CLIMATE CHANGE-RESPONSIVE INTEGRATED RIVER BASIN MANAGEMENT AND DEVELOPMENT MASTER PLANS FOR THE 8 CLUSTERED RIVER BASINS

Executive Summary for Cluster 8
(Dipolog, Dapitan, Aloran, Clarin, Langaran, Oroquieta, and Palilan)

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1 Rationale

Pursuant to Executive Order (EO) Nos. 510, 816, and 50, the River Basin Control Office (RBCO) was created to be the lead government agency for integrated planning, management, rehabilitation, and development of the country's river basins. To achieve this mandate, the agency aims to develop a national master plan that will address several problems besetting the different river basins in the country such as flooding, land degradation, and decreased ecosystem services, among others. Also, the plan will ensure sustainable water supply for the Philippines.

In 2007, an integrated river basin management and development master plan was crafted identifying eighteen (18) major river basins in the country. These major river basins were adopted as priority areas of the government from the passing of Resolution No. 2012-001 on May 2, 2012 of the Cabinet Cluster on Climate Change Adaptation and Mitigation (CCAM).

In addition to these major river basins, 34 principal river basins were targeted for master plan formulation. These 34 river basins were clustered into eight (8). Cluster 8 River Basin, which is comprised of Aloran, Dipolog, Dapitan, Langaran, Palilan, Clarin, and Oroquieta Principal River Basins, is one of the target clusters of river basins.

2 Project Objectives

The objective of this project was to formulate the Integrated River Basin Management and Development Master Plan (IRBMDMP) of the Cluster 8 River Basin. The master plan took into consideration the biological diversity and the Cluster 8 River Basin's capacity to provide goods and services. The plan incorporated the implications of the new climate normals in addressing the concerns of the river basins on the following:

1. Water resources management;
2. Forest ecosystems and biodiversity 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 and Limitation

The project formulated the Integrated Management and Development Master Plan of the Cluster 8 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 was consisted of two phases, the scope of which included:

1. Profiling of the river basin and vulnerability assessment;
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 methods and approaches to accomplish the objectives (Figure 1). The following tasks were undertaken during the implementation of the project:

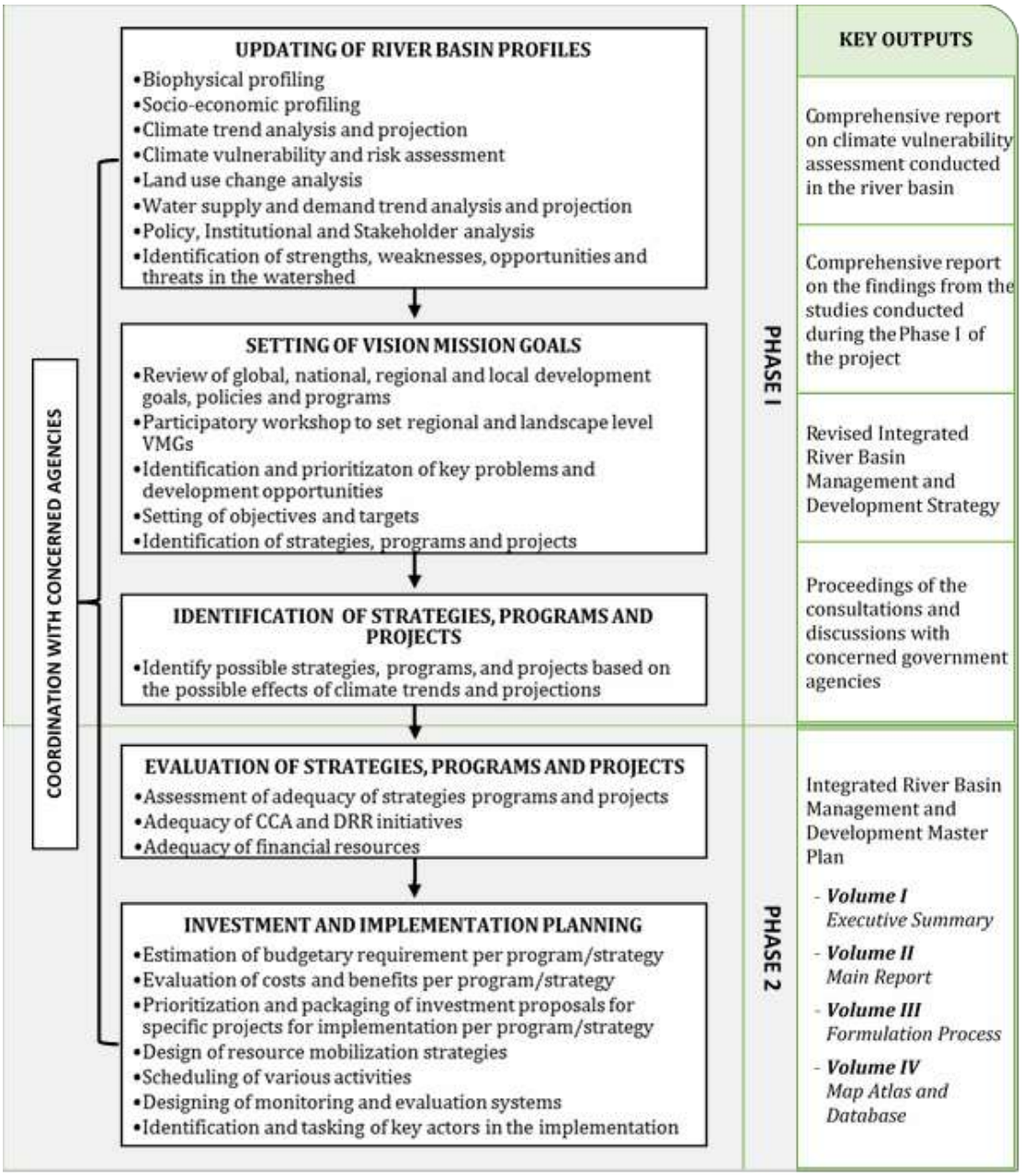

Figure 1. Flow of activities in the formulation of master plan for the Cluster 8 River Basin.

5 Assessment Reports

5.1 Geophysical Profile

5.1.1 Geographic Location

The Cluster 8 River Basin is situated at 8° 39' 3.31" to 8° 11' 1.14" north latitudes and 123° 19' 55.2" to 123° 51' 57.6"east longitudes. It is composed of seven (7) principal river basins and 26 minor watersheds. These principal river basins all have headwaters along Mt. Malindang. Namely, they are Dipolog, Dapitan, Aloran, Clarin, Langaran, Oroquieta, and Palilan principal river basins. The Cluster 8 principal river basins are located in Zamboanga Peninsula (Region IX) and Northern Mindanao (Region X) covering a total area of over 138,434 ha. Likewise, the cluster encompasses two (2) provinces, 25 municipalities, and 451 barangays.

5.1.2 Climate Trends

The Cluster 8 River Basin falls under a Tropical Rainforest Climate in the Köppen Climate Classification System. The historical data obtained from the Dipolog City Weather Station approximates the Cluster to have an average annual rainfall of about 2,352.9 mm. Monthly rainfall ranges from 82.5 mm to 380.9 mm. November has the highest monthly rainfall while March has the lowest. Overall, the mean monthly rainfall amount is about 196.07 mm. The highest average monthly temperature was observed during the month of May which was 26.3°C. Conversely, lowest average monthly temperature was 24.8°C for the month of January. The amount of rainfall in 2050 are projected to decline by about 4.9 mm to 16.7 mm all throughout the year aside from the months of June, July and August. During these months, the cluster is expected to have an increase of 16.4 mm rainfall. Therefore, in this scenario, it is expected that the Cluster 8 River Basin will have drier dry months in as much as wetter rainy months. On the other hand, the temperature in the Cluster 8 River Basin, on the average, is expected to increase by 1.21°C and 1.57°C on 2050 and 2085, respectively. The months of December, January and February have the most increase in both 2050 and 2085 projections, showing an increase of 1.29°C and 1.69°C, respectively.

5.1.3 Topography

Most areas in the cluster have an elevation of 0 to 200 meters above sea level (masl). A bulk of the cluster that has this elevation come from the Dipolog and Dapitan watersheds. These two watersheds, in total, have 51,137.1 ha of land area that is within the 0 to 200 masl elevation class. The other 30.85%, on the other hand, has an elevation ranging from 200 to 600 masl. The midstreams of all the watershed within the cluster have this elevation range. Finally, the 23.87% of the cluster is comprised by the land areas having more than 600 masl. Almost 20.72% of the area covered by the Cluster 8 watersheds belong to the 3% to 8% slope class which is considered to be in the gentle slope class. Likewise, about 18.32% of the cluster belong to the steep slope class. On the other hand, only about 2,988.60 or 2.16% of the whole cluster has a severely steep slope.

