

Climate-Responsive Integrated Master Plan for Cagayan River Basin

VOLUME I - EXECUTIVE SUMMARY



Submitted by
College of Forestry and Natural Resources
University of the Philippines Los Baños

Funded by
River Basin Control Office
Department of Environment and Natural Resources

Table of Contents

1	Rationale	1
2	Objectives of the Study.....	1
3	Scope.....	1
4	Methodology	2
5	Assessment Reports	3
5.1	Geophysical Profile	3
5.2	Bioecological Profile.....	6
5.3	Demographic Characteristics.....	6
5.4	Socioeconomic Profile	7
5.5	Infrastructure	9
5.6	Land Capability Zoning	10
5.7	Stakeholder Analysis.....	11
5.8	Policy Assessment.....	11
5.9	Vulnerability Assessment	11
5.10	Institutional Setting.....	13
6	Management and Development Plan	14
6.1	Introduction	14
6.2	Vision, Mission, Goal, and Development Objectives.....	14
6.3	Integrated River Basin Management and Development.....	15
6.4	Development Issues and Challenges	15
6.5	Implementation Plan.....	18
6.6	Investment Plan.....	22

EXECUTIVE SUMMARY

1 Rationale

In compliance with Executive Order 510, the River Basin Control Office (RBCO) of the Department of Environment and Natural Resources (DENR) crafted an Integrated River Basin Management and Development Master Plan for the 18 major river basins. With this, most of the river basin master plans had been formulated and approved by the late 2000's. With the passage of the Climate Change Act of 2009 and the Disaster Risk Reduction Law of 2010, the significance of integrating potential climate impacts in development planning had become recognized. Furthermore, the Cabinet Cluster on Climate Change Adaptation and Mitigation had also adopted the river basins as priority areas of the government.

The Cagayan River Basin is one of the 18 major river basins. However, its master plan predated the establishment of the RBCO and the passage of the Climate Change Act and the Disaster Risk Reduction Law. Thus, there is a need to review and update the master plans not only to make it more relevant to the present conditions of the river basin, but also to incorporate and adopt climate change adaptation and mitigation, and disaster risk reduction and management into the planning framework in order to address the evolving needs and challenges in the river basin.

2 Objectives of the Study

The objective of this project is to update the Integrated River Basin Master Plan of the Cagayan River Basin to incorporate the implications of the new climate normals in addressing the concerns on:

- 1) Water resources management;
- 2) Watershed management;
- 3) Flood control/mitigation, disaster risk reduction and hazards management;
- 4) Wetland management (to include rivers, river deltas, marshlands and coastal areas);
- 5) Economic development; and
- 6) Institutional linkages and organizational structure for river basin management.

3 Scope

The project updated the Integrated Management and Development Master Plan of the Cagayan River Basin, taking into consideration potential climate change impacts to provide a sound basis for management decisions in the sustainable management of the resources therein. The project consisted of two phases, the scope of which includes:

1. Updating of river basin profile;
2. Revision of vision, missions, and goals;
3. Identification of strategies, programs and projects;
4. Evaluation of strategies, programs and projects; and
5. Investment and implementation planning

4 Methodology

The project adopted the following approaches and methods to accomplish the objectives and expected outputs of the project stated in its Terms of Reference. The following tasks, presented in Figure 1, were undertaken.

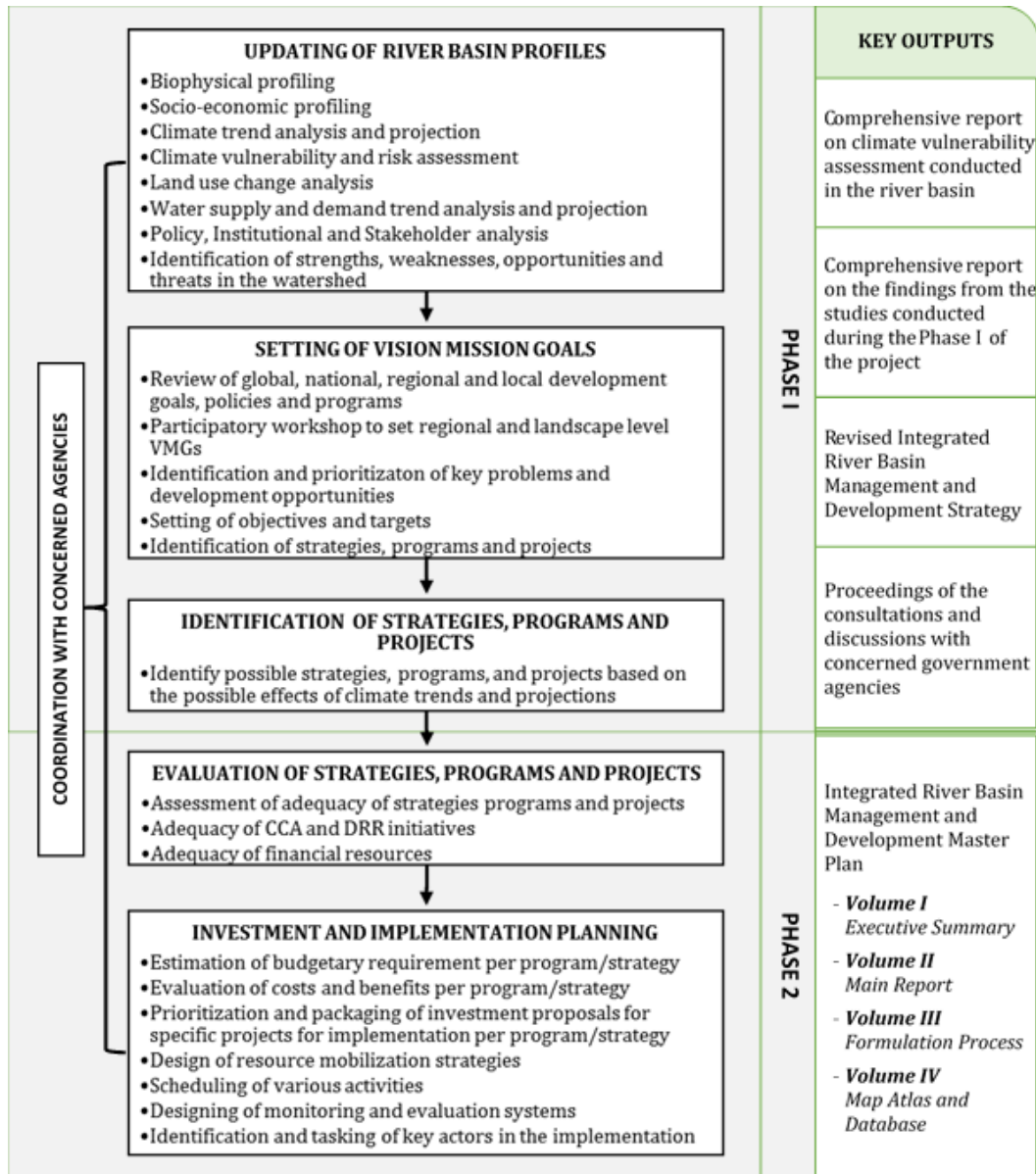


Figure 1. Framework for Developing a Climate-Responsive Integrated Master Plan

5 Assessment Reports

5.1 Geophysical Profile

Geographic Location

The Cagayan River Basin (CRB) is situated at 121° 35' 34.8" east longitude and 17° 6' 15.1" north latitude at the northeastern part of Luzon. It is bounded by Sierra Madre to the east, Central Cordillera to the west, Caraballo mountain ranges to the south and Babuyan Channel to the north. It is the largest river basin in the country with a total land area of 27,493.49 km². The Cagayan River Basin covers the provinces of Apayao, Benguet, Ifugao, Kalinga, Mountain Province and outskirts of Abra in Cordillera Administrative Region; the provinces of Cagayan, Isabela, Nueva Vizcaya and Quirino in Region 2; and parts of Aurora and Nueva Ecija in Region 3. In totality, Cagayan River Basin covers 12 provinces, 122 municipalities/cities and 2,459 barangays. The river basin is divided into 23 sub-watersheds.

