwater aquifers - the main source of potable water supply. In 27% samples nitrate is above permissible limit of 45 mg/l for drinking water (WHO) and in 23% samples it is 90-120 mg/l crossing 90 mg/l limit for Blue Baby Syndrome (Methaemoglobinaemia). Soil fertility indices are on decline. Despite heavy N-fertilizer application, available nitrogen (N) is very poor in soils (99 to 160 kg/ha); it should not be <250 kg/ha. Same is true for soil organic carbon (SOC) which is in 0.1-0.6% range (critical below 0.4%).

Recommendations:

- Restricting N-fertilizer application to 120 kg/ha; use of bio-fertilizers/green manures.
- Changing crop pattern from alternating wheat/rice to alternating wheat or rice with beans and pulses to enhance Nitrogen in soils.
- Enhancing sprinklers/drip irrigation.
- Increasing minimum size of holdings to 10-20ha by starting 'cluster cooperative agriculture'.
- Planning artificial recharge of aquifers in eastern Haryana from flood water of Yamuna river and surplus water of Sutluj-Beas rivers.

Taking water into account: the natural capital perspective



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Keywords: Natural capital accounting, water accounts, development planning, resource efficiency, sustainable development

Introduction and objectives

Despite its importance for human welfare and economic growth, water resources are typically not included in analyses of wealth and economic growth. In natural capital accounting (NCA), natural capital is incorporated into national accounts to support better decisions for inclusive development. Wealth Accounting and Valuation of Ecosystem Services (WAVES) is a global partnership led by the World Bank that aims to promote sustainable development by mainstreaming natural capital in development planning and national economic accounts. Water accounts are developed in partner countries to measure and assess tendencies in water use and impacts on their economy and water resources.

Methodology approach

The paper presents case studies from two partner countries, Botswana and Guatemala. The framework used is the System of Environmental and Economic Accounts (SEEA, UN 2012), an international statistical standard, and the framework developed in manual on water accounts, SEEA-Water. Data was compiled for water supply and use on the national and regional level, and disaggregated to different economic sectors: agriculture, manufacturing industries, forestry and fishing, building infrastructure and households. The agricultural sector further disaggregated to different crops. The resulting datasets were used for analyzing water use intensity, the economic contribution of water, and water pollution by different economic actors.

Analysis, results, conclusions and recommendation

For Botswana, it was found that self-providers account for half of the water consumption, and yet they are often overlooked in discussions about water resource management. The water supply and use of self-providers deserves much more attention in future water resource management. Unlike with water-service providers, no separate abstraction and use figures are available. A striking finding was the large amount of waste water, which if recycled can provide a significant resource. Competition for potable fresh water could be eased in the future by increasing use of saline water in mining operations. Irrigation expansion must be evaluated together with growing demands of mining sector and settlements.

A recommendation from the study was that water scarcity should become one of the considerations in the economic diversification drive. It should discourage economic diversification toward water intensive sectors and encourage the development of a water conservation industry for local and export markets. A challenging question in Guatemala, where water regulations and their enforcement are weak, was how much different economic and consumption activities contribute to pollution of water sources.

The water accounts helped identify the main uses and users of water, on the national level as well as disaggregated by management regions. The data produced by the process showed that 70% of the water extracted to be used by the economy returns to the environment as waste water lacking any type of treat-

ment. The analysis furthermore showed the intensity of water use by each economic and consumption activity, which gave important input to implement policies promoting a more sustainable management. It was shown that water consumption by households varied significantly between regions and between urban and rural population. Both studies provided important policy recommendations. The accounting system was shown to provide a consistent framework where data could be consolidated and data gaps and inconsistencies identified, to be addressed in future work. Moreover, the links between water resources and economy were highlighted.

Awakening of Lives- (Divi Aruna) Successful Sri Lankan Experience



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Keywords: System investments, allocation practices, preconditions, hard and soft components, sustainable solutions, economic progress

Introduction and objectives

Water resources and adequate water supplies coupled with sufficient system investments and efficient allocation practices will be essential preconditions to the achievement of economic development. Currently more than 2.2 million people die each year and 6000 children die every day due to inefficient water allocation, utilization and poorly manage water investments and sanitation solutions, Water is central to this challenge. Without it, no productive economy to live healthy lives cannot produce foods, energy and other basic necessities. In addressing the challenge new government enacts innovatively development pathway titled 'Divi Aruna'. The project encourages participatory and responsible water management.

Methodology approach

The objective of this paper is to discuss the methodology used in the DA project. Which coordinates by the National Council for Economic Development, mobilizing the relevant ministries, researchers and CBO, together with NDB and public private partnerships. Also it explained the prioritized investment plans and how they initiative fundamental structural Reforms, Ordinance and newly introduced alternative systems. Further discussed critical hard and soft components for sustainable solutions to achieved economic progress and how eradicates the extreme poverty by managing the economic and social consequences of water allocation, utilization among different water sectors, with lessons for future policy formulation.

Analysis, results, conclusions and recommendation

Today, water demand for emerging cities, food production, industries, environment and tourism are growing faster than the supply can be replenished by nature. While in most regions there is enough water to meet every ones needs, but they are wasting much water or used inefficiently. Responding that the project provided financial support for water resource investments and use through the NDB bank. They monitored the inefficient allocation rules creating a network of institutions to supply technical support through skills development.

It developed a knowledge-based community in the country, without considering the social, environmental, political and cultural throughout the 9 districts and 89 local authorities implementing 465 Water Associations, processed a strong links to water, economic development, social progress, equity and promoting healthy and rich environment. Water for food production has a fundamental roll in development agenda, DA has practiced proper water management to link Rain-fed and Irrigated Agriculture to gain the food security. It generates many growth opportunities, fisheries, agriculture, tourism and SME development to improve the economy of marginalized people.

They account for deposits to the value of over Rs. 55 billion with approximately five billion depositors. Hence Sri Lanka has been quite impressive in achieving most national targets, i.e. 86%, 94% and 98%

country's population has access to safe drinking water, sanitation and electricity respectively with 98% food security. (UNDP Report 2012 said that Sri Lanka have performed well) They could properly managed and used by organizing and harmonizing with the economic and social consequences, such as land and monetary policies, programs formulating effective regional action plans, practical tools considering the program and implement them within limited time frame along with continuous research. Thereby country could successfully achieved essential development objectives through the proper water resource investments and utilization, giving poor a better deal.

Strategic river basin planning and water allocation



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Keywords: Strategic Basin Planning Water Allocation

Introduction and objectives

Growing competition for water has driven major changes in the way river basin planning is undertaken and water is shared. This has resulted in a shift away from 'technical' approaches designed to maximise water availability and led to more strategic approaches. This paper summarises research by WWF and the General Institute of Water Resources and Hydropower Planning and Design, Ministry of Water Resources (People's Republic of China) on lessons from international approaches to river basin planning and water allocation. Our aim was to produce guidance on planning and allocation, especially in the context of complex and heavily contested river basins.

Methodology approach

We commissioned expert reviews of basin planning and transboundary water allocation in the USA, Australia, China, South Africa, Mexico, India, and Europe. Each review addressed questions regarding the planning, including prioritisation of desired outcomes and interventions; approaches to defining regional water allocations; institutional responsibilities; and lessons learned. From these reviews and a broader literature analysis we summarised the evolution of basin planning and allocation and distilled key challenges. We combined this analysis to derive strategic frameworks to guide basin planning and water allocation. The frameworks were specifically tested for suitability for addressing existing challenges in China.

Analysis, results, conclusions and recommendation

Traditional approaches to basin planning have adopted a technical/engineering approach to water resources management, aimed at meeting relatively straightforward, externally set objectives (in terms of supply, hydropower production, etc.). Such approaches are not suitable to highly developed and highly complex river basin systems, where it is not possible to meet all demands for water resources. At the same time, the case studies suggested that there are significant challenges evident in many countries with the application of the principles of integrated water resources management.

The study recommends a more strategic approach to basin planning in order to identify and satisfy social, economic and environmental priorities. Such an approach should be characterised by:

- Trade-offs between alternative economic, social and environmental objectives.
- Sophisticated understanding of environmental requirements
- Understanding basin interactions, including a range of hydrological, ecological, social and economic systems and activities at work within a basin.
- Alignment with development and other planning initiatives
- Robust scenario-based analysis to addresses future uncertainties
- Prioritisation: planning that identifies priorities in terms of economic development, social justice or environmental protection.
- High level objective setting at different time frames.

Economic development upstream vs water security downstream: Central Asia Case



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Keywords: hydro-economic model; water allocation; water-energy-food nexus; Rogun Dam

Introduction and objectives

Water resources are unequally distributed among Central Asian countries. Upstream countries of Kyrgyzstan and Tajikistan together control about 68% of the total water flow in the Aral Sea basin; in the same time the downstream countries of Kazakhstan, Turkmenistan and Uzbekistan consume about 85% of water resources in the basin. Such a large disproportion in water consumption transferred problem from just hydrological issue to the political aspect. The objective of the study is to show at macro-economic level how the planned Rogun Dam may change economic benefits that different countries derive from the river for their agricultural and energy sectors.

Methodology approach

This study investigates the linkages between water consumption, energy production and food security with the focus on the planned Rogun Hydropower Plant on the second largest Amu Darya tributary i.e. Vakhsh River. This study makes use of integrated hydro-economic model developed for the Amu Darya River Basin, consisting of hydrologic, agronomic and economic elements. The model shows how the differing water allocation modes enabled by the planned Rogun Dam (emphasising hydropower or irrigation, for example) result in differing economic benefits for different riparian countries.

Analysis, results, conclusions and recommendation

This study presents the analysis of possible future water allocation modes of the controversial Rogun Dam, located in the major tributary of the Amu Darya River. The hydro-economic modelling results of two water allocation modes –Energy Mode and Irrigation Mode– emphasise that the Dam can be operated in very different ways, leading to radically differing economic benefits and losses for the riparian countries of Uzbekistan, Turkmenistan and Tajikistan. However, neither operation mode provides as such optimal economic benefits for all the countries, emphasising how difficult it is to reach win-win situations in large river basins.

Both modelled water allocation modes have significant economic consequences, as Energy Mode causes reduction of water supplies downstream in summer and consequent decrease in potential agricultural land area in Uzbekistan and Turkmenistan. Similarly, Irrigation Mode would leave Tajikistan with practically no additional electricity supply from the Rogun Dam in winter.

The challenge of combining the economic benefits derived from water, energy and food sectors into one planning framework is therefore demanding, and calls for development of new approaches such as water-energy-food (security) nexus approach. Transboundary settings are particularly challenging, as they require also consideration of the highly political nature of water management between the riparian countries. At more general level, our study shows that while new water infrastructure (such as hydropower dam)

are often designed to produce only certain type of economic benefits (usually energy), the additional water allocation possibilities they provide may actually be used also in other ways to benefit other sectors as well. Discussing such possibilities is particularly important in transboundary river basins, where the economic benefits for one country may lead to severe economic losses in another.

