Climate Change-Responsive Integrated River Basin Management and Development Master Plans for the 8 Clustered River Basins

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Executive Summary for Cluster 7 River Basin
(Ayala, Bolong, Curuan, Manicahan, Tumaga and Vitali-Taguite)

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

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EXECUTIVE SUMMARY

1 RATIONALE

Pursuant to Executive Order (EO) Nos. 510, 816 and 50, the River Basin Control Office (RBCO) was created to develop, among others, a national master plan to address flooding and to provide sustainable water supply for the entire country. The sustainable management of river basins is critical as they are considered as drivers of the Philippine economy. In line with the Philippine Development Plan, the preparation of the river basin master plan used the integrated river basin management approach. The plan intends to address several concerns on watershed conservation, river basin rehabilitation, flood control/mitigation, water security for domestic, irrigation and industrial uses, and livelihood and economic opportunities in the area.

For CY 2016, several river basins were targeted for the preparation of the master plan. A cluster of which is situated in Zamboanga Peninsula, which consists Ayala, Bolong, Curuan, Manicahan, Tumaga and Vitali-Taguite River Basins. In relation with the passage of Republic Act (RA) No. 9729 or the Climate Change Act of 2009 and RA 10121 or the Disaster Risk Reduction Law of 2010, climate change perspectives were incorporated and mainstreamed together with disaster risk reduction issues and measures.

2 PROJECT OBJECTIVES

The objective of this project is to formulate the Integrated River Basin Management and Development Master Plan (IRBMDMP) for the Cluster 7 River Basin (Ayala, Bolong, Curuan, Manicahan, Tumaga, Vitali-Taguite), taking into consideration biological diversity and their capacity to provide goods and services. The plan incorporates the implications of the new climate normals in addressing the concerns of the river basin on:

1. Water Resources Management;
2. Forest Ecosystem and Biodiversity Management;
3. Flood Control/Mitigation, Disaster Risk Reduction and Hazards Management;
4. Wetland Management (including rivers, river deltas, marshlands and coastal areas);
5. Economic Development; and
6. Institutional Linkages and Organizational Structure for River Basin Management.

3 SCOPE AND LIMITATION

The project formulated the Integrated Management and Development Master Plan for the Cluster 7 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. Formulation of river basin profile;
2. Crafting 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 methods and approaches to accomplish the objectives (Figure 1). The following tasks were undertaken during the implementation of the project:

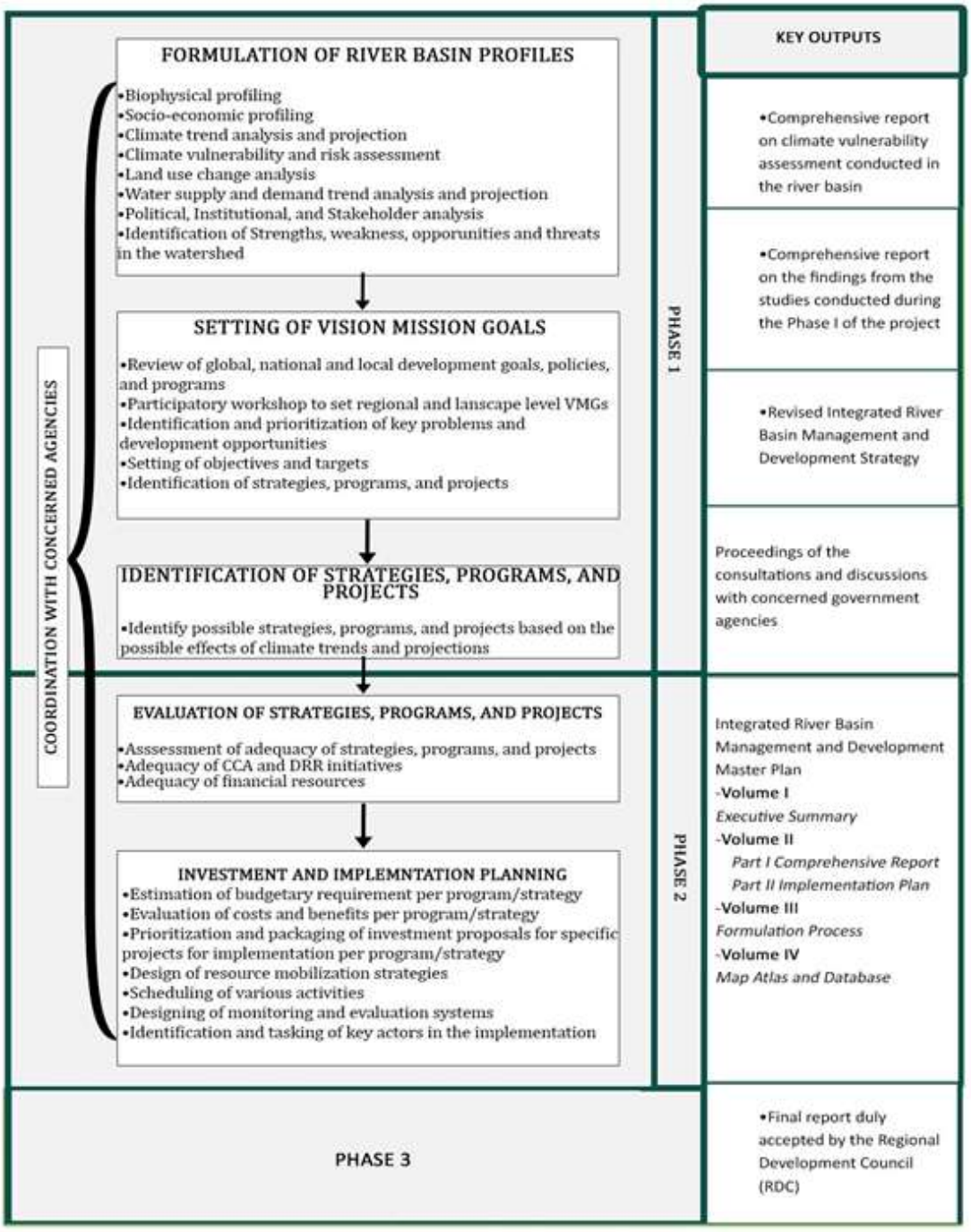

Figure 1. Flow of activities in the formulation of master plan for Cluster 7.

5 ASSESSMENT REPORTS

5.1 Geophysical Profile

Geographic Location

The Cluster 7 River Basin is located along the Eastern Portion of the Zamboanga Peninsula and it spreads northward from the peninsula's southern tip. It is composed of six principal river basins, namely Ayala, Bolong, Curuan, Manicahan, Tumaga and Vitali-Taguite. The largest in terms of area is Vitali-Taguite with about 30% of its area belonging to Barangay Vitali of Zamboanga City, while only about 12% of the river basin belongs to Zamboanga Del Norte. The five other principal river basins are located within Zamboanga City. Between these six, 26 minor watersheds were identified. The total area of the Cluster is 98,445 ha.

Climate Trends

The area of the Cluster 7 River Basin falls under Type III of the Modified Corona Climate Classification System, where seasons are not very pronounced. The annual mean normal temperature is 28.3°C. January is the coldest month and April is the warmest. The average annual rainfall in the area is 1,266.5 mm. Meanwhile, the number of rainy days per month in the City varies from 6 to 16 days. Annually, the normal number of rainy days on average is 133 out of 365, which is equivalent to about 36%. In terms of temperature projection for the mid-21st century (2036-2065), an additional increase of up to 1.3°C and 1.7°C were projected for the RCP 4.5 and RCP 8.5 scenarios, respectively. For the late 21st century (2070-2099), it is expected that the cluster will experience an increase of up to 1.7°C for the RCP 4.5 scenario, or up to 3.3°C for the RCP 8.5 scenario. In terms of the rainfall projection for the mid-21st century (2036-2065), the amount will generally decrease by 1 mm to 40.9 mm for the RCP 4.5 scenario. For the RCP 8.5 scenario, the amount will decrease only for two seasons, in DJF and SON. There will be an increase for MMA and JJA. For the late 21st century, the largest decrease will be during the SON season for both the scenarios. An increase is expected during the MAM season.

Topography

Majority or about 79% of the total area of the Cluster 7 River Basin are located in relatively low elevation (0 to 400 masl elevation range). Only about 1% are in elevation above 1,000 masl. Meanwhile, about 65% of the total area are in level slopes to moderate slopes. The most frequent slope class is 8%-18% or moderate slopes, covering about 35% of the Cluster.

Soils and Geology

There are 13 soil types present in the Cluster 7 River Basin. The most dominant soil type is undifferentiated mountain soil covering 51% of the total area. It is followed by Pasonanca loam and Bulacan clay loam, which encompass 15% and 12% respectively. In terms of geology, there are nine distinct geologic formations underlying the area. Additionally, there is one fault system that traverses the river basins, namely the Zamboanga Fault System.

Water Resources

With six principal river basins and 26 minor watersheds, the Cluster consists of numerous tributaries; however, the only available streamflow records obtained are from Tumaga

River. The drainage area is around 210.5 km^2. Based on the available data, the annual average flow is about 5.46 m^3/s. By frequency analysis using Log-Pearson Type III, the 80% dependable monthly flow ranges from a low of 1.66 m^3/s during March to a high of 4.95 m^3/s in October, with an average annual dependable flow of 3.01 m^3/s or about 324.34 MCM/yr. In terms of groundwater, the Cluster is comprised of local and less productive aquifers (43%), rocks without any significant groundwater (36%), and rocks with limited potential (21%). The NWRB classifies Zamboanga City as one of the areas with stressed groundwater. Using the latest PAGASA climate projections, it is estimated that by 2050, groundwater development potential or the total extractable groundwater from the aquifers in the river basin is about 28.5 MCM/yr.

Land Classification and Land Cover

Most of the Cluster 7 River Basin is classified as forestlands (65%), with only 35% of the area classified as alienable and disposable. The most dominant land cover in the area is perennial crops, encompassing about 36% of the Cluster. It is followed by brush/shrubs (31%), closed forest (10%) and grasslands (9%). In terms of land cover change analysis from 2010 to 2015, grasslands increased by 4,527 ha and mangrove forests by 832 ha. Both the closed forests and open forests decreased in 2015 by 1,153 ha and 530 ha, respectively.

Natural Hazards

About 18% of the area or 17,667 ha of the Cluster 7 River Basin is very highly susceptible to flooding. Among the barangays largely affected by this hazard are Tumaga, Tolosa, Sibulao (Caruan), Bunguiao and Curuan.

In terms of landslide, the Cluster has a larger area susceptible to rainfall-induced than with earthquake-induced. About 71% of the total area are highly susceptible to rainfall-induced landslide. Meanwhile, about 10% of the Cluster are very highly susceptible to earthquake-induced landslide, and 33% are classified as highly susceptible.