Climate Trend and Projections

Based on the Modified Coronas Climate Classification of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the Cagayan River Basin falls under Type I, Type III and Type IV climate type. This classification system is based on the monthly rainfall received for a year. Type I is characterized by having two pronounced season, dry from November to April and wet during the rest of the year. Maximum rain is experienced from June to September. Type III climate is described as a short dry season from November to February while Type IV is described with more or less has evenly distributed of rain throughout the year. The 1981-2010 data from five stations within and adjacent the CRB were used to present the climatological normal and extremes. These PAGASA stations are Aparri, Tuguegarao, ISU-Echague, Baguio and CLSU.

Climate change is one critical challenge that poses various threats to water, production and even security. In order to address this challenge, climate projections were being developed. The PAGASA used the PRECIS (Providing Regional Climates for Impact Studies) model to generate projections of temperature increase and rainfall change in the Philippines for 2020 and 2050. A2 (high-range), A1B (mid-range), and B2 (low-range) are the three emission scenarios used to run the said model. The climate projection used for the Cagayan River Basin is the A1B scenario. Comparing to the baseline data, 2020 and 2050 data, CRB will have a drier summer months and wetter rainy season. Temperature is also expected to increase from 0.8-1.1°C in 2020 and 1.6-2.2°C in 2050. Table 1 and Table 2 show the 2020 and 2050 projections on rainfall and temperature, respectively.

Table 1. Seasonal temperature change (in °C) in 2020 and 2050 under medium range emission scenario in the provinces covered by CRB

PROVINCE	BASELINE (1971-2000)				CHANGE IN 2020				CHANGE IN 2050			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
CAR												
Abra	24.5	27.4	27.2	26.4	↑ 0.8	↑ 1.0	↑ 0.8	↑ 0.9	↑ 2.0	↑ 2.1	↑ 1.6	↑ 1.9
Apayao	24.8	28.0	28.4	27.1	↑ 0.8	↑ 0.9	↑ 0.9	↑ 0.8	↑ 1.9	↑ 2.1	↑ 1.9	↑ 1.8
Benguet	19.4	21.9	22.0	21.2	↑ 0.9	↑ 1.0	↑ 0.8	↑ 1.0	↑ 2.0	↑ 2.1	↑ 1.7	↑ 1.9
Ifugao	22.2	25.6	25.8	24.5	↑ 0.9	↑ 0.9	↑ 0.9	↑ 0.9	↑ 1.9	↑ 2.1	↑ 2.0	↑ 1.9
Kalinga	23.8	27.5	27.7	26.1	↑ 0.8	↑ 0.9	↑ 0.9	↑ 0.8	↑ 1.9	↑ 2.1	↑ 2.0	↑ 1.9
Mountain Province	22.7	26.0	26.1	24.9	↑ 0.9	↑ 0.9	↑ 0.9	↑ 0.9	↑ 1.9	↑ 2.1	↑ 1.9	↑ 1.9
REGION II												
Cagayan	24.5	28.1	28.9	27.1	↑ 0.8	↑ 1.0	↑ 0.9	↑ 0.8	↑ 2.0	↑ 2.2	↑ 2.0	↑ 1.8
Isabela	24.1	27.9	28.7	26.8	↑ 0.8	↑ 0.9	↑ 0.9	↑ 0.8	↑ 2.0	↑ 2.1	↑ 2.1	↑ 1.9
Nueva Vizcaya	22.3	25.4	25.4	24.4	↑ 0.9	↑ 1.0	↑ 0.9	↑ 0.9	↑ 2.0	↑ 2.1	↑ 1.9	↑ 1.9
Quirino	23.7	26.8	27.6	26.2	↑ 0.7	↑ 1.0	↑ 1.0	↑ 0.9	↑ 2.0	↑ 2.2	↑ 2.0	↑ 2.0
REGION III												
Aurora	24.5	27.1	27.9	26.7	↑ 0.9	↑ 0.9	↑ 1.0	↑ 1.0	↑ 1.9	↑ 2.0	↑ 2.0	↑ 2.0
Nueva Ecija	25.3	27.7	27.5	26.8	↑ 0.9	↑ 1.1	↑ 0.9	↑ 1.0	↑ 2.0	↑ 2.1	↑ 1.8	↑ 2.0

Table 2. Seasonal rainfall change (in %) in 2020 and 2050 under medium range emission scenario in the Provinces covered by CRB

PROVINCE	BASELINE (1971-2000)				CHANGE IN 2020				CHANGE IN 2050			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
CAR												
Abra	43.5	220.6	1218.9	634.4	↑ 5.00	↓ (1.80)	↑ 22.30	↑ 14.00	↓ (2.10)	↓ (28.10)	↑ 35.00	↑ 15.90
Apayao	144.6	184.0	822.7	720.1	↑ 2.60	↑ 0.40	↑ 5.80	↑ 16.60	↑ 3.00	↓ (23.70)	↑ 1.10	↓ (0.30)
Benguet	47.7	422.3	1734.9	931.8	↑ 8.00	↑ 0.20	↑ 31.60	↑ 21.70	↓ (6.00)	↓ (26.70)	↑ 63.10	↑ 21.80
Ifugao	102.6	321.0	1071.1	724.9	↓ (6.00)	↓ (9.60)	↑ 14.40	↑ 8.90	↓ (1.30)	↓ (24.20)	↑ 17.60	↓ (2.90)
Kalinga	92.3	228.0	892.3	691.9	↑ 1.00	↓ (9.10)	↑ 4.50	↑ 14.80	↑ 4.20	↓ (21.00)	↑ 3.90	↑ 1.10
Mountain Province	74.8	286.8	1121.1	699.2	↓ (2.70)	↓ (7.70)	↑ 16.40	↑ 14.90	↑ 1.10	↓ (27.40)	↑ 26.60	↑ 8.50
REGION II												
Cagayan	284.4	207.7	538.4	832.1	↑ 6.90	↓ (3.60)	↑ 2.90	↑ 16.30	↑ 14.60	↓ (23.30)	↑ 0.90	↓ (1.00)
Isabela	412.2	325.0	530.8	867.0	↑ 3.90	↓ (8.60)	↑ 5.10	↑ 13.50	↑ 25.10	↓ (29.20)	↑ 8.70	↑ 1.70
Nueva Vizcaya	180.9	416.8	1149.8	880.5	↓ (3.50)	↓ (8.60)	↑ 20.10	↑ 9.80	↓ (7.80)	↓ (23.60)	↑ 36.10	↓ (0.50)
Quirino	419.0	465.9	928.7	957.9	↓ (5.70)	↓ (18.20)	↑ 9.70	↑ 6.10	↓ (0.90)	↓ (33.90)	↑ 12.90	↓ (5.80)
REGION III												
Aurora	615.7	546.4	768.7	1151.1	↓ (0.30)	↓ (17.10)	↑ 6.70	↑ 5.80	↑ 8.70	↓ (29.20)	↑ 7.40	↓ (5.70)
Nueva Ecija	155.2	316.5	995.0	745.0	↑ 7.50	↓ (13.80)	↑ 10.10	↑ 1.60	↓ (7.40)	↓ (25.70)	↑ 22.70	↓ (2.40)

Topography

CRB is relatively flat along the river course. Elevations in these areas vary from 0-100 masl to 100-200 masl. A total of 694,844 ha of the river basin has an elevation of 0-100 masl while about 364,325 ha has 100-200 masl. High elevations can be found on mountainous areas like Kalinga, Mountain Province, Ifugao, and Nueva Vizcaya. On the other hand, around 634,080 ha of CRB has an elevation of 500-1000 masl and about 463,039 ha has elevation above 1000 masl.