Risk Sharing in PPPs to Advance Water Infrastructure



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Keywords: Risk-sharing, Water infrastructure, Institutional investors, Risks in water infrastructure, Bankable water PPPs

Introduction and objectives

The 2008 financial debacle not only brought more stringent capital measures for institutional investors but also deterred them from investing in Public Private Partnerships (PPPs) with blurry risk-sharing structures. PPPs, and particularly those undertaking water infrastructure projects, are struggling to get funding given their complexity and the fact that water is generally regarded as a public good. If we want increased funds to be channeled towards this type of infrastructure, an appropriate risk management strategy needs to be devised. The presentation explores the value of effective risk-sharing mechanisms to increase the attractiveness of PPPs for water infrastructure.

Methodology approach

The authors' underlying hypothesis is based on the "bankability" concept – encompassing projects with effective risk sharing mechanisms and attractive returns. The discussion then moves to the notion of a standardized risk management strategy as an effective method to lower funding costs and increase resources available to water PPPs.

Analysis, results, conclusions and recommendation

Water PPPs generally find themselves unattractive for investment, given low water charges and poor recovery rates in many places. The uncertainty of fee collection and cost recovery acts as a huge default risk, which hinders funding. If additional risks are considered, like poor financial conditions and inaccurate or incomplete baseline data on the condition and reach of the existing distribution and sewage networks, the scenario becomes particularly risky and almost prohibitive for investors. Moreover, there is reason to doubt the capacity of many procurement offices to exhibit the enterprising behavior that allows for an adequate structuring of water infrastructure deals.

The presentation will suggest that if risks are properly identified and categorized (E.g. endogenous and exogenous), and a judicious negotiation process identifies which party is the most prepared to handle them, then a standardized risk management methodology can result in more attractive PPPs, reduced funding costs for water infrastructure, and better water services.

By increasing the capacity of the public sector to structure effective PPP deals, the goal is to contribute to the Sustainable Development Goals (SDGs) by increasing the both the number of people served by water services, and improving the quality of the service they receive.

Water and Green Growth, Beyond the Theory for Sustainable Future



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Keywords: finance, financing, infrastructure

Introduction and objectives

Growing population, rapid urbanization and unpredictable climate change put water at greater risk. As the importance of water is rising in the post-development agenda, green paradigm should be considered as a solution for tackling water-related challenges. In such regard, the international co-research project, titled Water and Green Growth (WGG) is being undertaken by the Government of Korea (MoLIT and K-water) and World Water Council since 2010. The research aimed to emphasize the role of water and suggest a set of policies that can help policy makers attain economic growth, environmental protection and social inclusiveness. In the workshop, the progress of the WGG Project will be introduced briefly and the main outcome of the project will be highlighted.

Methodology approach

Achieving Water and Green Growth objectives highly depends on a solid policy framework. As the research steps went on, the policy guideline has been elaborated and strengthened based on case study analyses. WGG Team selected 26 cases in the phase 1 based on the common challenges each country may face. The number of cases was narrowed down into 11 cases based on each region's particularities, for example in terms of the level of development or the endowment of water resources. When analyzing case studies, both qualitative and quantitative methods were adopted to explore effective institutions and policy instruments. A list of questionnaires and interviews were utilized for quantitative analyses and the qualitative approach was used to examine the relationship between exogenous and endogenous factors, institutions and their effects on project performance.

Analysis, results, conclusions and recommendation

As a result of the analysis, WGG suggested a set of policies, types of policy mix and policy implementation roadmap. Since water is cross-cutting natural resource and the water-related challenges cannot be overcome by a single instrument, the policy mix helps policy makers to identify which institutions and policy instruments are appropriate for development needs in each country. It can be an opportunity to frame the scope of institutions and policy instruments depending on specific contexts and needs of a country. As the final step, policy makers can follow the policy implementation roadmap considering short-term and long-term timeframes.

In the context of the post-2015 SDGs, it is worth paying attention to the WGG Project. The WGG Project can provide practical approaches to using water as a vector through which green growth can occur in the both developed and developing countries.

Workshop: Sustainable Cities: a pipe dream or realistic future?

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Strengthening institutional and governance arrangements for small city sanitation, Indonesia



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Keywords: Sanitation, Indonesia, decentralisation, cities, governanc

Introduction and objectives

The Government of Indonesia has set an ambitious target for achieving 100% access to adequate sanitation by 2019. A key barrier to success is continued low investment by local governments, who have primary responsibility for sanitation under decentralisation. The research aims to support local governments to plan, budget, finance and deliver sustainable and equitable sanitation infrastructure and services. It explores institutional aspects including: capacity, resources, regulations, budgeting, local governance structures, and central-local government interactions.

The project fills knowledge gaps for small cities, which like large cities experience urbanisation, but are additionally challenged by the constraints of smaller local government.

Methodology approach

This project was implemented by the research team (University of Technology Sydney, Kemitraan Partnership Indonesia, and SNV Indonesia), in partnership with the Government of Indonesia (BAP-PENAS) and local governments; supported by Australian Aid. The research drew on political economy analysis and institutional analysis approaches. In six local government case study locations, stakeholders were engaged through participatory focus group discussions, semi-structured interviews and workshops. Stakeholders from provincial, national and international agencies/organisations were interviewed, and planning and budgeting documents reviewed. Stakeholders from different cities, sectors and levels of government met to share experiences in workshops.

Analysis, results, conclusions and recommendation

Local governments are assisted by a central government program to develop multi-year sanitation strategies (SSK – Strategi Sanitasi Kota/Kabupaten). SSKs are required for local governments to access certain central government and international donor funding. However, processes to ensure the quality and completeness of SSKs are weak. In practice in some locations, SSKs have limited or nil relationship to sanitation budget allocations or implementation.

Central law requires local governments to establish a pokja sanitasi (committee) to conduct sanitation planning and coordinate activities between departments. In practice, several pokja are not operational and in these cases local government provide limited services. In other locations a pokja functions effectively, but faces challenges in arguing the case for adequate sanitation budgets, mainstreamed across various departments.

This project is exploring ways to strengthen governance arrangements to clarify pokja roles and responsibilities to improve the linkages between planning, budgeting and implementation.

Low community demand for sanitation, poor governance, local government reluctance to invest in network-scale infrastructure, and confusion about central government regulatory frameworks are often cited as major barriers to sanitation outcomes.

Our case studies confirm and provide further specific details about these issues, and also reveal some latent opportunities for leveraging networks amongst local stakeholders. Civil society organisations are actively involved in engendering demand, advocating for sanitation provision to the poor and vulnerable and promoting awareness of local government responsibilities. Local government officials with external roles within the community, and community members with networks within local government, are instrumental in motivating both community and local government action.

Constructed Wetland for Decentralized Wastewater Treatment in Tanzania Informal Settlements



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Keywords: Constructed Wetlands, Technology, Informal settlements, financial mechanisms, potential of alternative financial mechanisms

Introduction and objectives

About 60-70% of the urban population in Tanzania currently lives in unplanned informal settlements, relying mostly on pit latrines and septic tank soak away systems for sanitation. Major problems with pit latrines and septic tanks are leakages caused by poor construction, flooding of low lying areas and lack of maintenance. Constructed wetland (CW) can solve these problems in informal settlements. The advantages associated with CW is that they use locally available materials and low costs in terms of operation and maintenance and can be decentralized meaning that they be used even in the space limited areas like informal areas.

Methodology approach

The pilot study of CW was conducted in Tanzania with the main objective of determining the performance treatment of CW with respect to organic compounds (TSS and BOD5) and pathogens (Fecal Coliform-FC). A pilot CW constructed at the University of Dar es Salaam was planted with Phragmite Mauritianus with dimensions of 0.6-m wide, 1.75-m long and 0.6-m deep. The study was also conducted to identify the current financial mechanisms for construction, operation and maintenance of the CW and explore the potential of alternative financial mechanisms in informal areas using structured and semi-structured questionnaires, interviews and field observations tools.

Analysis, results, conclusions and recommendation

CW system achieved TSS load reduction by 89.35% which is 15.97g TSS/m²/day while BOD5 load reduction by 84.47% which is 9.29g BOD5/m²/day was achieved. The FC removal rate of 99.99% was also achieved. By achieving mean effluent TSS of 12.64±4.12mg/l, BOD5 14.12 ± 3.84mg/l and effluent FC concentration of 790 FC/100ml it was concluded that application of CW technology can be considered technically as one of the most appropriate technologies for wastewater treatment in informal settlements of Tanzania.

In terms of the current financial mechanisms, the study has identified 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 informal areas of Tanzania it 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 CW analysis reports that 35% are willing to pay in cash for CW in their area, 40% are willing to contribute through labour charge and 25% are not willing to pay in their area due to the fact that they are aged and don't have enough money.

Financial mechanisms for building CWs that have a potential for future in informal areas of Tanzania include micro credit savings, government subsidy, public financing, and private sector in complimentary nature. The study concludes that there is no single financial mechanism that suits CW but a combination of different financial mechanisms is crucial for sustainability of the financial mechanisms.

The Diamond Business Approach for Sustainable Sanitation in Cities



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Keywords: innovative financing, business approach, diamond approach, government, urbanization

Introduction and objectives

Rapid and uncontrolled urbanisation causes major sanitation and waste problems. Especially marginalised people in slums have little access to private or public toilets. Their open defecation leads to health problems. Traditional approaches (NGOs build subsidised toilets for a community) do not work: these solutions are not sustainable and cannot meet the demands of a growing population. Local governments are often not equipped to address growing needs. The private sector is not yet convinced of sanitation as a viable business. The Diamond Business Approach provides sustainable sanitation in cities and accommodates population growth, with NGOs playing a supportive role.

Methodology approach

Within the domain of sanitation the WASH Alliance is working on the development of an enabling environment: creating a well functioning WASH market and a well functioning WASH public sector aiming to increase access to sanitation facilities. To realise this sector development, WASH Alliance partner WASTE has developed a unique approach called the Diamond Business Approach. It is an institutionalized business approach that is system-oriented and driven by demand and supply mechanisms. This approach requires a new facilitating role of NGO's. The approach specifically applies for cities since, compared to rural areas, it is easier to create a market here.

Analysis, results, conclusions and recommendation

Since the diamond approach is an institutionalized business approach, core stakeholders are the private sector and its clients (households, landlords, municipalities) and organizations that enable the business environment (e.g. financial institutions and local authorities). Other organizations, such as NGOs or consultants have supportive roles in this system. These parties only provide support services to the core stakeholders in the diamond.

During the last years, WASTE (specialists in sanitation) gained experience with this approach in Ethiopia, Zambia and Malawi. Here the approach is being up-scaled from three to twelve citywide interventions. The FINISH programme, initialized by WASTE, in India has been running for 5 years now and FINISH managed to leverage government subsidy by 1:20. Under this programme a new toilet is built every 3 minutes. Micro Finance Institutions are at the heart of the FINISH partnership.

With her approach, WASTE aims to set up sustainable sanitation systems in all countries in which the organisation is active. It is the objective that by the end of 2015 'functioning diamonds' are up and running in which all stakeholders know their roles and responsibilities and act accordingly.

By now, demand for improved toilets among households and landlords is present, toilets are being built,

loans are being provided by local (micro) finance institutions to both households and entrepreneurs and people pay back there loans. Local entrepreneurs are being trained to construct toilets of good quality and to transport, dispose, treat and process the sludge safely.

In the Diamond Business Model everything is geared towards sustained development based on local funding mechanisms and strengthened existing institutes. There is no place for a traditional role of NGOs, using external subsidies to provide infrastructure. Making such a shift from subsidies towards a market driven approach is a challenge for NGO's, governments and end users.