For storm surge events, about 216 ha are highly susceptible to 2-m inundation (A1 Alert Level), while 1,413 ha are moderately susceptible. For at least 5-m inundation (A4 Alert Level), about 4,177 ha are highly susceptible within the Cluster, while 1,379 ha are moderately susceptible.

About 10,126 ha of the Cluster are classified as susceptible to tsunami. This area includes the portions of the barangays Ayala, La Paz, Tulungatung, Bolong, Curuan, Buenavista, Latuan (Curuan), Manicahan, Arena Blanco, Boalan, Divisoria, Guiwan, Mampang, Mercedes, Pasonanca, Putik, Santa Maria, Talon-talon, Tetuan, Tugbungan Tumaga, Zambowood, Limaong, Mangusu and Vitali.

The Cluster experienced severe drought impacts in 1982-1983, 1997-1998 and 1987-1988. These periods were also those recorded as the worst El Niño experiences in the Philippines between 1977 and 2000. In more recent years, the 2014-2016 El Niño event significantly affected Zamboanga City. It was reported that out of the 25 irrigation dams in the area, nine dried up, six were in critical conditions and 10 were below the normal water level.

In terms of tropical cylones, among those that have affected the area are Typhoon Violet in 1955 and Typhoon Vinta in 2017. In general, Mindanao has a low occurrence of tropical cyclones, but despite this, its indirect effects such as rains and strong winds are experienced.

5.2 Bioecological Profile

The importance of the biological diversity of the Cluster 7 River Basin is evidenced by the presence of several conservation and special interest sites in the area. Among these are two protected areas, including the Pasonanca Natural Park, one key biodiversity area, and several wetland areas.

As listed, the Pasonanca Natural Park is dominated by 70 tree species belonging to 30 families. Nine of these species are endemic to the Philippines, while 14 species are listed as threatened. In terms of faunal diversity, the park is home to numerous species of birds, mammals, amphibians and reptiles. There are at least 39 bird species, 24 mammal species, 44 amphibian species, and 71 reptile species. Some of which are considered as threatened.

The area is also rich in coastal resources, from seagrasses, corals and fishes to mangrove forests. Zamboanga City has an approximate coastal length of 208 km. There are eight species of seagrasses covering 5,436 ha, 4,367 ha of corals, 16 species of mangroves, and at least 86 species of fishes. The city is likewise considered as the Sardines Capital of the Philippines.

5.3 Demographic Profile

Based on the 2015 Census, the Cluster 7 River Basin has an estimated population of 715,435. Among the barangays that comprise the river basins, the most populous are Talon-talon and Mampang with 34,916 and 34,312 respectively. The two barangays are both in Tumaga river basin, which is the largest in the cluster in terms of estimated population. The least populous among the six is Manicahan with an estimated population of only 29,180. The population in the Cluster is expected to continuously increase over the years, but at a decreasing rate. By 2045, the estimated population is expected to reach 1,086,859. The estimated population density of Zamboanga City is at 609 persons/km^2.

The area has an expansive population pyramid, which indicates a younger population. It also siginifies that the Cluster 7 river basins and watersheds will experience population growth through time, especially when the younger segment of the population enters their reproductive stage.

5.4 Socio-economic Profile

Settlement Pattern

In 2015, the urbanization level of Zamboanga City is 85.6%. From 2007 to 2010, the urban population within the Cluster 7 River Basin increased. This is possibly because urban areas generally have better access to basic services. Per river basin, more than 50% of the population of Ayala, Bolong, Manicahan and Tumaga reside in urban barangays. The river basin with the largest urban population is Tumaga. Only Curuan and Vitali-Taguite river basins have residents that mostly reside in the rural areas.

Cultural Patterns

The population of Cluster 7 is primarily composed of Zamboangeño Chavacano, which comprise 38% of the total population. It is followed by the Tausug, a dominant ethnic group in the Sulu Archipelago, which comprise 22%. Other ethnic groups are Bisaya, Samal, Yakan, Sama Bangingi, Hiligaynon, Ilonggo, Tagalog, Cebuan, Subanen, Ilocano, Badjao, Sama Badjao, Chinese and Sama Laut. In terms of religious affiliation, the most dominant among the population of Zamboanga City is Roman Catholicism comprising 60%, followed by Islam with 35% of the population as members. Other Christian denominations comprise about 4%, among others.

Housing Tenure

About 48% of the households in Zamboanga City own their house. 10% of the households rent their house or room, including lot, and another 6% own a house, but rent the lot. This data on property ownership can be an indicator for household participation, especially in activities on watershed management.

Energy Consumption

Majority or 88% of the households use electricity for lighting. About 9% use kerosene, while others use other sources, such as LPG, oil, solar panel and solar lamp. About 489 households in the city do not have any source of lighting.

Health

The leading causes of morbidity in the Zamboanga Peninsula include acute respiratory infection, hypertension and ALTRI and pneumonia. In terms of death rate, the number of deaths per 1,000 population in 2017 is 4,391, where 2,537 are male

Literacy and Education

The average literacy rate in Zamboanga City for both sexes is 97%. Most of the population in Cluster 7 are elementary (10%) and high school (15%) graduates or at least have reached these levels; 26% are elementary undergraduates and 15% are high school undergraduates. About 11% of the population or 87,756 are academic degree holders, while 13% are college undergraduates.