5.1.4 Soils and Geology

The most common soil series is the Castilla Soil Series, covering about 81,243.8 ha, which is about 58.69% of the entire cluster. On the contrary, beach sand is the least common soil type within the cluster. About 95.2 ha of the entire cluster soil is identified as hydrosol

which is about 0.08%. In terms of geological origins, most of the area (~52.05%) were formed chiefly by pyroclastics and/or volcanic debris at foot of volcanoes. Additionally, about 26.95% of the cluster originated from dacitic and andesitic plugs. These areas originate mainly from non-active cones that are generally pyroxene andesites. Conversely, only 0.02% or 22.61 ha of the cluster originated from sandstones, shales and reef limestone. These areas were from extensive mixed shelf marine deposits largely wackes with paralic coal.

5.1.5 Water Resources

The Cluster 8 River Basin has six (6) rivers with recorded streamflows. These rivers include the Aloran, Clarin, Dapitan, Jimenez, Langaran and Layawan Rivers. The Dapitan River has the highest dependable flow exceeding the total monthly dependable flows of any four of the five remaining rivers combined. Its dependable flow ranges from a low of 11.4 m^3/s during April to a high of 20 m^3/s during November with an annual average of 14.8 m^3/s. The annual rainfall projections were based from the latest PAGASA climate projections, using the median of RCP8.5 (high level of GHG emissions) condition. Only the projected changes in seasonal rainfall in the Mid-21st Century (2036-2065) were available from PAGASA. For 2050, the estimated projected annual rainfall is about 2039.7 mm and the groundwater development potential or the total extractable groundwater from the aquifers in the watershed is about 127.22 MCM/yr.

5.1.6 Land Classification and Land Cover

About 66.06% of the Cluster 8 River Basin is classified as alienable and disposable land. These are lands of the public domain, which have been the subject of the present system of classification and declared as not needed for forest purposes. Likewise, lands with 18 percent slope and below are classified as Alienable and Disposable (A and D) lands which may be released for non-forest purposes (agriculture, industrial and residential) subject to additional conditions such as contiguity of area and environmental considerations. Most of the cluster is identified as A and D since the majority of the cluster's slope ranges from level to rolling ($\geq$18%).

The land covers of the Cluster 8 River Basin in 2003, 2010, and 2015 were determined and compared. In the cluster, perennial crop is the major land cover type during the three aforementioned years. The perennial crop increased by 12.84% from 2003 to 2010 but decreased by 0.21% from 2010 to 2015. The next most common land cover type within the cluster is the closed broadleaved forest. This land cover type decreased by 15.57% from 2003 to 2010 and increased by 5.44% from 2010 to 2015. The inland water, on the other hand, covers the least area within the cluster only having about 0.03 ha in 2003. In 2010, the inland water consequently increased by about 97.53% thus covering an area of 1.22 ha. Another notable change in the land cover within the cluster is the annual crop which drastically decreased by 238.93% from 2003 to 2010. Nevertheless, this change was compensated by an increase of 33.78% from 2010 to 2015. The mangrove forest inside the cluster also experienced a decrease from 2003 to 2010 (166.55%) and an increase from 2010 to 2015 (69.17%). The only land cover type that constantly increased within the twelve-year observation period was the open broadleaved forest which increased by 2.10% and 2.74% from 2003 to 2010 and 2010 to 2015, respectively.

5.1.7 Natural Hazards

In the Cluster 8 River Basin, most of the area has high susceptibility to landslide. These areas comprise the 44.05% of the total land area of the cluster. Likewise, 11.98% of the Cluster 8 River Basin is very highly susceptible to earthquake-induced landslide. On the other side of the spectrum, 23.96% of the cluster has a low susceptibility to earthquake-induced landslide. Finally, the debris flow consists the least portion of the cluster accounting for the 0.10% of the entire area of the cluster. Conversely, 88.03% of the Cluster is not susceptible to flooding. Meanwhile, the other 11.97% is comprised of areas with low, moderate and high flood susceptibility.