Semi-Decentralized, Modular Wastewater Treatment Concept for Fast Growing Cities



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Keywords: semi-decentralized, urbanization, wastewater treatment, water reuse, biogas

Introduction and objectives

Fast growing cities and towns are facing great challenges and high pressures due to rapid urbanization and insufficient water supply and wastewater treatment utilities, especially in developing countries or regions. With the semi-decentralized water infrastructure concept DEUS 21, a highly efficient and future-oriented approach to water and wastewater management has been developed by Fraunhofer IGB (Fraunhofer Institute for Interfacial Engineering and Biotechnology). While decentralized systems are not feasible in the urban context due to high specific costs and inadequate maintenance, centralized systems need large sewers for the transport of wastewater and are very inflexible due to their size.

Methodology approach

The concept DEUS 21 has been demonstrated in a development area with 100 plots in Knittlingen (southern Germany). In 2014, the concept has been adapted to the situation in China in the project “Integrated Resource Management in Asian cities: the urban Nexus” in cooperation with GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). In the course of the research project in Knittlingen, technical options for the utilization of wastewater as a resource have been demonstrated. In China, a solution for the challenges at the specific site has been developed, on the basis of the technological options demonstrated in Knittlingen.

Analysis, results, conclusions and recommendation

In Knittlingen, a vacuum sewer system has been built for collecting wastewater and kitchen waste. For wastewater treatment, an anaerobic membrane bioreactor (AnMBR) has been demonstrated, producing an effluent free of pathogens but containing all the nutrients, therefore suitable for irrigation and fertilization in agriculture. The recovery of these nutrients with MAP-precipitation and ion exchange has been demonstrated as well. Biogas production was significantly higher than in conventional treatment plants, as the process was purely anaerobic and kitchen waste has been added to the wastewater. Rainwater was collected in separate tanks and purified in the water house. The quality of the treated rainwater allows for flushing toilets, watering gardens, operating washing machines and dish washers and use in sinks and showers.

In the concept adapted for China, black water is collected separately from grey water. Grey water is treated in an aerobic process, disinfected and reused for toilet flushing, cleaning purposes (e.g. staircases, roads), irrigation, or it can be discharged into lakes and creeks. Black water is treated separately in an anaerobic pre-treatment (e.g. UASB- Upflow Anaerobic Sludge Blanket process) and an aerobic polishing step. As most of the nutrients are concentrated in the relatively small black water stream, an elimination of these nutrients is not recommended. They should be used with the disinfected water for fertilization in

urban agriculture, e.g. in greenhouses which can grow crops all over the year. Stormwater is stored and treated before discharge into the surface water or reuse.

With these modular approaches, the semi-decentralized concept could be a blueprint for fast growing cities particularly in the rapid urbanization areas in China, as the infrastructure is installed step by step according to the real demand, and the resource efficiency is higher compared to centralized solutions, as the reuse of water, nutrients, and energy is possible.

Water-use efficiency using spatial and temporal clustering analysis of pipe-failures



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Keywords: Failure Analysis, GIS, Geo-statistical model, AC pipes

Introduction and objectives

Although the spatial and temporal scale of pipe failure impacts are an important concern, analyzing pipe failures interactions is hindered by the quality of available data. This research presents a novel approach that aims to analyze spatial data to evaluate the water network reliability and to analyze the temporal data of failures. This analysis addresses how varying temporal and spatial resolution changes the water pipeline reliability value. A spatial and correlation analysis is used to determine the temporal and spatial scale.

Methodology approach

We employed ArcGIS10 software to analyze the data. Water pipe failure database provided from the Syabas Company (Kuala Lumpur Water Company). Database covers the pipe failures from 2006 and 2010. This proposed approach is described and tested in a data set that consists of about 2500 breaks that occurred over four years in a 2500 km of main water supply network in Kuala Lumpur. Advanced geo-statistical and spatial analysis techniques in ArcGIS 10 have been used to present the failure clustering and relationship between distance and temporal intervals between failures.

Analysis, results, conclusions and recommendation

Prediction maps have been created from pipe failures using the kriging tools in ArcGIS.

The spatio-temporal data set for pipe failure in Kuala Lumpur. These records allow us to examine the spatial structure of pipe failure and to address the role of several parameters. We use advanced application of spatial analysis to evaluate the occurrence of spatial clustering in the cases using different temporal windows. The spatial location of failures was also confronted against the spatial location of water network. Spatial clustering of pipe failures was detected at different temporal and spatial scales. The spatial clustering of failures relative to water network, and its timing, suggests an effective role of several factors in pipe failures such as pipe leaks, existing of district meter zones, rainfall intensity.

The results presented in this research indicate that there is a relation between spatial and temporal interval between failures especially for AC pipes. According to statistical spatial analysis, the pipe failures in Kuala Lumpur expected to be occurred in clusters. Also this research presents the importance of clustering to understand the factors contributing in pipe failures. Furthermore, the research presents the technical implication of our approach results.

The technical department can make the accurate decisions based on clustering of database. It is clear that the main failures are in AC pipes with diameter 100mm. Pressure management using District Meter Zone (DMZ) has no actual effects to reduce the pipe failures due to high deterioration of AC pipes. Water pressure management is temporary solution to reduce pipe failure. According the long-term plan, the sustainable improvement of water network become more effective in the schedule of pipe replacement of AC pipes.

Safe human waste recycling for agriculture in India



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Keywords: Sanitation, Resource recovery, Safe reuse, Water saving, Agriculture

thus enormous. Recommendation is to explore opportunities for replication (including scaling up) in other areas. Main focus areas are: Rajasthan, Gujarat, MP, Odisha, Bihar, Jharkand, and UP. Education is needed for more farmers to understand the economic value in compost and training is required for SMEs to maximize nutrient value in compost and therefore maximize its sales price.

Introduction and objectives

A large amounts of human waste generated and gets dumped irresponsibly. This waste has economic value when safely managed and recycled. This standpoint provides an innovative solution to challenges of clean water availability and over-dependence on chemical fertilizer in Indian agriculture sector.

The objective of the pilot is to recover nutrients from human waste generated in the city of Udaipur for agriculture in a manner that is financially sustainable. This way, large amounts of water are saved with non-sewered system and nutrients are recovered. More importantly, the financially sustainable model is replicable and scalable to other regions of India.

Methodology approach

The pilot area is Rajasthan, India. WASTE and FINISH (local partner of WASTE in India) is working together with the Morarka Foundation, an organic group in India to answer the following question: “Can the human waste be converted commercially and in a safe manner into a product that can be marketed?”. Compost is the targeted end product. Morarka Foundation is responsible for the pilot operation, local market scanning, and product marketing. WASTE is accountable for quality monitoring and provision of technical inputs.

Analysis, results, conclusions and recommendation

Sludge was collected from pits and tanks (every three days) with collection cost at INR150/tonne. It was then sprayed with natural disinfectants to remove smell at a cost of INR235/litre and got diluted (15 days of processing time). Afterwards it was mixed with 25% cow dung, worms were put into it and covered with leaves to avoid direct sun exposure.

Watering and aeration is provided every one to three days and three days, respectively.

The compost produced was similar to the vermin compost produced by other manufacturers in the market. Morarka Foundation had no difficulty in marketing the product. Ideal sales price is INR3,000/tonne (€1=80 INR), yet actual sales price is much lower (INR1,800/tonne) for affordability and marketing reasons. Organic entrepreneurs are therefore able to use different pricing strategy. Price breakdown of the product: Sales price INR1,800- 3,000/tonne; Material INR 150/tonne; Processing INR300/tonne; Transport INR 300/tonne; Packing INR 400/tonne; Profit INR650-1,850. Regarding water-saving, this non-sewered system uses 1 litre/flush as compared to 10 litre/flush in conventional system. A household of 5 people can save up to 30 m³ of fresh water per year.

Indian government plans to increase organic fertilizer production by 5% next year, as it is more sustainable and affordable. Effective uptake of urea (chemical fertilizer) in agriculture is 11%–13% (max.17% in good soils). If compost is used, uptake goes up significantly. Farmers who prefer sustainable and affordable production of nutrients have demand for the product. Potential market is

Performance Improvement planning(PIP) tool for improved water and sanitation services



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Keywords: Water, Sanitation, Performance Improvement, Too

Introduction and objectives

Traditionally, urban local governments in India are characterized by poor service levels and financial dependency on national-state grants for provision of urban infrastructure. Existing urban infrastructure financing mechanism in India focuses on standalone projects; on outputs and not outcomes. Experiences from cities that have implemented projects suggest that such investments are often unsustainable, as the techno-financial implications of the operation and maintenance of the infrastructure are usually ignored. Therefore, Performance improvement planning tools were developed with an objective of moving from “infrastructure investment plans” to “service improvement plans” with a wide set of actions including policy and process reengineering.

Methodology approach

Performance Improvement Planning (PIP) tool is developed to support decision making process for local governments for water-supply and sanitation services. PIP tool has three main interlinked components of performance assessment, inter-sectoral action planning, and financial planning. Service oriented PIP tool offers detailed guidance on identifying an appropriate set of actions, and assess the impact of these interrelated set of actions on both service performance and finances. For selected actions, it creates different improvement plans with life cycle cost assessment, and enables comparison of different scenarios. The performance improvement plans developed through this approach are multi-year integrated technical and financial plans.

Analysis, results, conclusions and recommendation

The Performance Improvement component of the Performance Assessment System programme has focused on development of tools and approaches to improve delivery of city level water-supply and Sanitation (WSS) services. 25+ local governments, with population ranging from 15 thousands to 500 thousand, in states of Gujarat, Maharashtra and Karnataka were supported to prepare performance improvement plans.

The PIP tool has been used extensively to prepare sanitation service improvement plans of four small towns in Maharashtra. Using the tool certain scenarios were build that consist of various technical options like on-site sanitation, non-conventional and conventional sewerage systems as well as different sources of finance for the various options like inter-governmental grants, public private partnerships-PPP, city's own sources and borrowings, and implications on tariffs. These scenarios were then compared and discussed with concerned city officials and elected representatives. These discussions have helped a great deal in making concerned stakeholders learn and sensitize that low or no-cost option, processes and policy related actions like regularizing illegal connections can help improve service levels and enhance revenues.

Capacity building workshops were held for city government officials and private consultants to disseminate the performance improvement planning approach and for training in the use of PIP tool. This tool is now being used for preparation of open defecation free city plans for 12 towns of Maharashtra. Our partner organization and private consultants are using this tool to prepare water and sanitation sector improvement plans in states of Karnataka and Maharashtra.

Customized reports on service levels and financial impacts provided in the tool helps users to compare performance, costs and implications on municipal finance. Such detailed analysis for different options provides a basis for an informed debate at stakeholders' consultation. This tool can be used during the project appraisal and for prioritizing the financial allocation for optimizing service performance.

Wastewater reuse and allocative efficiency in Sub Urban Bangalore



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Keywords: Wastewater reuse, Social acceptance, Decentralized treatment.

Introduction and objectives

Bangalore's urban agglomeration has imparted greater pressure on Bangalore Water Supply and Sewerage Board (BWSSB) to expand its water supply service to new sub urban areas. There are 110 villages which have become self-sustaining sub urban areas, though economically very productive they lack productive infrastructure with respect to water and sanitation. There is unregulated high groundwater abstraction. Hence, the focus of this study is to examine how effectively decentralized waste water treatment systems can be used and what is social acceptance level for implementing these technologies at a local level?