Soils and Geology

Since the river basin is bounded by the three mountain ranges, CRB is dominantly covered by mountain soil (46%). Pliocene-Pleistocene is the most common geologic formation in the area. There is also presence of various metallic and non-metallic resources in the river basin. Mineral resources found in the area are gold, copper, iron and manganese. Sand, gravel, gypsum, limestone/lime, pyrite and sulfur are the non-metallic resources in CRB. Sand and gravel are the most in demand mineral extracted particularly in Region 2.

Water Resources

Cagayan River, the main river in the river basin, is the longest river in the Philippines measuring about 520 km. Groundwater in CRB is mostly comprised of rocks with limited potential and local to less productive aquifers. Most of the water extracted in the area was used for irrigation (83%), while other water use includes domestic, municipal, power, industrial and livestock use. About 78% of the extracted water in the river basin came from surface water while 22% is groundwater.

In terms of water balance in CRB, it was modelled using the Soil and Water Assessment Tool (SWAT). The stream flow data in Addalam River gauging station in Aglipay, Quirino and Cagayan River gauging in Lallo, Cagayan were used to calibrate the model. Figure 2 shows the graphical representation of the computed water balance for CRB. The water balance is simulated from 1980-2014. Values showed that large proportion of the rainfall is loss as surface runoff (42.85%) and only a minimal proportion is going to recharge the groundwater aquifer (10.65%). Low groundwater recharge is governed by the geologic property of the watershed. On the other hand, stream flow (water yield) of the Cagayan River is about 55.04% of the annual rainfall.

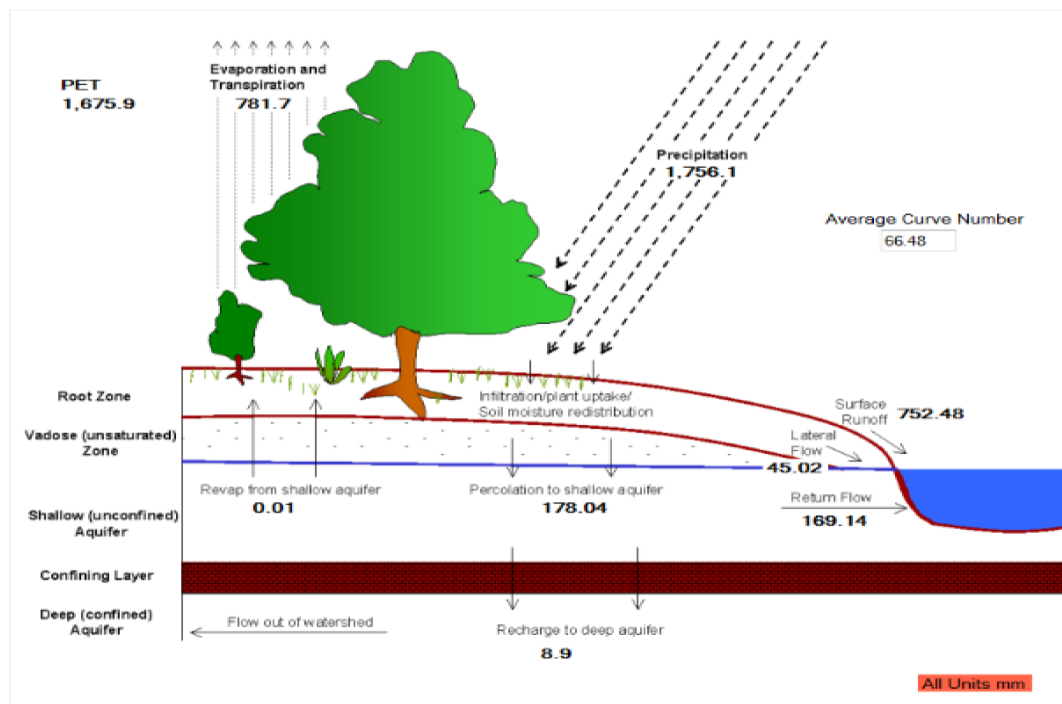


Figure 2. Basin wide water balance of the Cagayan River

Land Classification and Land Cover

CRB is predominantly classified as forestland (69%) while the remaining 31% is classified as alienable and disposable land. In addition, there are 18 various land cover in CRB identified through the 2010 data of the National Mapping and Resource Information Authority (NAMRIA). As an agricultural region, annual crops covered the largest portion of the river basin with an estimated area of 864,546 ha comprising about 31.44% of the total land area.

Natural Hazards

About 30% of the river basin is highly susceptible to drought (Isabela Province) while 26% of the river basin is moderately susceptible (Ifugao, Kalinga, Mt. Province). Also, about 30% of the river has low susceptible to drought and that includes the provinces of Aurora, Cagayan, Nueva Ecija, and Nueva Vizcaya. Those with very low susceptibility only comprise 4% of the river basin (Abra, Apayao, and Benguet).

Most of the river basin (64%) has high risk to earthquake. Mainly areas along danger zone are those with steep slopes. Those with no present risk are along the floodplains of the river basin.

Only about 14% of the river basin is susceptible to flooding. Areas near the river systems have high to very high susceptibility to flooding of which cover mostly parts of Isabela and Cagayan. Flooding is one of the perennial problems existing in the basin.

The river basin is highly susceptible to landslide because most of its provinces are naturally located on steep slopes. Areas that are highly susceptible to landslide are mainly located in the mountainous parts of CRB specifically provinces of Benguet, Mt. Provinces and Nueva Vizcaya. Landslide in CRB is normally rain-induced. Furthermore, about 48% of the river basin is classified with moderate to severe erosion.

5.2 Bioecological Profile

Data for faunal and floristic diversity for the river basin is mostly from the Northern Sierra Madre National Park (NSMNP). There are about 89 tree species identified in the NSMNP, 9% are endemic to the Philippines. Ten are classified as critically endangered species based on the International Union for Conservation of Nature (IUCN) Red list of Threatened Species. Moreover, about 36 flora species are identified in the Casecan Protected Landscape.

On the other hand around 121 bird species were recorded, 46.3% of it is endemic to the Philippines. The NSMNP is also home to two of the most threatened birds, the Philippine eagle (*Pithecophaga jeffryi*) and the Isabela oriole (*Oriolus isabellae*) which are endemic species. There are 17 mammal species identified in NSMNP which consist of 11 volant and 6 non-volant mammals. Out of the 11 bat species (volant mammals), 5 are endemic. Also, there are around 46 amphibians and reptiles species recorded in the area. Out of this, 2 species are endangered namely, the *Platymantis cagayanensis* and the *Platymantis taylori*.

There is limited information on the diversity of fish species in the Cagayan River Basin. Data from the Bureau of Fisheries and Aquatic Resources (BFAR) shows that there are about 35 species in the Cagayan River. Common fish species in the area are from the family of Cyprinidae (catfish, bighead carp, carp, silver carp, rohu) and Thiaridae (variety of snail or *agurong* in local term).

5.3 Demographic Characteristics

Cagayan River Basin shelters around 3,217,200 individuals in 2010 and around 3,601,484 in 2015. In 2050, it is expected to reach about 6.4 million with a rough estimate of 56,600 individuals to be added every year. With generally dense population, there is a significant amount of pressure in the use of CRB's natural resources particularly land and water for settlement and food production. Such figure also indicates the potential magnitude of negative environmental impacts on human if CRB

will be degraded. Population density within the river basin ranged from 15 to 173 persons/km². Municipalities with high population density based on Philippine Statistics Authority (PSA) in 2016 are: Tuguegarao, Solano, Reina Mercedes, San Mateo and Cabatuan. Generally, there are more males in the river basin accounted to about 51% of the total population. CRB is also mostly comprised of working age population, which are ages 15-64.

On the average, fertility rate recorded in the river basin is 3 children per woman. Furthermore, crude birth is higher than crude death in all provinces of CRB with life expectancy of 71 years for female and 66 for male. CRB is mostly comprised of young population.