Poverty and Subsistence

The 2012 poverty incidence estimate for Zamboanga City was 12.6%, which is lower than the 26.3% national average. This is likewise an improvement than in 2009, which was 19.9%. Meanwhile, in the two municipalities of Zamboanga del Norte, where some areas of Vitali-Taguite river basin is located, the poverty incidence estimates are higher. In 2012, Sibuco had a poverty incidence of 67.2%, while Sirawai had 41.5%.

In 2015, the food threshold reported for Zamboanga del Sur, where Zamboanga City is statistically grouped, was Php 13,949. The subsistence incidence estimate among population is 7.5%. The estimate is lower in comparison with the national average for 2015, which was 8.1%.

Human Development Index

Human Development Index (HDI) is a measure for human development, which focuses on three dimensions, namely health, education, and income. The 2012 HDI of the area was valued at 0.56, which is lower than the national estimate of 0.64. This implies that the government needs to improve its delivery of basic services to areas within the Cluster.

Employment

The employment rate in the area area is relatively high (95.7%). The underemployment rate is 9.2%. Most of the gainful workers in the area are employed as service and sales workers (54,172 individuals). It is followed by those with elementary occupations (17%) and skilled workers in the agriculture, forestry and fishery sector (17%).

Sectoral Production

Historically, there is an increasing volume of production for corn from 2007 to 2017. For rice production, the trend was slightly decreasing from 2015 to 2017. For the top five other crops, the production of coconut decreased, while cassava production increased. The volume of production for banana *Saba* and mango remained stable over the years. In terms of fisheries production, the trend for commercial fisheries is decreasing. In contrast, production from aquaculture and municipal fisheries have slightly increased from 2007 to 2012. For tourism, records from 2011 to 2017 have shown that tourist arrivals in Zamboanga City have increased over the years, especially from domestic travelers.

5.5 Infrastructure

Educational Facilities

For the school year 2015-2016, there are 21 pre-school facilities within the area, 223 elementary schools and 71 secondary schools. For higher education, there are 18 tertiary schools in the City and there are 34 technical and vocational schools. The student-classroom ratio for elementary is 43:1 and for secondary is 45:1, which are also both within the standard set by DepEd.

Health Facilities

There are 13 medical hospitals within the area. Among these hospitals, six are owned by the government, while seven are privately owned. In addition to the hospitals, there are also rural health units (RHU) in the area. In 2015, Zamboanga City barangays with existing RHUs include Ayala, Calarian, Canelar, Curuan, Guiwan, Labuan, Manicahan, Mercedes, Sangali, Sta. Catalina, Sta. Maria, Talon-Talon, Tetuan, Tumaga, Vitali and Baliwasan.

Roads and Bridges

The total length of national roads in Zamboanga City is 146.12 km. A total of 33.96 km and 18.52 km are described with poor and bad conditions, respectively. The rest are in either fair or good conidition. The total number of national bridges in Zamboanga City is 49, which has a total length of 1,475 lm. Over half of these bridges (51%) are in good condition while others (47%) have fair condition, and only one bridge is described with poor condition.

Evacuation Centers

There are about 44 evacuation centers within and around the watersheds as listed by DSWD in 2015. Most of the facilities used for evacuation are gyms. Meanwhile, DPWH Region IX listed one evacuation center in Cabatangan, Zamboanga City.

Water Supply

About 96% of households in the area have access to improved safe water supply. Majority (74%) of these households have access to Level 3 water supply, while 14% and 12% have access to levels 2 and 1 water supply respectively. The water supply for cooking and drinking in Cluster 7 is usually sourced from own use faucets or community water systems. The main water distributor in the area is the Zamboanga City Water District.

Dams and Irrigation

There is currently one operational dam located in Manicahan river basin that was established through a LWUA loan. Other similar structures are located in Bolong river basin, namely Bonguioa Dam, and the Guiwan Overflow Dam in the Tumaga river basin.

Sanitation Facilities

Presently, the City operates a 10.6-ha sanitary landfill situated at Brgy. Salaan. The said facility is designed to receive about 200 tons per day of solid waste from the City for 15 years. Its operation started on March 31, 2015. The City also operates a Styro/Plastic densifier and grinding machine used to recycle about 40 kg of styro, converting them to about 60 block/pavers per day. Also, there are 31 Materials Recovery Facilities (MRFs) within and around the area for separating, processing and preparing recyclables to bring it back into the market.

Communication

There is currently an insufficiency in the number of information and communication facilities and network in the area. Out of the 175,010 households of Zamboanga City in 2010, only 15,755 have access to internet. Also, major communication lines in the City only pass through one path, which makes the possibility of complete communication line issue high in the event of disasters.

Financial Institutions

The financial institutions within and around the Cluster 7 river basins include 120 banks (as of 2015) and 265 pawnshops (as of 2012). The presence of banks in the area plays an important role in socioeconomic development.

Energy

The primary provider of electricity is the National Power Corporation (NPC) complemented with several other independent power producers. The Zamboanga Electric Cooperative (ZAMCELCO) is the main power distributor. ZAMCELCO has seven substations in Zamboanga City. Other power providers in the area include AMORE and ZAMSURECO 2. In 2014, ZAMCELCO was able to serve 90 barangays. As of 2016, there are 12 power plants in Zamboanga City.