Methodology approach

Assessments were made at 4 sub urban areas spanning an area of 27 sq km. Primary and secondary data sources were used to determine the amount of wastewater generated and relative costs of wastewater treatment and recycling. This study emphasized on socio – technological approach to adopt wastewater management within a community. Contingent valuation techniques were used to determine the willingness to pay for the wastewater services and determine the environmental concerns and priorities of the respondents.

Analysis, results, conclusions and recommendation

This study is part of PhD research and data collections through questionnaires and field investigation is completed. Now the data are being collated and analyzed.

The presentation will showcase quantitative data on consumers' behavior modelled and results on the following:

1. Percentage of reclaimed water that can be allocated to street cleaning, firefighting, gardening, washing of cars and buses in garages.
2. Percentage of respondents who trust water authority and show greater agreement to reuse recycled water.
3. Percentage of respondents who perceived risk of reusing treated recycled water
4. Cost saving by adopting decentralized wastewater treatment systems than proposed centralized systems.
5. The study provides a helpful insight to water agencies to improve their allocative efficiency with respect to quality i.e., the reclaimed water of a certain quality to a certain non potable use.

From a project execution perspective we find that small scale solutions can be effectively enacted for a target group.

From policy perspective our study has identified that there are best practice policies and guidelines on

paper but due to lack of stringent monitoring mechanism, effective implementation is not seen. One such guideline is for usage of reclaimed water for construction activities and to treat the construction wastewater on site, but the builders are not following it.

BWSSB is planning to adopt centralized sewage treatment plant in these areas but it is capital intensive and time consuming task as they have to draw sewer lines. Instead low cost decentralized systems are proposed.

There are 10 sewage treatment plants which are ready to sell the reclaimed water, but agency is unaware of public acceptance. This study aided in bringing about the public perception towards usage of reclaimed water.

Promising initiatives are under way. Emphasis is on toilet to tap concept to make cities more resilient and sustainable.

Private Sector Delivery of Sanitation and Hygiene Services, Malawi



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Keywords: Malawi, private sector, Rural, Sanitation

Introduction and objectives

This report presents the findings on research in private sector participation in the delivery of sanitation and hygiene services in Nkhata Bay district, in Malawi. The study was aimed at analyzing and creating an understanding of the involvement of the private sector through the sanitation chain in program implementation and current and recommend measures to mitigate against the challenge within a rural district.

Methodology approach

In this study, data was collected through administration of questionnaires with key informants, in-depth interviews, field observations, focus group discussions (FGDs), household survey and non-participant observation. A total of 311 households were interviewed during this survey by trained research assistants and supervisors. The study also organized three review workshops, which were held in the District to review project finds.

Analysis, results, conclusions and recommendation

The study established the potential opportunities for sanitation as a business were eight fold, namely: (1) innovative improved latrine designs; (2) improved sanitation as public toilets in market area; (3) lack of service providers for emptying septic tanks; (4) tourist attraction center sanitation services; (5) motivated entrepreneurs; (6) high population growth rates (7) existence of motivated development partners and (8) high unemployment.

This study recommended: (1) to support private sector sanitation participation the sector should focus on commercial business loans to the private sector, rather than household (customer) loans; (2) low cost improved sanitation solutions should be available at a cost of less than MK12,132 (18£), or where households can reduce the cost of the private sector services by providing materials (bricks or cement); (3) marketing and community education is needed (4) commercial banks create sanitation funds to offer loans for sanitation business ; (5) the Nkhata Bay District Coordinating Team (DCT) should co-opt commercial financial Institutions in sector planning to promote funding mechanisms for build-up of the private sector, and modeling after water user association savings funds, the same model may have an opportunity to be extended for provision of sanitation services at the community level.

Improved WASH Services in Low Income Communities of Dhaka



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Keywords: public-private partnership, pro-poor policies, urban water supply, Water Operator Partnership, Community Based Organisation (CBO)

Introduction and objectives

Dhaka, with its 12 million inhabitants, is one of the fastest growing cities in the world, absorbing an estimated 300,000 to 400,000 migrants annually. About 28% of the total population of Dhaka city is poor and lives in the slum known as low-income community (LIC). Vitens Evides International (VEI), a Dutch drinking water company, Simavi (a Dutch NGO) and Dushtha Shasthya Kendra (DSK), a local NGO have been working closely with Dhaka Water and Sewage Authorities (DWA-SA) involving civil society organizations to ensure the provision of Sustainable integrated WASH services to the inhabitants of LIC's in Dhaka.

Methodology approach

Service provision in the slum areas is potentially not sustainable, as they lack the tenancy rights. There is always a risk of denying use of the area by the private landlords. The "CBO model" was adopted by Dhaka drinking company, after they were convinced that communities can be seen as a reliable clients. This allows them to sell water via a bulk meter to a registered CBO which is formed/empowered by a NGO. The CBO is responsible for billing/ collection from the individual households and pays the bill. The illegal connections will be removed to decrease the non-revenue water.

Analysis, results, conclusions and recommendation

- Often, the poor population in LICs pay much more to illegal water vendors for their water bills compare to other inhabitants of city. They are therefore willing to pay the public utilities tariff (even higher), if regular provision of the water is ensured.
- The illegal water vendors can pose a serious risk to the provision of WASH facilities to LICs, since their business gets endanger. CBOs need to be empowered to be able to effectively intervene if such conflicts arise.

Results:

- Sustainable WASH facilities for inhabitants of LICs in Dhaka;
- CBOs develop full capacities to effectively and sustainably operate and maintain these WASH facilities in LICs;
- Effective cooperation between stakeholders, most notably CBOs, Dhaka drinking water company and Dhaka City Cooperation (DCC), is institutionalized; Drinking water company ensures supply of sufficient water to LICs and the CBOs in return ensure timely payment of water bills. Dhaka City Cooperation also ensures provision of other services such as solid waste collection from the slums. CBO also takes the responsibility of the O&M of the sanitation services in the slum.
- All unauthorized water connections in the area are legalized with water meter and all new connections are registered. Drinking water company (DWASA) will receive revenues from its registered customers.

- Inhabitants develop knowledge and awareness about personal, domestic and communal hygiene aspects and put these into practice.
- CBOs are capacitated through training to monitor ongoing implementation procedure of infrastructure of water points, toilets and to control whether quality materials are being purchased as well as quality work is being ensured.
- Through close collaboration with the relevant drinking water department, the empowered CBOs can bring their concerns to the right authorities when needed.

Workshop: Information technologies for a smarter water future

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Mobile money technology, convenient for water bills payment in Uganda



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Keywords: Mobile money, technology, convenient, Water bills payment

Introduction and objectives

In the past, the public struggled to queue long hours and travelling long distances to pay water bills in Uganda urban centers. This made people become reluctant to pay for water bills leading to continuous cut offs and losing trust in the National Water and Sewerage cooperation in Uganda. The use of mobile money technology has changed and made access to water in the urban centers more effectively and efficiently. The convenience of mobile money to the public came as a real time solution and has eliminated delays in updating customer accounts and reduction in physical movements of bill payments

Methodology approach

Mobile money is an electronic payment system that transfers money to and from an electric account that can be accessed via a mobile phone. Each customer account is linked to their mobile phone number by means of a built sim-card application. physical cash withdraws and deposits are facilitated by a network of rental agents.

To pay water bills by mobile money, you have to own a mobile phone and registered with a network. You go to menu and select mobile money, select pay bills and then select NWSC. Select the region, type customer reference Number and amount to be paid.

Analysis, results, conclusions and recommendation

The National Water and Sewerage Cooperation came into partnership with mobile money service providers like MTN and airtel to initiate the use of mobile money technology as a convenient method to pay water bills.

The NWSC wanted to ease lives of the customers whom they believe as the king. They phased out cash offices in a bid to concentrate on customer care and the provision of water which is their core business and it was the reason for the NWSC to partner with dynamic organizations like MTN to make water bill payment easier.

Results

- Bills are sent on people's individual phones.
- Reduced expenses on travel.
- Reduced time spent in long queues.
- Reduction in risks by the NWSC
- Water utility bills payment made simple
- Less physical movements by customers

- Convenience
- Increased reliability of water supply to customers.

Recommendation

I call upon the SIWI organizers and convening organizations to support me in creating awareness and sensitize the public on the use of mobile money to pay water utility bills. This is because many people in the urban areas who access water from the NWSC have telephones but do not know how to use this technology to pay for the water bills. Sensitizing these people will make more people have access to water and improved development.

Conclusion

Despite a compelling challenges like delayed reconciliation of billing systems, limited customer awareness and technological constraints hindering some customers' uptake mobile water payments, those customers paying their bills with mobile money enjoy considerable saving in time and money costs usually incurred when settling water bills at physical payments points. Identifying mobile money payment applicable could reach and benefit low income and vulnerable groups in both urban and rural areas to help tackle ongoing water service delivery challenges.

Assessing the Effectiveness of Malawi's Water Policy Using Mobile Technology



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Keywords: mobile technology, AKVOFlow, Malawi, Water, Functionality

Introduction and objectives

In 2005, The Malawi Government instituted the National Water Policy (2005) as a guide to achieving universal access or what is locally known as “Water For All, Always”.

Malawi recognized that the “Always” part of their objectives required communities to own their water systems which involved operating, maintaining, replacing, and extending their water services without external assistance.

In 2012 and 2014, Water For People, and a local government partner, conducted district wide mapping of Chikhwawa, a district in the southern region of Malawi, which provided a comprehensive data-set for reviewing the effectiveness of the water policy approaches and strategies.

Methodology approach

The presentation will illustrate how effective the National Water Policy has been by reviewing data collected using a mobile phone app called AKVO Flow from between 2012 and 2014

Initially developed by Water For People, Akvo FLOW uses Android cellphones, combined with GPS software, to give users the ability to record data from thousands of water points around the world. This data is then used to determine the level of service (water quantity, quality, access, distance, etc.) and level of sustainability (financial management, spares available, etc.) of each system.

The analysis will be based on 4384 lines of data.

Analysis, results, conclusions and recommendation

Water For People, in collaboration with local government partners, collected data in 2012 and 2014 of over 2000 water points across the district of Chikhwawa. The data collected, not only helped provide an understanding of the current state of water supply across the district, but also helped assess some significant changes at a district wide level.

The results show that, despite significant investment by bilateral/multilateral agencies, International NGOs and foreign governments, there has still been an overall decline in functionality of water points by close to 2%. In addition to this:

- Only 26% of water committees collect tariffs on a monthly basis
- 82% of water points in some geographic location had serious problems requiring preventative maintenance
- Tariffs are decided by communities and are predominantly based on affordability and not life cycle costs
- Non-need based interests have distorted distribution of water systems

These results call into question the effectiveness of the strategies and approaches outlined in the Malawi National Water Policy (2005) and, thus, require a thorough re-think of what actually works and what should change.

As such, it is recommended that the standard approaches such as community-based management, for example, need to be re-designed with newer approaches that provide real incentives for communities to own, operate and sustain their water system over time. Such approaches could include borehole banking which converts tariffs into savings/shares managed by the local water point committee.