5.4 Socioeconomic Profile

Settlement Pattern

The Cagayan River Basin is generally considered as a rural community. About 82% of the barangays in CRB are classified as rural. Urban barangays are mostly in the provinces of Nueva Ecija, Isabela, Benguet and Cagayan.

Language and Ethnicity

CRB has many dialects varying from coastal ecosystem zone to forest ecosystem zone. The most dominant dialect in the river basin is Ilocano which is almost spoken by all people from coastland to upland.

Access to land and land rights

Reflective of the respective population per province, the provinces of Isabela and Cagayan have the most number of households owning a land. About 69% of the lands privately owned are classified as agriculture and 25% are residential type. Roughly 3% were re-possessed by tenant-farmers through the Comprehensive Agrarian Reform Program (CARP) of the government.

Housing Tenure

Around 90% of the population in CRB has their own house(s). Only 9% of them are renting either free with consent of the owner or free but without consent of the owner.

Energy and Fuel Consumption

Majority of CRB population depends on electricity for lighting (64%) and cooking (46%). Liquefied petroleum gas (LPG) is also one of the major sources of domestic fuel (lighting (30%) and cooking (22%)). Other sources include wood, charcoal and oil which could also be obtained from watershed.

Health

The province of Benguet registered the highest infant mortality among the provinces in CRB with a rate of 12.61%. The lowest, on the other hand, is observed in Nueva Ecija with a rate of 3.27%. In terms of maternal mortality, the province of Aurora recorded the highest rate while the lowest is in Kalinga (22.17%).

Literacy and Education

Based on 2010 records, the literacy rate in CRB was about 91.5%. Overall, literacy was found increasing as in the previous years: 1994 (89.8%); and 1990 (90.2%). About 40% and 34% of the total population are graduates of elementary and high school, respectively while only 10% of the population are academic degree holders.

Poverty Incidence and Subsistence Incidence

Most of the provinces with high poverty incidence belong to CAR except Benguet whose index was the lowest. Other provinces that also exhibited increased poverty incidence in 2012 were Apayao, Aurora, Ifugao, Nueva Vizcaya and Quirino. Generally, most of the provinces in CRB have decreased poverty incidence from 2012 to 2015 except for Benguet, Cagayan (slight increase), Mt. Province and Nueva Ecija. In addition, among the provinces, those with the lowest subsistence incidence in 2012 are Benguet, Nueva Ecija and Quirino. Almost all of the provinces also have decreased subsistence incidence by year 2012 with exception to provinces of Benguet, Ifugao, Nueva Vizcaya and Aurora.

Human Development Index

Based on the most recent (2009) records, HDI was found highest in Benguet (0.85), followed by Nueva Vizcaya with 0.68. HDI was found generally improving in the case of Apayao, Aurora, Benguet, Cagayan, Isabela, Kalinga, Nueva Ecija and Quirino.

Employment

The current employment rate in CRB is at least 93%. Among the provinces, Mountain Province has the highest index with 99.6%. This is closely followed by Quirino with 99.1%. Moreover, among the 12 provinces, Apayao and Mt. Province have the highest labor participation rate with 86% and 85.8%, respectively. The lowest rate was noted in Benguet with only 61.7%.

Household income and expenditure

Based on 2006 records the average annual family income (in PhP) was found largest in Benguet with around P280,000. However, Benguet is also the top spender. Overall, income was found larger than expenditure in all provinces of CRB.

Natural Resource Dependent Activities

Nueva Ecija, Isabela and Cagayan belong to the top most producers of corn and rice in the country, both irrigated and rainfed. Aside from these products, CRB also has fishery productions. Sectors of fishery productions present in the river basin are the commercial fisheries, municipal fisheries and aquaculture. Among these three, municipal fisheries contribute to the highest production of fish. There are also log and lumber productions in the river basin which are mostly in Nueva Vizcaya and Quirino areas. Agriculture, forestry and fishery are the top most livelihoods in CRB based on the 2010 Census of Population and Housing (CPH). These activities are perceived to be affected adversely during the occurrence of risk events.

Commercial and Industrial Establishments

Agriculture, forestry and fishing were noted as the most common type of business in CRB. Based on the regional data, the sector of Wholesale & Retail Trade; Repair of Motor

Vehicles and Motorcycles has the highest number of establishment. It is followed by Manufacturing, Accommodation and Food Service Activities, and Information and Communication. Region 3 has the highest number of establishments among the three regions in CRB.

5.5 Infrastructure

Educational Facilities

Based on the 2013-2014 data of the Department of Education (DepEDd), there are around 2,977 public schools in the provinces within the river basin while the number of secondary schools in CRB accounts to around 772. The provinces of Isabela and Cagayan have the most number of enrollees in public schools.

Health Facilities

There are about 1925 barangay health services (BHS) in the CRB. Isabela province has the most number totaling to about 487 BHS. BHS are expected to respond to simple medical concerns in the barangay level while those that require serious treatment can be responded by the different primary, secondary and tertiary hospitals.

Roads and Bridges

In general, large portion of road networks in CRB are concrete except for provinces in Region 3 where about half are better with asphalt-finish. Some areas (in CAR: 820km; R2: 242km) remain in rough condition particularly those farm-to-market roads situated in the upland areas.

Dams

There are about 70 completed dams in the river basin; 2 on-going and 63 proposed constructions. These dams are classified as diversion dam, water impounding system, small water impounding system. Magat dam is the largest dam in the river basin.

Water Supply

Tube / piped deep well is the most common form of domestic water (cooking and laundry washing) supply in CRB. This is followed by households who have their own tubed/piped deep well.

Sanitation Facilities

Toilet with water-sealed sewer septic tank is the most common toilet design of households in CRB. Most of households with this design are exclusively using/own their toilet. Few other designs are open pit and close pit, particularly in the upland areas.

Waste Disposal

Burning is the most popular form of household-level waste disposal in CRB (52%). Other waste disposal practices include collection by trucks (by the local government), dumping in backyard pit, composting and feeding to animals (if recyclable food).

Financial Institutions

Majority of the banks in CRB are mainly concentrated in Nueva Ecija, Isabela and Benguet while in terms of other financial institutions such as pawnshop, Nueva Ecija, Cagayan and Isabela have the highest number of such facility

Energy

CRB has around 8 power plants that supply energy within and near the river basin. Most of them are housed in Isabela, Benguet and Nueva Vizcaya. The biggest power plant is the Magat Hydroelectric Power Plant (HEPP).

Transportation

Transportation in the river basin can be by land through the various road systems in area and by air through the presence of two functional airports inside the river basin that are located in Cauayan City, Isabela and Tuguegarao City, Cagayan.

Irrigation

As of January 23, 2014, a total of 303,745 ha of the Cagayan River Basin were considered as firm-up service areas while 453,957 ha are to be developed. Most of these service areas are considered as national irrigation system while others are communal irrigation system, private irrigation system and OGA-assisted. Abra, Benguet, Aurora and Nueva Ecija have more firm-up service areas than the estimated total irrigable areas. Overall, 90% of the river basin is non-irrigable while only 10% is irrigable.

5.6 Land Capability Zoning

More than half of the river basin's area is determined to have soil erosion potential (SEP) within 0-5 tons/ha which constitutes 22.9% of CRB. The 5-12 class is about 17.9% while the 12-20 class constitutes about 16.7%. Also, there are areas that have been found to have 50-75 tons/ha of SEP which comprised 12.1% of the area. The class 30-50 tons/ha was found to have the least percentage of 8.7% only. However, large portions of the river basin are identified to have SEP of >75 tons/ha. In this scenario, 0-5 tons/ha is the dominant SEP same with the scenario in 2020 and 2050. However, SEP class for 2050 scenario is slightly lower compared to 2020 scenario.