Transportation

In terms of intra-urban transportation, land travel within the city is usually through tricycles, PUVs and private cars. In addition, there are also buses in the area, stationed at the Integrated Bus Terminal at Brgy. Divisoria. The two main entry and exit points are Zamboanga City-Labuan-Limpapa Road and the Pagadian-Zamboanga City Road. For inter-urban transportation, travel methods include land, air and sea, depending on the destination. The city is likewise connected internationally through the Zamboanga

International Airport. Other than air travel, the city has a seaport, the port of Zamboanga, which serves as link to neighboring Southeast Asian countries.

5.6 Land Capability Assessment

The land capability zoning output for the observed rainfall scenario summarize the basis for the allocation of lands. The strict protection areas comprise about 7% of the total land area in the Cluster. The agroforestry zone covers about 40% of the Cluster or 39,624 ha. The limited production zone covers about 5%, while the strict protection zone covers 7% or 6,291 ha. The combination of the two buffer zones only comprises about 0.3%. Lastly, the unlimited production zone comprises about 48% of the total area or about 46,926 ha. The 2050 and 2085 land capability zones were also obtained using the rainfall projections obtained from PAGASA.

5.7 Stakeholder Analysis

Based from the FGDs, there are at least 33 major stakeholders in the Cluster. These stakeholders were grouped into three categories: user groups, mediating groups, and external interest groups. Seven of which are classified as user groups, 17, which are mostly government offices, are placed under mediating groups, and at least nine were identified as external interest groups.

At least 13 motives that cement alliances were identified. These are water quality, social responsibility and community participation, economic interests, livelihood, policy and programs, protected area management, irrigation and water system, 4Ps, National Greening Program, assistance to LGUs, planting materials and seminars, conflict resolution, and fertilization program. Meanwhile, sources of conflict include use of land resources, resistance from the community and problems in terms of social perception, access to irrigation, water contamination, environmental sanitation and protection/destruction, land use and river protection, land boundary issues, and development projects in susceptibe areas.

In terms of importance and influence, 23 stakeholders are identified as both very important and highly influential. Six are classified as important and less influential. These six stakeholders are said to be marginalized; thus, they must be included in the various interventions for the river basin.

5.8 Policy and Institutional Assessment

Many policies encompass the management of the river basin, including the Sustainable Development Goals (2015-2030), Philippine Development Plan (2011-2016), Mindanao Strategic Development Framework (2010-2020), Sustainable National Action Plan (2009-2019), National Climate Change Action Plan (2011-2028), Philippine Strategy for Sustainable Development (1999), etc. These policies have a goal to improve the quality of life through poverty alleviation, sustainable development, capacity building, disaster risk reduction, and climate change adaptation.

These frameworks 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 IWRM by GWP. Its 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 focus of this project.

Various key government agencies from national and subnational levels play crucial 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, forest ecosystem and biodiversity, 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, it is proposed that there must be a coordinating mechanism that would harmonize the initiatives in the river basin. This should be accompanied by a coordinating body to facilitate delivery of goods and services for the stakeholders as well as provide mechanisms for conflict resolution.

5.9 Vulnerability Assessment

5.9.1 Hazard Vulnerability Assessment

The vulnerability of the Cluster 7 River Basin to three hazards, namely, flooding, landslide, and storm surge were assessed. In terms of flooding, around 5% (4,808 hectares) of the entire cluster were classified to be vulnerable. These vulnerable areas are mostly within Zamboanga City, which is situated along the east coast of the Peninsula. Barangays with the largest areas classified as highly vulnerable are Bolong, Cabaluay and Mercedes

In terms of landslide, approximately 4% of the cluster is classified as highly vulnerable in terms of landslide. Most of these highly vulnerable areas are located in Zamboanga City, wherein Vitali has the largest area with 1,339 hectares.

In terms of vulnerability to storm surge, roughly 1% of the Cluster is characterized as highly vulnerable. This area is just confined to the coastal barangays of Zamboanga City. The most vulnerable barangays are Mampang and Mercedes.

5.9.2 Vulnerability of Water Resources

It is assumed that the domestic and industrial water demands will be sourced mainly from groundwater, while the agricultural water demands will be subtracted from the surface water supply. The estimated agricultural water demands for 2030 and 2050 are still within but very close to the capacity of the surface water sources at 80% dependable flow. Under such condition, reservoir type irrigation systems should be studied for implementation to take advantage of the high streamflow during the rainy season.

If the conservative scenario domestic and industrial water demand projections were used, it would translate to a water demand of 44.5 MCM/yr in 2030 and 84.5 MCM/yr in 2050. These values are way more than the estimated groundwater availability of 19.5 and 28.5 MCM/yr in 2030 (taken from the present groundwater availability) and 2050, respectively, based only on 5% recharge from the annual rainfall.

5.9.3 Participatory Risk and Vulnerability Assessment

The risk evaluation for the whole river basin was arrived at by assigning a numerical value for the degree of likelihood and consequences. Using these values, the degree of likelihood and consequences for each risk event was assessed. Results show that flood and drought pose the highest risk in Cluster 7, followed by landslide and tsunami. Flood, drough and landslide were assessed as high-risk events, which calls for high priority control measures. On the other hand, tsunami was assessed as moderate-risk event.

6 MANAGEMENT AND DEVELOPMENT PLAN

6.1 Vision

The vision statement for the Cluster 7 River Basin was crafted using the keywords from the inter-agency focus group discussion. It was made in accordance to an integrated river basin management approach. The stakeholders agreed to the following vision statement:

> *"A sustainable, well-managed, productive and resilient cluster of watersheds supporting a balanced ecosystem with empowered communities while sustaining its multiple uses"*

The statement highlights the need for empowered stakeholders in taking care of the watersheds. Moreover, it recognizes the importance of economic growth and human development, without compromising the environment.