Mobile platform for water quality data management in Senegal



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Keywords: water quality monitoring, information and communication technologies (ICTs), mobile phones, remote data collection, Senegal

Introduction and objectives

Water quality monitoring is key activity carried out by water suppliers and health surveillance agencies to help ensure access to safe drinking water; however, many institutions struggle to make the data accessible for immediate action or long-term decision-making. Mobile phone-based data management applications can aid in making data accessible and in collating data from multiple remote testing locations. The objective of this study was to design, test, and evaluate the efficacy and sustainability of a mobile phone-based data management system with the national health agency in Senegal, Service National de l'Hygiène (SNH) to improve information flows.

Methodology approach

SNH's monitoring program was established before the ICT intervention, in which health agents collected water samples and recorded source information and water quality measurements; they tested >2,500 water samples between July 2013-September 2014. Each of 13 testing locations started recording data through an Android phone equipped with the CommCare application between September-December 2014. We collected and analyzed quantitative data to compare the accuracy of data collected through the paper vs. phone-based system and qualitative interview data to understand SNH's data management challenges and perceptions of the mobile platform.

Analysis, results, conclusions and recommendation

SNH health agents from the 13 sub-areas collected and tested over 400 water samples and simultaneously reported data through their traditional paper workflow and CommCare.

There are some notable lessons learned thus far:

1. Mobile phone data collection has improved the timeliness of aggregated data and introduced consistent data collection; previously, each multiple remote regions collected different data about water sources.
2. Benefits may be limited because sampling was only a few days per month, resulting in minimal phone use and reduced cost-effectiveness. For health agents for whom water quality is only one of many responsibilities, it may be advantageous to use the phone additional activities (e.g. sanitation, training, or equipment and inventory management).
3. While it was relatively easy to introduce the application onto existing workflows (collecting and testing water samples), it was difficult to introduce mobile data collection into workflows that were not standardized across regions (e.g. follow-up actions). This highlights the importance of establishing successful, standardized workflows before introducing ICTs.
4. One testing location was unable to test at all because of a damaged vehicle, highlighting the many other challenges faced in carrying out water quality testing.

The popularity of mobile phone data management applications has fostered the perception that all

field-based data collection activities will benefit from their use. However, in the case of regulated water quality monitoring, water quality data is almost always collected in laboratories, which promotes data entry on computers. We propose that mobile phone applications will provide the greatest efficiency gains among institutions that collect data from many remote laboratories (i.e. where smart phones are cost-effective alternatives to computers). Also, while this intervention focused on improving information flows within an organization, ICTs also have the potential to improve the sharing of results with local authorities and the public.

Fresh Water Watch: A Citizen Scientist Platform to Monitor Global Water Quality



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Keywords: Citizen Science, Monitor, Web-Platform, Data

Introduction and objectives

Urbanization is impacting on freshwater ecosystems, yet managing this impact is limited by a lack of information on water quality. FreshWater Watch (FWW) addresses the need for these data by engaging a range of audiences (Corporates, Research Organisations, Environmental Groups and Communities) to monitor freshwater ecosystems around the globe. The platform enables citizens to act as a network of sensors who upload data via smartphone apps to an open database which can be interrogated and shared. The Platform already has over 6000 data points and is being utilised by both HSBC and Shell to engage their employees.

Methodology approach

The need for water quality data is particularly acute for small urban waterbodies (such as rivers, streams and ponds) which aren't typically monitored. FWW is engaging citizens around the globe to upload data on these water bodies and provide insights into the relationship between development and water quality. The Platform consists of a network of over 30 scientists and policy-makers who can access this data for dedicated research projects but the data can also be used by anyone. The Platform uses standardised parameters, whilst individual projects can add their own specific parameters to answer explicit localised issues.

Analysis, results, conclusions and recommendation

The Platform is just over two years old but has already engaged over 3000 Citizen Scientists who have generated more than 6000 datasets. This rapid uptake has been achieved by working with Corporates such as HSBC and Shell who have a large, global workforce and wish to engage employees in sustainability issues.

While the main benefits of this growing set of data occur in the medium term, the Platform has already acted as an early warning system at a local scale on numerous occasions (e.g. highlighting potentially toxic algal blooms in potable water supplies). Preliminary results provide important insights into urban water management and have revealed that smaller water bodies typically present better ecological conditions than larger waterbodies. This suggests the need for a fundamental shift in water management priorities.

The Platform continues to engage new participants and is seeking to double the number of Citizen Scientists engaged by 2017. This will be achieved via a novel model of engaging people through their work place, local organisations, schools or communities. Techniques on motivating Citizen Scientists are embedded into the Platform to encourage long term engagement. Participants can form collectives and networks with one another as well as with scientists and other policy makers. In addition, 'gamifica-

tion' techniques reward participants for the amount of data and level of engagement they undertake. In conclusion, recent advances in web and mobile technologies have enabled citizen science to become more widely adopted than ever before, with 'Mass Citizen Science' projects now becoming prevalent. Earthwatch will continue to utilise these technologies to grow the FWW Platform and engage with a variety of audiences to add to this already considerable scientific output to better inform decision makers about how to manage of our fresh water and associated ecosystems.

Lessons from implementing ICT applications in the African water sector



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Keywords: ICT, Lessons, Africa, Water, Government

- Lead to progressive improvement in water services

We conclude that by leveraging ICT significant improvements in water services can be achieved, even within existing capacity constraints, as long as holistic design principles are respected and accompanying actions put in place.

Introduction and objectives

The use of new ICT tools to support water services provision is expanding rapidly. Yet too often the focus appears to be on the tools themselves or the ability to collect data in different ways; insufficiently on what the data gets used for, or how the provision of data actually changes the dynamics on the ground. The paper looks to critically analyse existing case studies to see what drives ICT adoption, to see how this in turn affects the usage of new systems, and thence look at whether these systems actually change water delivery in practice.

Methodology approach

A case study method is followed, with a political science approach taken to in order to look at the different drivers that shape stakeholder's adoption (or disregard) of new ICT tools, particularly those seeking to improve the monitoring of water services. By critically analysing experience in South Africa, Tanzania and Mozambique, and interviewing those directly involved in putting systems in place (governments, regulators, NGOs, municipalities, users) lessons are drawn and recommendations made on how to design new systems in order to have maximum impact.

Analysis, results, conclusions and recommendation

Too often the focus is on “which tool” or “which technology”, whereas it is crucial to pay great attention to what any data collected will be used for and how the provision of this data leads to actual actions that change the dynamics on the ground.

A political science approach helps clarify the different drivers for monitoring – from internal to external – for financial reasons versus ‘efficiency-driven’ approaches – helping to reveal why specific stakeholders will engage or disengage with new initiatives. The result is a slight ‘reality check’ to the implementation and adoption of ICT – with the intention of the paper to help ensure that positive contributions in this field are not lost through bad design, over-ambitious approaches or misaligned incentives.

Case studies from Tanzania, South Africa and Mozambique help to clarify that the use of ICT tools alone cannot solve issues; a number of accompanying activities are required, including the need to raise awareness about and to prioritise monitoring (from Mayor to Technician), to forge good communications between diverse role players, to put in place well-designed feedback loops. Above all, there needs to be commitment and capacity to turn data collection and interpretation into action.

When supported in this way, the application of ICT tools (whether cellphone or web-based) can:

- Offer real-time reporting of quality of service by municipalities and other service providers
- Provide a means to cross-check this information with customers, citizens and other groups
- Enable early or strategic intervention in areas facing significant problems (and possible public health threats)

Real-time optimal operation computerized system, For large-scale water supply networks



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Keywords: Optimal operation, real-time, computerized system, energy saving, supply network

Introduction and objectives

As treated waste water developed to be a major of water source for irrigation in Israel it called for investment in optimal operation systems. Israel's need to deliver about 170MCM/Y of treated waste water over vast spatial area through complex network brought MEKOROT (Israel's National Water Company) to develop a unique computerized system for real-time integrative operation of the network. The system gives solution to a good number of challenges and constraints from hydrological to geographical by evaluating dozens of thousands of variables and manage automatically in real time dozens of sources, intermediate system components and hundreds of supply points.

Methodology approach

The paper firstly reviews the development and implementation phases of the system "M.B.T- 3" while comparing it to other practices of development of such a system. The second part of the work is concentrating on the main characteristic of the system and their practical use. The last part of the paper is an evolution of the results of 4 years operation in order to consider the achievements and recommending further actions. The methodology used in all 3 parts is review of relevant papers, review of working meetings summaries in MEKOROT and in-depth interviews with key players.

Analysis, results, conclusions and recommendation

The waste water of Israel's main urban center is treated at 3rd stag, percolate and stored in an artificial aquifer. The main irrigated region is spread over vast area up to about 200 km from the artificial aquifer. The main bulk of water is extracted by 150 wells from this aquifer and distributes 170 MCM/Y, by consumption 200 million kWh. The water system consists of 57 pumps grouped at 16 pumping stations, 5 seasonal reservoirs, 6 operational reservoirs, and 6 operational tanks. In order to manage the system in the most efficient way MEKOROT used innovative "Agile development methodology" to develop its own complex software system "M.B.T-3". The development was done dynamically and adaptively with tight connection between the developers and the users, while all partners were defined as a joined team. "M.B.T-3" consists of 4 main modules which are grouped into a unified system. It dynamically collects measurements from all the plants. Hourly demands at each operational region are forecasted for 168 hours and for 1 year ahead. In real-time the system defines the optimal planned operation of each plant for a given planning period. It is achieved by solution of a large scale optimization problem with dual objective functions, 177,000 decision variables and 77,000 constraints. The M.B.T-3 has been successfully applied since January 2010. A comparative study was done during 2011, and indicated that, during 2010, in compare to year 2009, 3.5 million USD of the energy cost has been saved. Additional improvements can be impaled in water extractions from wells and in supply reliability level. The paper concludes that such system contributes dramatically to the optimal operation which can be applied in other large-scale water supply networks.

Online assessment system for water and sanitation services in India



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Keywords: Online system, benchmarking, assessment, capacity building

Introduction and objectives

Access to water and sanitation services in urban India is widespread, but little is known about the quality and level of service, and coverage of the poor households. A key challenge in the sector in India is the lack of adequate and reliable information. This poster describes the journey of 400+ cities in two states of India from a rudimentary paper based system to an online measurement and monitoring system, prepared under PAS project at CEPT University, funded by BMGF. Together, these cities house 76.5 million people, with cities as large as 12.5 million to cities as small as 4000.

Methodology approach

The performance measurement framework (PMF) has been developed for state-wide implementation with a focus on the 'real' context for benchmarking water and sanitation in developing country context, and includes aspects of equity and on-site sanitation. The data collection for initial two years was conducted through spreadsheet based questionnaires and required face to face interaction with city officials. The online data entry, analysis and monitoring system was deployed on the PAS portal, www.pas.org.in for the subsequent years, and was actively adopted by city and state officials. The portal now hosts six years of information for all cities.

Analysis, results, conclusions and recommendation

In the initial phase, there were serious gaps in data recording and management in cities. In some cases, there was no recording of relevant data at the ground level or if data was recorded, it was not collated or summarized to be analyzed and reported to higher officials. There were lapses and ignorance towards data collection at the ground level and reporting and analysis at the management level. Most of the records are paper based and fragmented. Where information existed, they were maintained in isolation and were not usually shared with each other.