Meanwhile, for current scenario, about 21.8% of the river basin has soil erosion index (SEI) greater than 5. More than half (55.8%) has SEI of 0-1. In the 2020 scenario, 21.7% of the river basin has SEI of more than 5 and 22.6% in 2050.

The land capability zones output for the current rainfall scenario summarize the basis for the allocation of lands. The strict protection in CRB comprises 45.7%, which is about 1,255,815 ha. Conversely, areas under the unlimited production comprise about 42.7% or 1,173,976 ha. Agroforestry production covers 6.6%; limited production is 1.9% while combining the two buffer zones constitutes 3.1%. The land capability classifications for 2020 scenario compared to the current scenario is of minimal difference. There is a 0.1% increase and decrease in the area covered for Unlimited Production and Limited Production zones. In 2050, a decrease is observed for unlimited and agroforestry production.

5.7 Stakeholder Analysis

There are about 12 user groups in the Cagayan River Basin. These groups have a direct interest in any of the resources provided by the river basin. About 9 stakeholders are considered as mediating institutions to include National Government Agencies, Local Government Unit, State Colleges and Universities, Non-government Agencies (i.e. APECO and CAVAPPED), Philippine Port Authority, Congress and People's Organization. Moreover, 11 stakeholders have external economic interest in the river basin. A total of 32 stakeholders have interest in the river basin. These stakeholders have formed alliances and/or conflict in managing the resources in the river basin. Most of the time, alliances are formed by supporting each other's mandate and through joint projects.

5.8 Policy Assessment

There are many policy frameworks in the Philippines. Notable of which are the Sustainable Development Goals (2016-2030), Philippine Development Plan (2011-2016), MSDF (2010-2020), Strategic National Action Plan (2009-2019), National Climate Change Action Plan (2011-2028) Philippine Strategy for Sustainable Development (1996) and Ramsar Convention on Wetland (1994). All these frameworks have a common goal of improving quality of life thru poverty alleviation, sustainable development, capacity building, disaster risk reduction and climate change adaptation. These frameworks basically evolved from the Water and Environment summits and principles such as the Dublin Principle for water scarcity, Earth Summit in 1992, Agenda 21 and the adoption of the Integrated Water Resource Management (IWRM) by GWP whose main objective is to promote sustainable development of water resources at all levels and sectors. It further expanded to the Integrated River Basin development and Management (IRBDM) which is the main focus of this project.

5.9 Vulnerability Assessment

Flood

The water surface level in year 2020 is about 5 m higher than that of in the current climate condition with 2-yr return period. This resulted to wider flood extents for the 2020 scenario. On the other hand, the flood extents for the current climate condition and the 2050 scenario were almost the same. Overall, climate change has no significant effects on the flood extents of the CRB based on the A1B climate scenarios. Since the assumption in the said scenario is economically and technologically developed with balanced use of energy sources, it can be the reason for the reduction of flood extents from 2020 to 2050, making the flood extents in the latter year similar to the current climate condition. With the positive assumption that the greenhouse gas emissions will be reduced through balanced use of fuel sources, the flood extents in 2020 is projected to be a little bit wider than the current condition; while the flood extents in 2050 is projected to be narrower than in 2020 and almost the same as in the current climate condition. For the 2020 and 2050 scenarios, the areas identified in more extreme events are the same. However, the depths are greater by about 1 m for 2020 and about 3 m compare with the baseline condition.

Earthquake

Based from the conducted Deterministic Seismic Hazard Assessment in Cagayan River Basin, the basin was affected by West Ilocos Fault System, Bangui Fault System, Abra River Fault System, PFZ: San Manuel Fault, PFZ: San Jose Fault, East Cordillera Fault Zone, East Zambales Fault, West Valley Fault, PFZ: Infanta Fault, Philippine Fault Zone

and East Luzon Trough, which were capable of producing a moment magnitude from a minimum of 6.2 to a maximum of 9.1. The bottom part of the river basin is mostly affected by East Luzon Trough and Bangui Fault System, which are capable of producing a moment magnitude of 7.9 and 7.5, respectively.

Landslide

Rain-induced

Moderate to low susceptibility zones are prevalent in the central part of the Cagayan River Basin due to the generally gentle slopes in those areas. Additionally, the presence of the Philippine Fault Zone, an active deformation zone in the country, is confined mostly to the western part of the basin. The hilly/mountainous parts of the basin range from moderately to highly susceptible to landslides, particularly due to their steep slopes, the underlying young sedimentary rocks, and the presence of splays of the Philippine Fault.

Seismically-induced

Landslides can cause widespread damage to both properties and lives. It occurs when the soil weight has exceeded its allowable shear strength that can be triggered by soil saturation or ground shaking due to earthquake. Assessing the possible occurrence of a landslide requires several factors, and in this study, shallow seismically-induced landslide was considered using the available soil properties and geology. Slopes of CRB are stable with regards to sliding considering only the weight of the sliding mass alone except for some portions that have a factor of safety of less than unity.

Water Resources

The water supply projections for CRB for 2020 and 2050 were generated from the water balance model of the river basin using SWAT model. Streamflow data from the Addalam River and Cagayan River, and rainfall projections, under medium range scenario (A1B) using PRECIS, were used in the model. The surface water supply and groundwater supply projections were taken from the water yield and aquifer recharge projections, respectively. Surface water supply is expected to decrease from 1,076.48 mm/yr [29,595.62 MCM/yr (million cubic meter/year)] in 2020 to 973.97 mm/yr (26,777.32 MCM/yr) in 2050. Groundwater recharge also is expected to decrease from 193.13 mm/yr (5,309.72 MCM/yr) to 176.97 mm/yr (4,865.43 MCM/yr) which are 10.27% and 9.91% of annual rainfall, respectively.

For the projection of available water, the water demand projections were subtracted from the water supply projections for years 2020 and 2050. It should be noted, however, that based on the NWRB water rights permitted in 2013, only the domestic water demand of Region 2 was sourced mainly from groundwater at 94% and only 6% was from surface water. Overall, including industrial and irrigation water demands, 99% and 97% were sourced from surface water in Regions 2 and 3, respectively, and the remaining water demands were from groundwater. These show that groundwater is fairly underutilized in these regions. There were no data for CAR.

Participatory Risk and Vulnerability Assessment

This section summarizes and analyzes the risks faced by CRB in the future in relation to climate-related events. The analysis considers the results of the participatory risk assessment, secondary data from government agencies and news reports, and outputs from other studies as reported in this revised master plan. It closely examines the

sources of risk by looking into the factors that contribute to it (i.e., hazard, vulnerability and exposure, including the socio-economic processes).

An overall evaluation of risk events was performed in CRB. The general risk estimates for the whole river basin was arrived at by assigning a numerical value for the degree of likelihood and consequences (i.e., very low = 1; low = 2; moderate = 3; high = 4; and very high = 5). Using these values, the degree of likelihood and consequences for each risk event was averaged from the five FGD sites. Results showed that flood poses the highest risk in CRB, followed by drought and landslide. Flood was assessed to be extreme risk events, where immediate actions are required. On the other hand, drought and landslide fall under high risk events, which call for high priority control measures.

5.10 Institutional Setting

Various key government agencies from national and subnational levels play important roles in river basin management and development. The institutional arrangements of these agencies possess differing relationship in terms of mandates and functions. Nevertheless, they have pertinent roles to carry out under the components of river basin management and development framework, namely; water resource management, watershed management, wetland management, flood management and institutional development.

To implement these management strategies and as a solution to further eliminate the issue of fragmentation, lack of coordination, inefficiency, overlaps, there must be a coordinating mechanism that would harmonize the initiatives in the river basin. Also, there should be a coordinating body to facilitate delivery of goods and services by the stakeholders as well as provide mechanisms for conflict resolution among stakeholders.