6.2 Mission

For the Cluster 7 River Basin, the mission statements were likewise crafted during the focus group discussions. The mission statements for the whole cluster, as listed by the stakeholders from the inter-agency FGD, are as follows:

- *To institutionalize partnerships and collaborations among stakeholders*
- *To implement research activities*
- *To conduct reforestation activities*
- *To provide tourism development activities*
- *To strengthen the community and promote inclusive development*

6.3 Development Issues and Challenges

6.3.1 Forest Ecosystem and Biodiversity Management

For this thematic area, the central problem identified is forest ecosystem degradation. It is brought about by inadequate vegetation cover, soil erosion, low public awareness and biodiversity loss. In 2015, the forest cover in the Cluster is estimated to be about 17.83%, which is a reduction of about 11% or 1,589 ha from the 2010 forest cover. This is also

identified as the primary cause for biodiversity loss in the area. This inadequacy in vegetation cover is a result of various issues, such as land conversion, illegal logging and forest fires, as well as rapid population growth and poor law enforcement. Primarily, the effects of the central problem are increased occurrence of risk events, decreased soil productivity, decreased water supply and environmental pollution.

6.3.2 Water Resources Management

The foremost problem for water resources in Cluster 7 is the threatened water supply. According to the results of the studies done, this is caused by various issues, such as water contamination, high water turbidity, decreased groundwater, saltwater intrusion, decreased streamflow discharge, and lack of investments to water infrastructures and facilities. Further, these causes are results of other issues that range from rapid population growth to pollution, deforestation and drought, among others. The NWRB also classifies Zamboanga City as one of the cities with stressed groundwater. Based from the projection, the estimated population of the cluster will generally increase from about 715,435 in 2015 to about 1,086,859 by 2045. This scenario leads to greater demand for water resources. As projected using a conservative scenario, domestic and industrial demand is expected to reach 44.5 MCM/year in 2030 and 84.5 MCM/year in 2050, which are more than the estimated groundwater availability of 19.5 MCM/year and 28.5 MCM/year, respectively. In terms of agricultural water demand, the projected values are still within, but are very close to the capacity of the surface water sources at 80% dependable flow.

6.3.3 Wetland Management

In terms of wetlands in Cluster 7, the foremost problem identified is wetland degradation. The causes of which include siltation, wetland conversion, invasive alien species and pollution. Siltation happens because of riverbank or soil surface erosion. Wetland conversion, on one hand, is caused by deforestation and illegal settlement. Meanwhile, unsustainable practices, particularly in agriculture and aquaculture, have resulted to the introduction of invasive alien species. These practices, together with improper waste disposal have resulted to environmental pollution, which degrades the wetlands. The effects of such wetland degradation include biodiversity loss, decreased ecosystem health and resilience, decreased fishery production and eutrophication. These effects further lead to a decrease in income, price increase and an increase in household expenses.

6.3.4 Disaster Risk Reduction and Management

The core problem besetting DRRM is the increasing number of people affected by disasters. This is said to be caused by various issues, which include insufficient facilities and equipment, insufficient IEC programs and climate change, among others. Other major causes are the presence of non-adaptive structures, weak zoning implementation and illegal settlement, which are results of weak law enforcement and rapid population growth. Among the disasters that affect the area are tsunami, landslide, flooding, drought, earthquake, heavy rains and tropical cyclones. The increase in the number of people affected by disasters results to numerous problems that include loss of lives, suspension of work and classes, damages to infrastructures, increase in health risks and damages to

agriculture. All these effects further result to several socioeconomic problems, such as interruption of social service delivery, increased government spending and increase in household expenses.

6.3.5 Economic Development

The core problem for the economic aspects of the Cluster is poverty. Its primary cause is the limited/low income in the area. This is a result of the limited livelihood and employment opportunities, which is caused by numerous issues in the river basin cluster. Among these are the insufficient economic development programs, limited investments because of the lack of incentives, peace and order situation, poor tourism industry, and damages brought about by climate change impacts. The effects of poverty that must be addressed are the increase in criminal activities and the limited resources for adaptation, which can lead to increased vulnerability of the population.

6.3.6 Institutional Development

The core institutional problem for Cluster 7 is the weak capacity of organizations. This weak capacity is brought about by four major causes, namely unresolved conflicts (i.e. peace and order situation), weak mechanisms for public consultations, weak inter-agency coordinating mechanisms and weak technical capacity of public sector agencies. The effects of this weak organizational capacity are poor enforcement of policies and inefficiency in the delivery of basic services. Both of which lead to improperly managed natural resources and hampered development, which can ultimately result to poverty.

6.4 Implementation Plan

6.4.1 Initial Identification of Preferred Measures

PAPs refer to specific programs, activities and projects that are designed to contribute to the attainment of set targets once implemented fully. The selected preferred measures and PAPs without saying are climate proofed having been selected based on the future targets calibrated against the projected influences of ongoing PAPs and climate change on the future values of each indicator. It is implied that the preferred measures and PAPs have built in ability to adapt to climate change and reduce disaster risks associated with extreme rains, temperatures, and winds. The process consisted of six (6) steps that are briefly described below:

1. **Selection of Key Indicators**

   In order to facilitate the identification and selection of preferred measures and PAPs, key indicators were chosen from many possible indicators. A total of thirteen indicators were initially identified. From a long list of 11 indicators, only a total of 9 shortlisted key indicators were eventually chosen. These indicators were Water Stress Index, Fecal Coliform, Forest Cover, Soil Erosion Rate, Wetland Area (based on

Land Cover), Number of Vulnerable Barangays to Hazards, and Poverty Incidence. Baseline and targets were then determined.