In the first year, it took almost 15 months to collect and validate data. But, this exercise created awareness about benchmarking and its context amongst city and state officials. In the online system, respective city officials are authorised to enter data, with levels of validation/approval built in for city commission/chief officer, and state officials. The portal also helps cities to analyse and monitor trends, compare with their peers and track progress towards targets.

The results of the assessment are made available at the state level, across all classes of cities. A comprehensive set of guidelines is prepared to assist city government in using online tool. Through a series of capacity building workshops, government officials are trained and made conversant with the online data entry tool. Subsequently they have started entering data online on their own and resulted in reduced timeline for annual performance assessment activity.

To disseminate the online tool, regional capacity building workshops were organised, as a result of which, the

states of Chhattisgarh and Madhya Pradesh, with 150 cities, have bought in and adopted the online tool for monitoring performance of UWSS sectors.

The data from the online system has been used for various policy interventions and improvement actions at state and city levels.

GIS/GPS based Customer Enumeration, a tool for improving Water Utility's efficiency



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Keywords: GIS, urban water supply, GPS, Nigeria, Information and Communication Technologies

Introduction and objectives

The Ebonyi State Water Corporation, conducted a three month GIS/GPS based Consumer Enumeration Exercise in 2014, in the Abakaliki town, South East Nigeria.

The objective of the exercise supported by Sustainable Water and Sanitation for Africa (SUWASA) a USAID funded project, is to enable the Corporation to know all the water consumers to serve them better, plan for extension of water supply to new and unserved areas, upgrade water supply to meet the needs of increasing population and help improve the relationship between the Corporation and its customers.

The author of this abstract was a Facilitator/Resource person of the Enumeration exercise.

Methodology approach

The 4 month exercise was conducted by trained 20 no enumerators in Abakaliki town using a combination of Geographical Information System software and Geographical Position System based computer tablets.

Prior to the physical enumeration, a GIS software was used to generate a Geospatial map which outlines all the streets in Abakaliki town, population 141,438, 2006 census. The map also highlighted existing water distributions and service lines.

Subsequently, 9no Geographical Position System based computer tablets were used to capture customers including geospatial information, service status, contact information and pictures of property.

The data was uploaded to a cloud and stored in a server.

Analysis, results, conclusions and recommendation

A comprehensive communication outreach programme embarked on before the commencement of the exercise helped in securing community support. The major challenge was getting customers to provide accurate data, and this was overcome by involving the utility staff (who are accustomed to the utility customers) to pair with the externally recruited trained enumerators.

Results

Over 16,500 households were captured over the four months duration of the exercise, conducted by Enumerators recruited and trained specifically for the assignment. The exercise increased the customer database of the utility from 4000 to 16500 for Abakaliki city with a potential to increase water revenues once water production increase. The customer enumeration exercise provided fresh and more detailed customer information, capturing data of existing, possible and potential customers. The exercise assisted in the development of EBSWC Billing Enterprise Software linked to the GIS and network mapping activities, and monthly printing of 7000 computerized utility bills and distribution to customers through short message service. The exercise improved the Non Revenue Water Management of the Utility as over 2000 customers who were accessing the public water supply, were not previously captured in the billing system, and as such were not paying water tariffs. The exercise improved billing efficiency as it provided accurate information on active and non active customers, physical structures of customers which helped to determine the tariff rate for the customer. The new

customer database updated the old one developed in in 2001. The exercise collected the telephone numbers of customers utility is now using this information to send SMS based messages to customers on service issues. The exercise provided the utility with feedback on various customers complaints and concerns

Conclusions and Recommendations

Water utilities need to harness Information, and Communications Technologies to improve their billing efficiency, customer service, leak detection, and general operational efficiency.

Harnessing ICT-enabled Citizen Observatories for Water Governance



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Keywords: Citizen observatory, citizen science, water governance, social innovation

Introduction and objectives

Citizen observatories, enabled by various information and communication technologies (ICTs) (e.g. sensors, social media, web technologies) facilitate the involvement of citizens - and not just scientists and professional - in the collection of data to address the persistent data gaps for environmental and water management. Advanced versions have the social innovation potential of presenting a new role for citizens in governance and a two-way communications paradigm between citizens and decision makers. We focus on the social dimensions of citizen observatories to understand how they can be embedded in existing governance processes to add to sound decision making and water governance.

Methodology approach

We examine the social dimensions of the citizen observatories of water (focused on floods) that are being implemented, tested and validated by the WeSenseIt project in three case studies: in the UK, Italy and The Netherlands. Following an action research methodology, face-to-face interviews and focus group discussions were carried out with a range of stakeholders in each case study location over a period of 2.5 years. These data collection activities were based on a conceptual framework derived from political sciences to analyse existing governance processes and how these have changed over time with the introduction of the ICT-enabled citizen observatories.

Analysis, results, conclusions and recommendation

The analysis shows how decisions are made, which stakeholders are involved, what their respective roles are as well as their influence on decisions, and reveals local patterns of participation in the cases: differing perceptions of the role of citizens, combined with the different strategies adopted by the three cases in response to relevant EU directives. These range from 'ad hoc' participation in The Netherlands, to 'selective' participation in Italy (preferring distinct, more 'reliable' stakeholder groups to collect data), to intense community engagement in the UK.

While citizen observatories, as a broader form of citizen science, have the potential to provide new ways (and perhaps even new paradigms) of citizen participation with significant impacts on existing governance processes, this research demonstrates that they are not 'plug and play' solutions. Tailored socio-technical systems are emerging, resulting in specific 'shapes and sizes' of citizen observatories that entail differing treatment and inclusion of data streams into existing decision support processes as well as various digital and hybrid (online and offline) interaction mechanisms for distinct stages of policy and decision making.

The appeal of an observatory, for the citizens, seems to be strongest if it is grounded in their current concerns while authorities are struggling to find a balance between the appeal of additional data streams and their concerns regarding the accountability and legitimacy of their decisions based on citizens' data. Similar to existing discussions about locally defining governance objectives, the extent to which such ICT-facilitated observatories will change the role of citizens in water governance depends on both, the role granted by authorities and that actually claimed by citizens. Our results provide a basis for recommendations on the conditions

for reaping the expected impacts of ICT-enabled citizen observatories in terms of improved water governance and sustainability of distinct areas of environmental and water management.

DOWSER: A New Android App for Dissemination of Groundwater Information



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Keywords: Android, Mobile app, Water Level, Groundwater, India

Introduction and objectives

According to a World Bank report, India is the largest user of groundwater in the world. Mass participation is considered the only possible alternative for effective groundwater management in India. An essential prerequisite to ensure effective mass participation is dissemination of usable information to the direct stakeholders. As per a survey, in the second quarter of 2014, India had nearly 111 million smartphone users. The smartphones can act as effective media to disseminate groundwater information. This paper presents a new app named DOWSER for the android devices aimed at disseminating water level data through smartphones to the direct stakeholders.

Methodology approach

The app DOWSER uses a database of nearly 20000 records. This database contains data generated and owned by Central Ground Water Board (CGWB). The database includes location details of the monitoring stations, their coordinates, measured water levels and dates of measurements. The app works in three steps: i) reads coordinates from the GPS of the mobile device, ii) calculates the distance of the mobile device from each monitoring station in the existing database and iii) reports the details of the nearest monitoring station and its last recorded water level. There is also provision for updating the database periodically.

Analysis, results, conclusions and recommendation

“Participatory groundwater management is a major component of the National Project on Aquifer Management (NAQUIM) that the Government of India has embarked upon. Empowering the direct stakeholder with usable information along with awareness and training is essential to ensure constructive mass participation. Water level data is one of the primary information for planning management interventions at local level. It is also the most sought after data by the users for digging of wells, installation of pumps, construction of buildings etc. Central Ground Water Board (CGWB), Government of India carries out monitoring of water levels using a network of nearly 20000 monitoring wells spread over the entire country. Such measurements are carried out four times a year.

The app uses a database derived from these data generated and owned by CGWB. The app provides two options to the user: i) Retrieve Water Level Data and ii) Update Database. The command ‘Retrieve Water Level Data’ reports the water level data corresponding to the monitoring station, which is nearest to the mobile device. Once the app is installed, the user can retrieve water level information without internet connectivity as the database resides on the mobile device itself. The ‘Update Database’ command connects to a server and downloads the updated database, if any. The app DOWSER for android devices is in validation stage and will be available to the users soon.

Using similar methodology and algorithm, groundwater quality and other usable hydrogeological informa-

tion can also be made available to the direct stakeholders through the smartphones. Being first of its kind, the android app described here is expected to harbinge a paradigm change in dissemination of groundwater data in India, which is essential for effective management of groundwater resources.

Developing new application “WaterCheck24” used to increase water efficiency



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Keywords: ArcGIS, WaterCheck, Gaza, GIS, Water quality

Introduction and objectives

This research provides a new technology for checking water supplied by ground water. This application is based on huge amount of database related to water quality including chloride and nitrate concentrations. This application combine between several dataset like meteorological data , groundwater level, water quality. This research application is based on data sharing between several departments to serve the end user. The end-user can know the real status of water based on the location of his smartphone. This application has been designed based on ArcGIS software.

Methodology approach

WaterCheck application will be useful to share water information in the internet such as pH and the concentrations of chlorine and alkalinity.

WaterCheck application is based on mobile ArcGIS software. Gaza Strip map has been uploaded in to application and location system is programmed using python language (GIS language programming) . Farmers can use this technique to know the real situation of water used in the area. Water quality specialist can also enter new data in new locations about the quality of water. These entered data could be sharing between customers.

Analysis, results, conclusions and recommendation

This application provides new techniques in reading and analyzing of water data. Integration of these features with one application in smart phones can make a new development with data mobility and usability. Moreover the research project provides the ability to know the water quality based on the nearest located points. Using spatial analysis tools in the application can give the user the general situation of water quality and water level in required zone.

WaterCheck application can be used in municipalities, water authorities, water companies and end customers. Data provided from this application improves human health and safety comparing it with international standards.

Distributed Monitoring of Shallow Aquifer Level using Community Handpumps



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Keywords: Monitoring, Handpumps, Machine Learning, Groundwater, Mobile

Introduction and objectives

Achieving the post-2015 target of “improving the sustainable use and development of water resources” requires new approaches to understanding those resources. We demonstrate a novel method of measuring groundwater level using handpumps, which could revolutionise groundwater monitoring across Africa, where handpumps are many, but monitoring infrastructure is scarce. We show that the static water level beneath a handpump can be estimated by measuring movement of the pump handle. Consequently, the handpump infrastructure across Sub-Saharan Africa can be transformed into a large-scale, distributed monitoring network, providing much-needed data on shallow aquifer levels, while simultaneously improving the sustainability of community water supplies.

Methodology approach

The Waterpoint Data Transmitter used in Oxford University’s “Smart Handpumps” project uses a low-cost accelerometer to measure the movement of the handle of a handpump in order monitor pump usage and estimate the volume of water abstracted. Using machine learning models derived from data generated by operational handpumps in Kenya, and a handpump installed in Oxford, we characterised dynamics in the time-series obtained from the accelerometer. By comparing these with measured depth-to-water, over a period of varying groundwater level, we aimed to determine whether these data can be used to measure changes in aquifer level and absolute depth.