The lessons learned from Philippine experiences and the assessments from the comparison of cases of river basin management accent the indispensable characteristics of a river basin organization that we must refer and tailor fit to the context of the river basin in focus. A River Basin Management Council (RMC) shall be organized and function as the governing body of the river basin. It shall formulate policies, approve plans and provide oversight function on the implementation of the climate change mitigation and adaptation master plan. It will ensure science-based decision making and good governance among its members. The approved policies, plans and programs of the RMC shall be adopted by all the members of the Council and the LGUs shall pass a resolution to formalize its adoption. The Council will be responsible to resolve conflicts and generate resources for the implementation of the Climate-Responsive Cagayan River Basin Master Plan. In this case, the Cagayan River Basin Management Council was organized.

6 Management and Development Plan

6.1 Introduction

The Cagayan River Basin, being the largest river basin in the Philippines, has so much potential in terms of its physical resources as well as ecosystem services to the region. Its main river, the Cagayan River which is also deemed as the longest river in the country, provides habitat to numerous aquatic resources, irrigation for various farming activities and water supply for domestic and agricultural use. However, there are also several constraints that somehow prevent further development in CRB. Six thematic areas of concern were identified to effectively manage and develop the river basin (water resources, watershed, wetland, flood and economic.). Core problems are identified and these include high variable water supply, deteriorating water quality, watershed degradation, declining productivity of wetlands, flooding, poverty and inadequate institutional mechanism.

With the increasing population and impacts posed by climate change, CRB is greatly at risk to various anthropogenic and natural threats. It is therefore vital to develop strategies that would prevent these threats and promote further growth and development in the river basin.

6.2 Vision, Mission, Goal, and Development Objectives

The vision, mission, goal and objectives are based from the output of the stakeholders during the workshops conducted in the previous Master Plan and this is still adopted to date. Stakeholder's consultation ensures stakeholders ownership of the river basin. The vision explains the state of the river basins in the future. The vision was crafted in order for the Cagayan River Basin to continuously provide for provisioning services, regulating services, cultural services and supporting services. The following are the vision, mission, goals and objectives for the Cagayan River Basin:

VISION

"An ecologically balanced Cagayan River Basin with biodiversity-rich resources owned and sustainably managed by empowered stakeholders enjoying fullness of life."

MISSION

"Improve quality of life through optimal development and sustainable use of Cagayan River Basin resources through an Integrated River Basin Management (IRBM) approach with the participation of all stakeholders."

GOAL

"Manage water and related resources of the Cagayan River Basin in an effective, sustainable and equitable manner."

OBJECTIVE

Implement basin-wide Integrated Water Resource Management (IWRM) approaches in regional, local and related sector frameworks and development programs for sustainable and equitable development.

6.3 Integrated River Basin Management and Development

Formulated by RBCO in 2007, the Integrated River Basin Management and Development (IRBMD) Framework is the basic system for all strategies in the Philippines for sustainable river basin ecosystem management. Figure 3 shows the four principal frameworks and development strategies: Integrated Water Resources Management, Integrated Watershed Management, Wetland Management, and Flood Mitigation

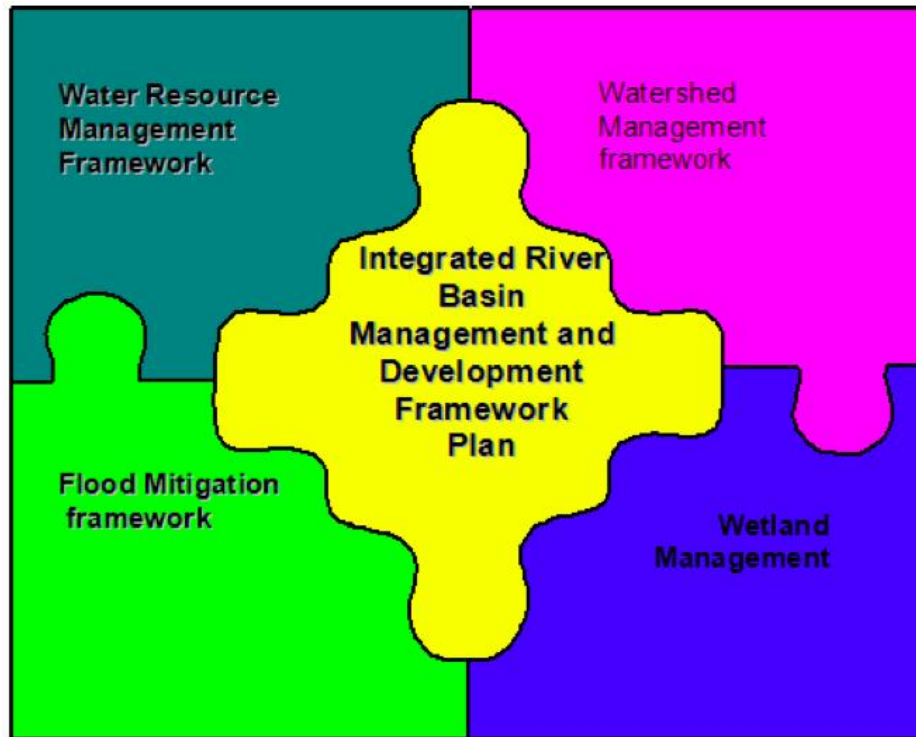


Figure 3. Relationships of Four Major Ecosystems

1. Integrated Water Resources Management – manages fresh water as an economic and public good while recognizing its vulnerability and limited supply.
2. Integrated Watershed Management – organizes land, people, and other resources in the watershed to provide goods and services without harming the soil and water.
3. Wetland Management – manages areas that are submerged or soaked by enough surface or groundwater to support ecosystems such as mangroves, coral reefs, swamps, rice paddies, estuaries, lakes and reservoirs
4. Flood Mitigation – protects and enhances coping capacities of communities and the environment against water-induced hazards

6.4 Development Issues and Challenges

Water Resources

High variability of water supply is one of the problems identified in for water resources. It is caused by the increasing rainfall during rainy season and decreasing rainfall during summer/dry month, both because of climate change. These scenarios cause problem in the river basin as it bring more water when water is not needed and less water when deem needed. Based on the PAGASA projection, rainfall will increase for the months of June, July and August in 2020 and 2050. Moreover, number of days with rainfall greater

than 200 mm will also increase for all provinces in the CRB. On the contrary, rainfall will all the more decrease in summer months (March, April, May) also in 2020 and 2050. Increase in temperature during these months is also observed, the increase ranges from 0.7- 1.1 in 2020 and 1.8-2.1 in 2050. Likewise, number of days with temperature greater than 35 degree Celsius will also increase.

Using the rainfall as input for SWAT simulation, both surface runoff and groundwater recharge are expected to increase in 2020 but will decrease in 2050. The problem on the variability of water supply is reflected also in the water yield in the river basin in 2020 and 2050.

Other problem that can affect water resources in the river basin is the deteriorating water quality caused by excessive soil erosion and improper waste disposal. Based on the erosion map provided by the Mines and Geosciences Bureau (MGB), about 48% of the total area of CRB is classified with moderate to severe erosion. Moreover, in the computed soil erosion index using the Universal Soil Loss Equation (USLE), about 22% of the area of the river basin has SEI of more than 5. Excessive soil erosion in the river basin may cause siltation of river waters and sedimentation. Historical data of Magat Dam shows that it is already silted.

Improper waste disposal in the area can also contribute to the deterioration of water quality in the river basin. According to the National Solid Waste Management Commission (NSWMC), waste generation in region II, III and CAR will increase. In addition, data from Philippine Statistical Authority (PSA) shows that the most common manner of waste disposal in the area is burning. As early as 2000, JICA study shows that there is a high coliform bacteria in the water of the river basin. High coliform bacteria in surface water indicate that sewage from residences and buildings are inflowing in the Cagayan River Basin.