2. Identification of the Current PAPs

If implemented fully and properly as planned originally by concerned agencies, the current PAPs are expected to contribute positively in the attainment of the desired targets on improving forest cover, conserving biodiversity, improving water quality and availability, reducing poverty, DRR/CCA and other key targets of the government related to the Cluster 7.

3. Estimation of the Reference Case Values of the Key Indicators

The reference case values are the baseline values of the key indicators taking into consideration climate change and the influence of PAPs currently being implemented. Using the panel of experts, the reference values of the key indicators were estimated the results.

4. Estimation of the Gaps

Gaps here refer to the difference between the desired targets and the reference case values of the key indicators. Positive difference means that the current PAPs will contribute in the attainment of the desired targets for the key indicators. On the other hand, negative difference represents the additional increase in the original desired targets for a key indicator. This implies that the amount of investments required to attain the adjusted target for a key indicator will be greater to implement enhanced current PAPs or new additional PAPs.

5. Identification of Preferred Measures

After the adjusted targets for each key indicator were determined, potential measures with corresponding PAPs were identified by the panel of experts and research staff. Each of the measures were then rated by the panel on how many percentage points each of these measures will likely contribute in attaining the desired targets for each key indicator.

6.4.2 Identified Programs and Projects

Programs and projects were proposed for the Cluster 7 River Basin under each thematic area (Table 1). Cross-cutting projects were likewise considered.

Table 1. Programs and Projects for Cluster 7 River Basin.

Theme	Objective	Measure	Program/Project
Forest Ecosystem and Biodiversity	Stable and Productive Ecosystem	Forest Ecosystem Restoration	**Adaptive Forest Ecosystem Restoration Program**
			Conservation Farming Villages
			Conservation Forest Villages
Water Resources	Improvement of Water Quality and Availability	Suppy-side Management	**Supply-side Management Program**
			Rehabilitation/Restoration of Existing Communal Irrigation Systems
			Construction of Additional CIS or new NIS
			Construction of Small Reservoir Irrigation Projects

Theme	Objective	Measure	Program/Project
			Construction of Small-Scale Irrigation Systems (SSIPs); e.g. SWIPs, STWs
			Construction of rainwater collectors
			Installation of new deep wells and distribution systems
			Rehabilitation of existing systems and water supply facilities
			Construction of Bulk Water Supply
		Demand-side Management	**Demand-side Management Program**
			Improvement of irrigation water management
		Effective Waste Management	**Effective Waste Management Program**
			Effective Ecological Solid Waste Management
			Water Quality Monitoring System Project
			Installation of centralized/decentralized treatment plants
Wetland	Improvement of Sustainability and Resilience of Wetlands	Restoration and Protection of Wetlands	**Wetland Restoration and Protection Program**
			Biodiversity and ecological assessment of wetland areas
			Harmonized wetland conservation strategy
			Strict and consistent protection of wetlands
			Create an enabling environment for wetland restoration
			Site specific wetland restoration projects and best practice
			Coastal Resource Program
DRRM	Disaster Risk Reduction and Climate Change Adaptation	Improvement of Adaptive Capacity and Reduce Risks and Vulnerability	**Adaptive Capacity Development**
			Livelihood Development for Relocated Communities and Improvement of Literacy on DRRM
			Improvement of EWS
			Enhancement/Construction of Evacuation Centers
			Climate-Adaptive Hazard Mitigation Infrastructure Program
			Flood Control Project
			Slope Stabilization
			Relocation
Economic Development	Inclusive Economic Growth	Enhancement of Value Chain Systems	**Business, Enterprise and Education Development Program**
			Improvement of Marketing Systems
			Industry and enterprise development
			Cooperative development
			Livelihood development for marginalized sectors
			Increase access to higher education
			Sustainable Climate-Resilient Livelihood Program
			Climate-resilient agriculture projects
			Sustainable fisheries projects
			Infrastructure Development Program
			Improvement of Market Access and Infrastructure System
			Establishment and enhancement of post-harvest facilities

Theme	Objective	Measure	Program/Project
			Tourism Planning and Development Program
Institutional	Cross-cutting		**Creation of River Basin Coordinating Council**
			Induced River Basin Coordinating Council Formation
			Establishment and Operationalization of the River Basin Office
			Result-based Management System Development and MIS Development
			Various Capacity Development Interventions
			Watershed Monitoring Program
			Comprehensive Natural Resources Assessment and Monitoring
			Watershed Instrumentation
			Other Crosscutting Projects
			Gender Equity and Social Inclusion Program
			Cultural Impact Assessment
			Sustainable Financing Mechanism
			Master Plan Caravan/Roadshow
			Development of Curricula for DepEd and CHED
			Mainstreaming of CCA-DRR to Local Development Plans
			Feasibility assessment of the Cluster 7 Master Plan

6.5 Investment Plan

The investment plan indicates the budgetary requirements of the various programs and projects that were developed under the climate change-responsive Integrated River Basin Management and Development Master Plan (IRBMDMP) for Cluster 7 River Basin, which is composed of Ayala, Bolong, Curuan, Manicahan, Tumaga and Vitali-Taguite River Basins. To pursue the objectives set forth in the Management and Development Master Plan, five (5) thematic areas were identified: Forest Ecosystem and Biodiversity Management, Water Resources Management, Wetland Management, Disaster Risk Reduction and Management, and Economic Development. In addition, programs and projects that are cross-cutting in nature were likewise identified as they address concerns of more than one thematic area.