Analysis, results, conclusions and recommendation

This approach has proven successful. We characterised appropriate features of the accelerometer signal from different combinations of users and pumping periods using various classification methods (support vector machines, Gaussian processes). We were able to determine the level of a shallow aquifer with an average error less than 10cm. These results show that, within the limitations of our proof-of-principle experiments, it is possible to estimate aquifer level non-invasively using accelerometer data from a single pump to a level of accuracy comparable to that of current standard methods.

That said, a handpump in normal operation will have multiple users, and will be subject to failures and other confounding factors. Therefore, data generated from individual operational handpumps will not be sufficiently accurate or reliable when taken in isolation. Our field tests in southern Kenya confirmed this. However, for pumps in close proximity, these other confounding factors will be largely independent, while the property of interest, change in aquifer level, will be closely correlated. Therefore by combining weighted estimates of depth-to-water from a small cluster of nearby pumps, it is possible to generate a single, accurate measure of the aquifer level in that area. As well as providing much-needed environmental monitoring, the data generate immediate information on handpump usage and functionality, which has enabled faster pumps repairs and improved rural water service delivery.

The implication of this is that the thousands of community handpumps across sub-Saharan Africa have the potential to act as a distributed groundwater monitoring network. This is especially important in areas that currently lack monitoring infrastructure. Increasing our understanding of groundwater fluctuations using this method will help meet the target of “improving the sustainable use and development of water resources”, while simultaneously improving rural water services to help meet the post-2015 target on “access to safe drinking water”.

Workshop: (Re)thinking governance

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Addressing governance and integrity challenges in community-managed water systems, Kenya



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Keywords: Integrity, Water Supply, Community-based, Regulation, Performance

Introduction and objectives

In Kenya, rural water supply is largely managed by community groups operating outside the regulatory system. Poor governance, failures in O&M and cost recovery often lead to poor services and non-functional infrastructure shortly after the supporting agency exits. There is thus a need to address integrity issues to improve water services in rural communities. The ‘Integrity Management Toolbox’ developed by WIN, CEWAS and GIZ proved to be a useful approach for formal urban companies. The simplified methodology presented in this paper shall enable community managed rural water systems to improve performance by managing integrity risks and formalising operations

Methodology approach

Caritas Switzerland and WIN are developing an Integrity Management Toolbox for community-managed water supply systems that is inspired from the process developed for urban water service providers. In a first step, key governance and integrity challenges to be tackled were identified in a regulatory assessment study of rural water services that took into account the current decentralization process and water sector reforms in Kenya. Based on the assessment and Caritas Switzerland field experience, the methodology was fundamentally adapted and simplified for community groups with low literacy level. It is currently being piloted in Kenya with community managed groups.

Analysis, results, conclusions and recommendation

The regulatory assessment as well as Caritas field experience showed that, integrity challenges in community-managed water supply systems largely arise from the informal nature of their operations. Besides not having a legal status as organisations, they are also not embedded within the regulatory framework that would compel them to adhere to certain standards of governance, service provision, tariff setting and cost recovery, O&M reporting and quality management. Therefore, the toolbox will also support communities to become compliant with the regulatory framework and to professionalise their operations. Thus, the approach fosters both upward accountability to oversight authorities, as well as downward accountability to the community served.

The toolbox is composed of a series of three workshops. During this first workshop, the main integrity risks and possible solutions to address them will be identified in a participatory and innovative way. Participants gain understanding of the governance framework in which they operate an awareness that being linked to the legal and regulatory framework is an enabling rather than a disabling factor – and that this would professionalize the way the water systems are operated, enhance accountability, ethical practices and transparency, and sustainability of the water systems. The following two workshops will review the progress of implementing the solutions. Once an integrity risk is addressed, next risks and

its respective solution can be considered and implemented.

The overall methodology, as well as large parts of the integrity risks and solutions can be replicated to any community-managed water systems. Regarding the specific steps on increasing compliance with the regulatory framework, the current toolbox is specific for the Kenyan Context. Adapting the toolbox to a new country would require an assessment of the regulatory framework.

The presentation will introduce the approach and share insights of the piloting process, which will have been finalised by then.

Multi-Stakeholder Platforms for Inclusive Economic Development

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Keywords: Multistakeholder, platforms, public, private, water

Introduction and objectives

No actor alone has the ability to solve the world's water problems alone, but by working together, developing and implementing strategies, policies, plans and programs, much more can be achieved. The 2030 Water Resources Group (2030 WRG) brings transformative change to water resources planning by convening national multi-stakeholder platforms and facilitating structured processes – including key public decision-makers, concerned private sector champions and civil society representatives – who catalyse sustainable, rational, economics-based solutions to closing the water supply demand gap. The Group's work approach is to raise awareness through analysis, triggering momentum through convening and enabling transformation by others.

Methodology approach

2030WRG is an innovative public-private-community platform for collaboration at the global as well as national and local levels. It mobilises stakeholders from public and private sector, civil society, centres of academic expertise and financing institutions to engage in fact-based, analytical water security approaches and coalition building.

2030WRG supports governments in their long-term development and economic growth plans by catalysing sustainable water sector transformations and accelerating reforms. 2030WRG was initiated in 2008 by multinational companies, donors and development banks. After incubation within the World Economic Forum, it became part of the World Bank Group (International Finance Corporation) in March 2012.

Analysis, results, conclusions and recommendation

Integrated water resources management projects are inherently cross-sectorial in nature, and require the active participation of many different types of organisations from the public sector, private sector and civil society to be effective.

By bringing together all these different types of organisations and high-level political leaders, multi-stakeholder platforms can deliver socially transparent, legally effective and institutionally fair solutions. Close and constructive collaboration overcomes water related conflicts that hold back development. Clear and transparent prioritisation of projects means that funds are spent effectively, benefitting host societies and alleviating water stress.

The 2030 WRG's convening initiatives are a central component of its engagement process, bringing together public, private, and civil society stakeholders to help create broader awareness, momentum, and to trigger actions. It is through our platforms and structured dialogue processes that stakeholders identify and agree on key priorities and activities, and to help forge trust-based partnerships towards transformation.

The 2030WRG recognizes that a structured and sustained multi-stakeholder dialogue process that has

the commitment of government is a significant step forward in countries in which 2030 WRG engages. Multistakeholder platforms are a key governance structure for inclusive development and fair deals. They can be constructed in various forms: as formal locally established multi-stakeholder platforms, as structured and ongoing dialogue processes, or even integrated into already existing entities, structures, and processes. 2030WRG is fostering effective compacts that foster the fair use of water for people, the environment and sustainable economic growth.

New-wave interventions to transform water governance and integrity: evidence from Africa



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Keywords: Water stewardship standards, social accountability, integrity, private sector, Africa

Introduction and objectives

Across Africa the implementation of progressive water resource policy and law has stalled and IWRM processes are stagnating. Their promise of better governance to coordinate water use for growth, ecosystems and livelihoods has been frustrated by a range of factors. ‘Explicit’ barriers include data, capacity and sector investment, but behind these lie a set of less well-aided ‘tacit’ constraints associated with incentives, authority, integrity and political economy. This paper reports on new civil-society led interventions which navigate these constraints and can unlock progress towards water security: social accountability monitoring, budget analysis and advocacy; and water stewardship standards and a global ‘integrity framework’.

Methodology approach

Two interventions by Water Witness International and partners are reported, along with initial outcomes and insights about scalability.

1. Uhakika wa Maji is the first systematic social accountability monitoring in WRM globally. With financial support from DFID and Scottish Government, communities facing pollution, conflict, drought and flood impacts or lack of entitlement are facilitated to activate water institutions and statutory duty bearers. Responses are tracked and combined with parallel budget analysis to diagnose sector performance and inform evidence-based advocacy.

2. The Alliance for Water Stewardship’s Standard has been implemented for the first time in Africa at a major coffee production site in the Ruvuma Basin, alongside an Integrity Framework. The implications, costs and benefits for the site, local communities, the basin and WRM institutional performance are reported.

Analysis, results, conclusions and recommendation

Both interventions show positive results for improved institutional functioning for water security at community, catchment and national level, with particular benefits for vulnerable communities. They also have potential for scaling, albeit with important conditions.

1. Since 2013 Uhakika has yielded:
 - a. Social accountability monitoring across ten case-studies and 50 activations of improved water security for 240 000 people, providing compelling evidence of the importance of functional WRM for poverty reduction and growth.
 - b. In some cases positive action is now underway to address issues including uncontrolled pollution, and to issue water use permits. Where action has not been forthcoming, barriers have been traced to inform ‘constructive advocacy’ targeted

at public, policy makers and practitioners. New action can be traced to address systemic challenges flagged by the cases.

- c. Budget and resource analysis of the sub-sector highlights: a disproportionate spend on consultancy, compensation and allowances vs operational WRM; unaccounted spend masks 10% of expenditure; unit costs such as establishing Water User Associations can be unexpectedly high.
- d. The analysis also reveals: that basin offices responsible for WRM have between 20% and 50% of the staff needed to operate effectively; that operational budgets are inadequate and arrive late; that self-financing appears unviable, and 1:9 ratio of government to donor investment on WRM. This new public oversight of sector expenditure is reported to be a significant factor in reducing fiduciary risk, improving integrity and aid efficacy.

Third party evaluation will verify achievements and explore impact in 2015, however it appears that locally-led social accountability monitoring has potential as a low-cost, high-impact intervention to activate WRM institutions, incentivise duty bearers in government and improve water security. Challenges include ensuring adequate gender inclusion, conflict mitigation, strong local ownership, and navigating the difficult landscape of fragmented/ungrounded WRM interventions, and the associated circus of workshops and per diem culture. Scalability seems contingent on freedom to constructively challenge government performance and the 'Uhakika approach' in more oppressive state regimes will be challenging.

2. WWI and partner support for implementation of the AWS standard and Integrity Framework at Olam International's Aviv site provides the following early insights:

- a. Implementation of the standard is a cost-effective methodology for a site and company to flag and respond to priority water risks at the site and catchment level, and to demonstrate this through third-party verification.
- b. The standard can perform well in driving equitable water use and improved governance within challenging basin contexts where water is contested among disparate water users and institutions under-performing and poorly resourced.

The standard and framework are potentially important drivers for integrity, accountability and greater water security, and the management of operational, reputational, regulatory and financial risks across global supply chains. Their wider uptake requires increased demand from supply chain managers, financiers and consumers and this is where immediate efforts for scaling should be focused.

Mis-streaming Gender in Water Governance



Author: Dr. Sara Ahmed, Gender and Water Alliance, India

Keywords: gender, governance, agency, equity, sustainability

Introduction and objectives

Gender analysis while critical to the knowledge base for water decision-making, has largely been 'mis-streamed' or reduced to a technical check-list. Moving attention to gender and social equity beyond disaggregated numbers remains a challenge both in terms of practice, measurement and policy influence. How, for example, do you measure a transformative agenda for water governance, or understand the complexity of women's agency and empowerment in water management? How has the enabling environment changed in the 21st century and what does this imply for access to safe and sufficient water for women and marginalised communities?

Methodology approach

Using reflexive analysis, the paper draws on structured, in-depth interviews and content analysis from diverse water-society environments (for example, rainfed agriculture to aquaculture) to understand the contours and challenges of a gender transformative water and livelihoods agenda in South Asia. The paper seeks to assess the role of leadership - from elected representatives to NGOs, donors and government at different levels, in facilitating gendered water governance in the context of economic change and climate uncertainty.