Watershed

Based on the land cover change analysis from 2003 to 2010, about 29% of closed forest in 2003 is converted to open forest in 2010. On the other hand, some open forest in 2003 were converted to shrubs and wooded grasslands. Based on National Mapping and Resource Information Authority (NAMRIA) 2010 land cover data, the remaining closed forests in CRB is only around 13% while open forest comprised 20.5% of the river basin only. Land classification of CRB indicates that 69% is forestland while 31% is alienable and disposable land. Activities such as upland migration, charcoal making, timber poaching, unsustainable upland farming and kaingin have induced forest cover loss in CRB. Data from DENR-Region 02 shows that there are still confiscated forest products and farm tools in CRB despite the implementation EO 23 in the country. Other cause of forest cover loss or deforestation in the area is the incidents of forest fires. In 2012, around 34,000 hectares of forest in CRB was affected by forest fire.

Non-conforming land uses is also one of the perennial problem in CRB. Based on the land capability zoning in CRB, around 46% of the area is under the strict protection zone. Meaning presence of built-up areas and cultivated lands in this zone is strictly prohibited due to high soil erosion index. However, land capability zones overlaid to present land cover types in the river basin shows that there are incompatibilities. Land cover types that should not be in protection zones comprised of about 13% of the total land area of the river basin.

Loss of forest cover and non-conformities of land cover in the river basin led to watershed degradation. Watershed degradation is one of the major problems in any river basin. It has caused overarching issue affecting wetlands and water resources.

Effects of watershed degradation includes loss of biodiversity and habitat, increased risk and vulnerability especially of those from the upland, decline water quality due to excessive soil erosion, and decrease of soil productivity.

Wetland

Wetland is one of the main sources of livelihood in the Cagayan River Basin, however there is a decline in its productivity as manifested in fish kill incidents and declining productivity of commercial fisheries. Data from the Bureau Fisheries and Aquatic Resources (BFAR) show that causes of fish kills in the river basin include poor water quality, low water level, overstocking, high ammonia level, abrupt change of water temperature, low dissolved oxygen, parasite infection, insufficient water supply from irrigation and overfeeding.

Sedimentation/siltation has been one of the causes of the reduction of productivity of wetlands. Riverbank erosion in particular is the common cause of sedimentation of surface waters in CRB. It is one of the reasons why riparian developments be pursued in the river basin. Study conducted by JICA in 2002 shows the sediment yield of major sub-basins using Murano Formula. Based on the study, Cagayan River Basin has a sediment yield of 30.8 MCM/year. Among the major sub-basin, Magat River and Chico River has the highest sediment yield.

Problem on water pollution due to wastes may also contribute to the declining productivity of wetlands in the river basin. Improper waste disposal especially of those living near riverbanks leads to further pollution of rivers. There are only about 408 material recovery facilities in the river basin serving about 934 barangays out of about 2,459 barangays within the CRB.

Disaster Risk Reduction, and Hazard Management

Flooding has been one of the major problems in the river basin. Based on the flood hazard map from MGB, only about 388, 494 hectares are susceptible to flooding in the area. However, it shall be noted that out of these area 60% has high to very high susceptibility. Moreover, these areas have resided by various residential areas and key establishments. Flooding had brought high cost of damage to both agriculture and infrastructure in the river basin. As of 2013, Typhoon Paeng in 2006 incurred the highest cost of damage in CRB with a total amount of more than 34 billion pesos. Excessive rainfall brought by climate change may cause more damage in the future. Based on the vulnerability assessment conducted in the course of this study, inundated area will increase in 2020 and 2050 scenarios except for the 2-year flood event in 2050. Prolonged and extensive flooding has been a long-term problem in CRB. Other contributory factors of this problem are the decreased capacity of dams to impound water during rainy days and siltation of waterways due to excessive soil erosion. As a result, flood occurs not just during typhoons but also during monsoon rains.

Landslide also has been posing threat not just to human lives in the river basin but also to its resources. Presence of steep slopes and the three mountain ranges in the river basin makes it highly susceptible to landslide. More than half of the total area of the river basin is susceptible to landslide. Among the 12 provinces in CRB, those in Cordillera Region are most prone to landslide. Rain-induced landslide susceptibility map using weight derived from AHP analysis also shows the same result. Excessive rainfall and improper land use also induce the occurrence of landslide.

Effects of flooding and landslide contribute to the impediment of economic development in the area because of the damage it cause to the environment, people and economy.

Impacts of these events include loss of lives and damage to property, decrease in crop yield and low productivity of workers and students.

Economic

Poverty is seen as a major problem in the river basin in terms on the economic development. This problem exists in the river basin due to increasing population. Population projection shows that population in 1990 might double up in 2050. Census of Population and Housing shows that population within the CRB is about 3,217, 200 while in 2015, it reaches to about 3, 601,484. Increasing population also indicates an increasing amount of pressure in the use of different resources. In addition, there is also low educational attainment in the river basin. As of 2015, only about 10% of population in CRB has academic degree. Most of the populations in CRB are graduates of elementary and high school. Higher educational attainment opens more opportunity for better and stable jobs. Moreover, people in CRB highly depend on agriculture, fishery and forestry for their source of livelihood. Data from the Philippine Statistical Authority in 2010 shows that 63% of the population is employed in these sectors.

Institutional Development

There are multi-actor, multi-level, cross-sectoral organizations which have multi-tier jurisdictional concerns that muddle institutional arrangements. This engenders confusion, stalemates actions and decisions of the actors. The situation worsens if actors intervene on their own without due consideration of attendant consequences to others wherein the “common dilemma” is magnified. This especially happens when there is weak governance and organizational arrangement that coordinates the panoply of actors.

6.5 Implementation Plan

The implementation plan recommends relevant programs and projects for the Cagayan River Basin. These are crafted based on the issues and problems that are currently faced by the river basin and congruent to the vision, mission, and goals. The suggested programs and projects aim to make the river basin climate-resilient. Six thematic areas are taken into consideration, the water resources management, the watershed management, wetland management, economic development, disaster risk reduction management and institutional development. There are also projects that cut across the different thematic areas.

Table 3. Different projects identified for each thematic area

Goal	Objective	Strategy	Program/Project
Water Resources Management			
Well-managed and maintained water resources in the river basin	To promote sufficiency of water supply for irrigation, domestic and other uses	Capture excess water and improve the efficiency and equitability of water supply distribution system	Water Collection and Storage Program Development of Water Impounding infrastructures in identified potential dam sites Development of rainwater harvesting systems
		Development of water supply system for	Water supply Development Program

Goal	Objective	Strategy	Program/Project
		domestic and irrigation purposes	Construction of water supply system Strategic Irrigation Development for the Cagayan River Basin Groundwater conservation and protection for the Cagayan River Basin
	To enhance water quality and monitoring system	Promote soil and water conservation practices	Soil and Water Conservation Program Conservation Farming Village Forest Landscape Restoration
		Improve waste disposal system	Ecological Solid Waste Management Program Facilitate Compliance to Local Government Ecological Solid Waste Management Plan Construction of Material Recovery Facilities (MRF) and Sanitary Landfill Facilities (SLF) Improvement of water quality monitoring system Establishment of Wastewater Treatment Facilities
Watershed Management			
Well-managed and protected river basins with recognition of local knowledge and indigenous rights	Improve sustainability of forest, land, soil, biodiversity and other resources including ecosystem services	Enhancement of forest cover	Forest Restoration Program Forest Landscape Restoration Conservation Farming Village
		Enhancement of forest protection and conservation	Forest Protection Program Enhancement of capability of LGUs and DENR to enforce forest protection laws and plans Updating of Climate Proofed ADSDPP
		Improvement of land use practices	Harmonization of CLUP, FLUP and other related plans Capability building of LGUs on IRBM, land use planning and other decision support tools