The total investment requirement of the Plan over a 15-year period is PhP 15.783 Billion, as shown in Table 2. Disaster Risk Reduction and Management has the highest funding requirement among the five thematic areas at PhP 10.053 Billion (63.7% of total), followed by Water Resources Management (26%), Forest Ecosystem and Biodiversity Management (3.9%), Crosscutting Programs (2.14%), Economic Development (2.12%), Wetland Management (1.9%).

Table 2. Total cost of proposed PAPs for the Cluster 7 River Basin.

Theme/Program/Project	Total Cost (PhP)
FOREST ECOSYSTEM AND BIODIVERSITY MANAGEMENT	
Adaptive Forest Ecosystem Restoration Program	
Conservation Farming Villages	488,808,750
Conservation Forest Villages	129,850,000
Subtotal	***618,658,750***
Total	**618,658,750**
WATER RESOURCES	
Supply-side Management Program	
Rehabilitation/Restoration of Existing Communal Irrigation Systems	1,605,193,920
Construction of Additional CIS or new NIS	659,689,000
Construction of Small Reservoir Irrigation Projects	963,000,000
Construction of Small-Scale Irrigation Systems	56,875,000
Construction of Rainwater Collectors	38,520,000
Installation of New Deep Wells and Distribution Systems	30,120,000
Rehabilitation of Existing Systems and Water Supply Facilities	15,060,000
Construction of Bulk Water Supply	214,000,000
Subtotal	***3,582,457,920***
Demand-side Management Program	
Improvement of Irrigation Water Management	32,500,000
Subtotal	***32,500,000***
Effective Waste Management Program	
Effective Ecological Solid Waste Management	2,000,000
Water Quality Monitoring System Project	42,000,000
Installation of Centralized/Decentralized Treatment Plants	480,000,000
Subtotal	***524,000,000***
Total	**4,138,957,920**
WETLAND MANAGEMENT	
Wetland Restoration and Protection Program	
Biodiversity and ecological assessment of wetland areas	20,000,000
Harmonized wetland conservation strategy	48,200,000
Strict and consistent protection of wetlands	68,700,000
Create an enabling environment for wetland restoration	21,000,000
Site specific wetland restoration projects and best practice	115,000,000
Subtotal	***272,900,000***
Coastal Resource Program	27,537,535
Subtotal	***27,537,535***
Total	**300,437,535**
DISASTER RISK REDUCTION AND MANAGEMENT	
Adaptive Capacity Development Program	
Livelihood Development for Relocated Communities and Improvement of Literacy on DRRM	1,500,000
Improvement of EWS	7,500,000
Enhancement/Construction of Evacuation Centers	30,000,000
Subtotal	***39,000,000***
Climate-Adaptive Hazard Mitigation Infrastructure Program	
Flood Control Project	6,332,244,454
Slope Stabilization	3,592,265,501
Relocation	90,000,000
Subtotal	***10,014,509,955***
Total	**10,053,509,955**
ECONOMIC DEVELOPMENT	
Business, Enterprise and Education Development Program	

Theme/Program/Project	Total Cost (PhP)
Improvement of Marketing Systems	9,000,000
Industry and Enterprise Development	9,000,000
Cooperative Development	9,000,000
Livelihood Development for Marginalized Sectors	9,000,000
Increase Access to Higher Education	9,000,000
Subtotal	***45,000,000***
Sustainable Climate-Resilient Livelihood Program	
Climate-Resilient Agriculture	59,500,000
Sustainable Fisheries	59,500,000
Subtotal	***119,000,000***
Infrastructure Development Program	
Improvement of Market Access and Infrastructure System	150,000,000
Establishment and Enhancement of Post-Harvest Facilities	10,000,000
Subtotal	***160,000,000***
Tourism Planning and Development Program	
Subtotal	***10,000,000***
Total	**334,000,000**
CROSSCUTTING PROGRAMS AND PROJECTS	
Creation of River Basin Coordinating Council	
Induced River Basin Coordinating Council Formation	700,000
Establishment and Operationalization of the River Basin Office	72,000,000
Result-based Management System Development and MIS Development	27,000,000
Various Capacity Development Interventions	5,000,000
Subtotal	***104,700,000***
Watershed Monitoring Program	
Comprehensive Natural Resources Assessment and Monitoring	56,250,000
Watershed Instrumentation	29,182,880
Subtotal	***85,432,880***
Other Crosscutting Projects	-
Gender Equity and Social Inclusion Program	7,480,000
Cultural Impact Assessment	30,000,000
Sustainable Financing Mechanism	20,000,000
Master Plan Caravan/Roadshow	12,000,000
Development of Curricula for DepEd and CHED	20,000,000
Mainstreaming of CCA-DRR to Local Development Plans	8,000,000
Feasibility assessment of the Cluster 7 Master Plan	50,000,000
Subtotal	***147,480,000***
Total	**337,612,881**
GRAND TOTAL	**15,783,177,041**