Analysis, results, conclusions and recommendation

Not surprisingly, despite the evidence, social equity and gendered analysis are often the last recourse or consideration when building institutions. Women leaders, particularly from socially marginally communities, face the double challenge of 'voice' and time for participation in environments where male outmigration is growing (the middle hills of Nepal) or decades of conflict have affected male demographics (Sri Lanka). Technologies that reduce women's water-related drudgery or provide income generating opportunities are critical, but not sufficient in moving towards a transformative agenda.

Governance, reform and aid - understanding what can go wrong



Author: Dr. Rim El Kadi, Centre for Comparative Water Policies and Laws - UniSA, Australia

Keywords: Reform, Aid, Donor, Development, Social capital

Introduction and objectives

The presentation addresses the challenges of implementing successful water sector reforms in fragile and aid dependent developing states. The various typical reform actors and their respective roles in supporting or undermining the various stages of the reform process are discussed. In particular, some of the controversial dilemmas that are associated with donor funded initiatives are explored with the aim of explaining reform failures and informing future aid interventions and strategies.

Methodology approach

The presentation draws on a completed PhD research project. Based on a case study approach, the research examines the water sector reform in Lebanon using quantitative and qualitative methods. The various chronological phases of the reform were outlined and evaluated. 43 key informants spanning the various institutional actors groups were interviewed and their views on the reform were analyzed. Furthermore, a donor funded survey was conducted on 1000 households across Lebanon to provide a quantitative statistical representation of water consumption and spending patterns, attitudes towards water conservation, public utilities, and the reform process.

Analysis, results, conclusions and recommendation

The study reveals a number of significant local and foreign actors and articulates their various roles in the different phases of the reform process, from formulation to implementation. The qualitative analysis of the transcribed key informants' interviews highlighted the complex interactions between the donors and the policy makers, and the resulting impact on the reform design and implementation phases. The survey results reflected the level of awareness of the general public about water issues and the reform.

The analysis reveals a number of shortcomings resulting from the donor pushed reform. Particularly with the attempt to implant packaged IWRM principles without fully taking into consideration the level of institutional maturity and the capacity of the actors to implement, the research indicates that that resulted in further weakening the existing institutional landscape as well as the overall measures of sustainability. This institutional landscape is further complicated by the various socio-political divides that segregate the various communities and weak law enforcement, making the management of any shared resource even more difficult.

The household survey also revealed, in addition to the significant water related socio-economic cost, a lack of public awareness of the ongoing reform and the issues it is trying to address. It also demonstrated a low level of trust in the public institutions.

The recommendations highlight the importance of customizing aid funded reforms that are based on global development guidelines and trends such as IWRM to the local landscape and specific country priorities. Social capital in its various dimensions also emerges as a critical success factor, and building this capital ought to be considered a priority in any development aid strategy regardless of the sector.

China's Role in Developing Mekong River Basin: Governance, Development, Sustainability



Author: Prof. Suzanne Ogden, Northeastern University, United States

Keywords: Mekong, China, hydropower, development, governance.

Introduction and objectives

As the Mekong's uppermost riparian, China has had few incentives to share costs imposed by its hydropower and natural resource development on the Lower Mekong River Basin (MRB); but China's approach to the Upper Mekong's natural resource and hydropower development has not necessarily differed from the Lower MRB countries' approach. Nor has China's development always been detrimental to them. With the creation of the Greater Mekong Subregion (GMS) concept, which is conceptually, geographically, and economically broader than just the MRB, China has more reasons to share in the costs/benefits of development and sustainability for the subregion.

Methodology approach

Study includes findings from field research in MRB. It examines costs/benefits associated with developing MRB and broader GMS. It focuses on the context affecting China's policy, institutional, and economic development and governance of MRB/GMS, including problems of environmental sustainability in a rapidly changing environmental, ecological, economic and political context. Tensions between Yunnan Province and Beijing on developing and distributing Yunnan's Mekong hydropower are contextually significant. Comparing China's and other five MRB states' approach to natural resource and hydropower development, study focuses on major challenges MRB states confront in sharing costs/benefits of basin development, and difficulties of carrying out regionally-based IWRM.

Analysis, results, conclusions and recommendation

The GMS Economic Cooperation Program has expanded the benefits of cooperative development among its six countries and is, arguably, leading China to share more of the benefits, and costs, of developing both the MRB and the GMS in a sustainable manner. China's efforts to develop Yunnan Province as the centerpiece of the GMS has led to its recognition of the benefits emanating from the subregion's growing interdependence in trade, transportation, tourism, and the need to cooperate on issues like human smuggling and drug trade.

The conceptual reasoning of the GMS, rather than that of IWRM, may provide the critical framework for moving China toward more cooperative, non-zero-sum thinking about controlling the Upper MRB. This could result in agreements concerning the sustainable development and security (national, food, energy, water) of the MRB/GMS countries.

The inability of stakeholders even within their own respective states to agree on defining 'the problem' illustrates the fundamental challenge of managing the MRB, as without agreement on 'the problem,' agreement on 'the solution' will be illusive. Even the meaning of "environmental protection" and how development is framed within the context of "environmental sustainability" is contested by NGOs, INGOs, governments, hydropower companies, and other stakeholders, in China and throughout the MRB.

China's most powerful stakeholders favor the developmental approach, with poverty alleviation in Yunnan Province as part of its "develop the West" strategy that began in 2000. Indeed, the debates over means, ends, and impacts are just as fierce within China itself as between China and downstream Mekong riparians. Understanding how politics, political values, economic necessities and the market, and social and cultural attitudes and values affect water management is essential. So, a multidisciplinary approach that integrates the social, political, and economic context/concerns with science is fundamental to better managing the MRB's complexities and sharing costs/benefits.

Social Accountability as Driver for Sustainable Development

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Keywords: social accountability, budget tracking, transparency

Introduction and objectives

Simavi uses different social accountability strategies at community level to give voice to the voiceless. Social accountability is an interactive process that aims to increase citizen influence (voice) and to strengthen the response of the local WASH providers and decision makers. It breaks social and systematic barriers in a context where national policies seem to be adequate, but where, in reality, these policies are insufficiently implemented and where inequality prevails. Ultimately it aims to realization of structural improvement in availability of equitable WASH services for communities. Our strategies used in Bangladesh, Tanzania and Kenya will be presented.

Methodology approach

In all the social accountability strategies used by Simavi and its partners, the citizens are mobilized and capacitated to understand their Right To safe Water and Sanitation. Knowing their rights and being capable of voicing their demands to the right stakeholders, and having a platform to interact, helps communities to hold the government and service providers accountable for provision of equitable WASH facilities. Our "Public WASH Budget Tracking", in Bangladesh, "Community Engagement" in Tanzania and "Citizen Report Cards" in Kenya will be presented as successful approaches which facilitated meaningful dialogue among stakeholders and led to increased equitable WASH services.

Analysis, results, conclusions and recommendation

- Most people in the communities are neither aware of their WASH rights nor of the national policies. Therefore they are not holding their government accountable to provide or facilitate provision of WASH services.
- Lack of clarity and overlap of roles and responsibilities of different service providers is a major obstacle for communities to demand their WASH rights.
- Local government authorities often lack the political will, knowledge about the national policies, technical capacity and other resources to take communities demand into consideration and improve access to equitable water.
- Applying the "WASH Budget Tracking" method in Bangladesh resulted in improved transparency and 12-18% increase of local public WASH budget in less than two years.
- Facilitating "Community Engagement" in Tanzania, resulted in improved Water Governance, where local government is taking its responsibility to manage the water source properly; the private company recognizes the right of people to access the water source and all the water users pay their share to ensure proper operation and maintenance of the water source.
- Employing "Citizen Report Cards" in Kenya showed that 75% of the population did not receive water from the service provider company. This evidence was presented to different stakeholders including Kenyan Government and local water service provider. The service providers were held accountable and pushed to make progressive steps to ensure peoples adequate access to WASH service.
- Endorsement of "Right to Information" by countries is an important step to start meaningful

dialogues between different stakeholders, where communities can voice their demands and hold service providers accountable.

- Facilitating stakeholder dialogues, empowering communities and making them aware of their rights, ensuring access to information and using evidence base methods in advocating for equitable WASH services are necessary to realize increased transparency and improved WASH governance.

Can decentralisation improve water security and promote equitable post-2015 development?



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Keywords: Africa, decentralisation, water governance, water institutions, rural development

Introduction and objectives

Decentralisation of governance to sub-national levels is argued to promote transparency with improved and more equitable development impacts. We examine the process of decentralisation emerging in Kenya since 2010 through analysis of water governance in a coastal catchment with unprecedented demands from rural communities and new economic actors (mining, irrigated agriculture) under conditions of increasing climate variability. New technologies remotely and transparently monitor community water use, enabling a supra-communal model of maintenance service provision. Applying Ostrom's socio-ecological systems framework we examine the interactions and impacts on balancing water security, economic growth and poverty reduction within this new water governance regime.

Methodology approach

A mixed methods approach applies Ostrom's socio-ecological systems framework (2009) in evaluating Kenya's new decentralisation framework as well as interactions and impacts between national and local government, resource users (mining, irrigated agriculture, communities, the environment), and resource units (flows, storage, consumption). Transmitters installed in the handles of community handpumps record daily usage data and drive a professionalised maintenance service. Governance data are generated through a policy document review, key informant interviews from national and county government, local and economic actors. Two rounds of longitudinal household surveys (n=3,000) are supported by focus group discussions with Water Resource User Associations.

Analysis, results, conclusions and recommendation

Kenya's new decentralised planning and implementation framework allows for the integration of new institutions and information flows, user participation and accountability mechanisms. We examine whether the reform can improve water service delivery for disadvantaged rural communities and promote more equitable and effective water resource management.

This study arrives at four conclusions. First, the three-year transition period involves uncertainties that are only partially addressed through Kenya's new Water Bill in terms of distribution of functions. Second, Kenya's devolution enables the integration of two institutional developments; devolution of water services to the county, and the creation of a countywide maintenance service provider for rural water sources. At county level new rural water service models lead to improved and reliable drinking water access through real-time information flows on handpump performance. At the national level, these data enable monitoring and regulation of the rural water sector. Thus, the combination of new institutions and high-quality information can contribute to improved governance at both local and national levels.

Third, participatory research with Kwale's Water Resource User Associations (WRUAs) demonstrates that although the devolved institutional structure of the water sector enables WRUAs to monitor large-scale water abstraction and manage conflicts, their agency in reconciling upstream and downstream demands is limited due to capacity and information asymmetries, which need to be overcome through reliable financing and training.

Fourth, the longitudinal analysis of 3,000 households over the first phase of decentralised governance demonstrates improvements in water access and development. However, it also demonstrates a disconnection between water users and their water resource institutions with only a small minority knowing their local WRUA.

In conclusion, results establish linkages between decentralisation reforms and water security, how improvements in water services are distributed and the extent to which they benefit the poor and vulnerable.

STOCKHOLM INTERNATIONAL WATER INSTITUTE

The Stockholm International Water Institute (SIWI) is a policy institute that contributes to international efforts to combat the world's escalating water crisis. SIWI develops and promotes future-oriented and knowledge-integrated policies, towards sustainable use of the world's water resources leading to sustainable development and poverty eradication.

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