Goal	Objective	Strategy	Program/Project
			Institutionalization of River Basin Master Plan as the framework for integration of different development plans
		Watershed Information and data management	CRB Watershed Information System Program Water Instrumentation Comprehensive Natural Resources Assessment and Monitoring River basin management information and decision support system
Wetland management			
Well managed wetland and coastal ecosystems for sustained aquatic resources	To improve wetland productivity	Improvement of knowledge and understanding on wetland ecosystems and manage	Comprehensive Research and Development Program Wetland mapping, biodiversity assessment and long-term monitoring of wetland ecosystem Integrated coastal resources management
		Reduction of siltation from erosion	Restoration and conservation program Forest Landscape Restoration Riparian Development Project
		Reduction of pollution coming from commercial, agricultural and residential areas	Sustainable Agriculture Program Sustainable Farming Project Conservation Farming Village
			Ecological Solid Waste Management Program Facilitate compliance to local government ecological solid waste management plan Construction of material recovery facilities and sanitary landfill facilities Improvement of water quality monitoring system

Goal	Objective	Strategy	Program/Project
Disaster Risk Reduction and Management			
Improved resiliency and adaptive capacities of communities from various climate-related hazards and impacts of climate change	To reduce risks and vulnerabilities associated with flood and landslide	Enhancement of resiliency and adaptive capacity of flood/landslide prone areas	Disaster Risk Reduction and Management Program Improvement of early warning and forecasting system Designing of relocation for poor household exposed to climate change related hazards
			Development of climate-adaptive structure program Cagayan River Flood Control Project (CRFCP) Slope Stabilization Construction of sediment containment system
		Promote soil and conservation practices	Restoration and conservation of watershed resources Conservation Farming Village Forest Landscape Restoration
Economic Development			
A sustainable and inclusive local economy that promotes equity and opportunities to communities in the river basin	To reduce poverty incidence	Enhancement of skills and competence of labor force	Quality Education and skills enhancement Program Technical Education and Skills Development for Poor Families
		Stimulate economic development that will create more livelihood opportunities in the river basin	Infrastructure Development Program Improvement of roads, transportation, power and telecommunication infrastructures
			Livelihood Development and Employment Program Climate Resilient Agriculture and Fisheries Cottage-based Enterprise Development Community –based ecotourism site development Payment for ecosystem services

Goal	Objective	Strategy	Program/Project
			Livelihood Development for marginalized women, elderly and youth groups
Institutional Development			
	To promote the integration of plans and programs of various agencies and LGUs	Development of framework mechanism	Capacity Development Program Strengthening of RBO and institutional linkages Harmonization and strengthening of various multi-sectoral bodies
		Communication Plan	IEC Campaign Program Cagayan Master Plan Caravan/Roadshow Project Social Mobilization and Development Project

6.6 Investment Plan

The investment plan indicates the budgetary requirements of the various programs and projects that were developed under the climate-responsive Integrated Master Plan for the Cagayan River Basin (CRB). This plan updates an existing master plan for the CRB. Some activities of the older plan were revised, but the current plan also includes new programs and projects to make the plan climate-responsive. The total investment requirement of the Plan over a 15-year period is P100.879 billion.

To pursue the objectives set forth in the Master Plan, six themes were developed: Water Resources Management, Watershed Management, Wetland Management, Disaster Risk Reduction and Hazard Management, Economic, and Institutional. In addition to these, there are also projects that are considered crosscutting in nature as they address concerns of more than one thematic area.

The Water Resources Management theme has the highest funding requirement among the six thematic areas at PH35.764 billion (35% of total), followed by Watershed Management (34%), Economic Development (20%) Disaster Risk Reduction and Hazard Management (10%), Wetland Resources Management (1%), and Institutional (0.1%). Project cost for each project is shown in Table 4.

Table 4. Total cost of each projects proposed for the Cagayan River Basin

Program	Project	Total Cost
WATER RESOURCES MANAGEMENT		
Water Collection and Storage Program	Development of Water Impounding Infrastructure in Identified Potential Dams	4,350,000,000
	Development of Rainwater Harvesting Systems	15,000,000
Water Supply Development Program	Construction of Water supply System	300,000,000
	Strategic Irrigation Development for the Cagayan River Basin	30,105,000,000
	Groundwater Management and Protection for the Cagayan River Basin	25,000,000
Sanitation and Solid Waste Management Program	Facilitate Compliance to Local Government Ecological Solid Waste Management Plan	170,800,000
	Construction of Material Recovery Facilities (MRF) and Sanitary Landfill Facilities (SLF)	420,000,000
	Water Quality Monitoring System	128,800,000
	Establishment of Waste Water Treatment Facilities	250,000,000
Soil and Water Conservation Program	Conservation Farming Village	5,850,000,000
	Forest Landscape Restoration	27,500,000,000
Subtotal		35,764,600,000
WATERSHED MANAGEMENT		
Forest Restoration Program	Conservation Farming Village	5,850,000,000
	Forest Landscape Restoration	27,500,000,000
Forest Protection Program	Enhancement of Capability of LGUs and DENR to Enforce Forest Protection Laws and Plans	50,000,000
	Updating of Climate Proofed ADSDPP (Ancestral Domain Sustainable Development and Protection Plan) for ICCs/IPs	22,000,000
	Capability-building of LGUs on IRBM, Land Use Planning and other Decision Support Tools	30,000,000
CRB Management Information System Program	Emerging Research on Climate Change Related Projects	100,000,000
	Watershed Instrumentation	100,000,000
	Comprehensive Natural Resources Assessment and Monitoring	50,000,000
	River Basin Management Information and Decision Support System	100,000,000
Subtotal		33,802,000,000

Program	Project	Total Cost
WETLAND MANAGEMENT		
Comprehensive Research and Development Program	Integrated Coastal Resources Management Project	420,000,000
	Wetland Mapping, Biodiversity Assessment and Monitoring Project	20,000,000
Restoration and Conservation Program	Forest Landscape Restoration Project	27,500,000,000
	Riparian Development Project	35,000,000
Sustainable Agriculture Program	Conservation Farming Village	5,850,000,000
	Sustainable Farming Project	150,000,000
Sanitation and Solid Waste Management Program	Development of Local Government Ecological Solid Waste Management Plan	170,800,000
	Construction of Material Recovery Facilities (MRF) and Sanitary Landfill Facilities (SLF)	420,000,000
	Water Quality Monitoring System	128,800,000
	Establishment of Waste Water Treatment Facilities	250,000,000
Subtotal		625,000,000
DISASTER RISK REDUCTION AND MANAGEMENT		
Disaster Risk Reduction and Management Program	Improvement of Early Warning and Forecasting System	257,600,000
	Designing of Relocation Program for Poor Household Exposed to Climate Change Related Hazards	10,000,000
Development of Climate- Adaptive Structure Program	Cagayan River Flood Control Project (CRFCP)	8,000,000,000
	Slope Stabilization Project	723,000,000
	Construction of Sediment Containment System	1,350,000,000
Restoration and Conservation of Watershed Resources	Conservation Farming Village	5,850,000,000
	Forest Landscape Restoration	27,500,000,000
Subtotal		10,340,600,000
ECONOMIC DEVELOPMENT		
	Technical Education and Skills Development Project	40,000,000
	Infrastructure Development Project	20,000,000,000
Livelihood Development and Employment Program	Climate Resilient Agriculture	10,000,000
	Cottage-based Enterprise Development	20,000,000
	Community-based Ecotourism Site Development	100,000,000
	Payment for Ecosystem Services	11,500,000
	Livelihood development for marginalized women, elderly and youth groups	60,000,000

Program	Project	Total Cost
<i>Subtotal</i>		<i>20,241,500,000</i>
INSTITUTIONAL DEVELOPMENT		
Capacity Development Program	Strengthening of River Basin Organization and Institutional Linkages	15,000,000
	Organizational Development and Capacity Building of existing women's elderly and youth groups	15,000,000
IEC Campaign Project	Social Mobilization and Development Project	64,000,000
	Cagayan Master Plan Roadshow/Caravan Project	12,000,000
<i>Subtotal</i>		<i>106,000,000</i>
TOTAL		100,879,700,000

*Note: Those in red font are projects that cut across different thematic areas