Likewise, almost the entire Cluster 8 is not susceptible to storm surges. Therein, it shows that about 99.25% and 98.44% of the cluster is barely susceptible to SSA1 and SSA4, respectively. However, about 0.06% of the cluster has low susceptibility in SSA1 level and 0.15% in SSA4. Likewise, about 0.18% and 0.55% have medium susceptibility to SSA1 and SSA4, respectively. Finally, about 1.32% of the cluster is highly susceptible in SSA1 and about 0.05 in SSA4.

5.2 Bio-ecological Profile

The study observed a total of 294 tree species belonging to 28 families – two of which are gymnosperms. Moreover, the lower quadrats were dominated by Dipterocarps. Furthermore, the diversity of the area was also determined using Shannon's Diversity Index and gave an indication with respect to species variation or evenness. Five plots have moderate diversity while three have low diversity. Plots 1 and 6 showed the highest values indicating diverse species in the area (2.89 and 2.7, respectively).

In the faunal assessment, with 108 species, insects are the most abundant arthropod accounting for 84% of the total 129 arthropod species in Mt. Malindang. The remaining 16 percent is comprised of arachnids (14 species), crabs (3 species), centipedes (2 species), and millipedes (2 species).

Overall, a total of 129 species representing five arthropod classes are recorded. The insects comprise the biggest bulk with 14 groups. Namely, these groups are cockroaches, earwigs, grasshoppers, crickets, walking sticks, beetle, true bugs, true flies, mosquitoes, butterflies, moths, wasps, bees and ants. Class Arachnida recorded two taxa, namely spiders and daddy long legs, while Class Crustacea, Class Chilopoda, and Class Diplopoda each recorded only one taxon each. Among these, the true bugs (Order Hemiptera) and butterflies (Order Lepidoptera) are the two most diverse in Class Insecta constituting 37% of the total insect species in the area. On the other hand, spiders are the most diverse taxon under Class Arachnida comprising 93% of the total Arachnid species.

5.3 Demographic Profile

The Cluster 8 River Basin is comprised of 365 barangays with a total population of about 461,167 people as of the 2015 Census of Population and Housing by the Philippine Statistics Authority (PSA). The projected population of the two provinces appeared to be both increasing with time. In 2010, the said provinces totaled a population of about 1,543,800. Five years later, in 2015, the population was about 1,668,200. Moving forward, it is anticipated to be 2,316,500 in 2045. The population density for the entire river basin is 340 persons per square kilometer, which is a little higher than the national population density of 337 persons per square kilometer.

The number of live births in the provinces of Cluster 8 watersheds has a total of 20,707 annually. Based on the historical data from the PSA, the two provinces have an average birth rate of about 17.75. There a total of 3,863 deaths that was recorded that year. About 61.43% of which were from Zamboanga del Norte. Out of these deaths, 53 came from infant deaths with a rate of 2.35%. On the average, the death rate of the two province is approximately 3.65%.
On the average, females within the cluster are expected to live for about 71.36 years. On the other hand, males within the cluster have an average life expectancy of about 66.51 years. In terms of marital status, most of the residents, which is about 534,358, are classified as married. Meanwhile, about 528,383 residents are single during the conduct of the 2015 census. On the contrary, there are 1,210 people whose marital status is unknown. Additionally, about 17,197 are classified as divorced or separated.

Finally, most of the population is aged within the five to nine years. This age group encompasses about 91,166 people or approximately 10.75% of the total population. The second and third most number of population belong to the Under 5 and 10-14 age groups, respectively. This means that the overall population inside the cluster is relatively young.

5.4 Socio-Economic Profile

5.4.1 Settlement Pattern

Within the cluster, both in censal years 2007 and 2010, the population within the cluster are more concentrated in the rural areas than that of the urban area. Furthermore, it can be depicted that in the rural areas, within three years (from 2007 to 2010), the population increased by about 48,994 in Zamboanga del Norte and Misamis Occidental, cumulatively. On the other hand, the population increased by about 37,727 within three years in urban areas.

5.4.2 Language and Ethnicity

The provinces covered by the Cluster 8 River Basin appeared to have a diverse range of languages, dialects and ethnicity. The most common dialect that is being used within the cluster is Bisaya or Binisaya. This dialect comprises the 79.89% of the entire population. This is followed by the Cebuano which accounts for the 8.96% of the population within the cluster. Furthermore, the Subanen (also known as Subanon or Subanun), as the primary indigenous cultural community inside the cluster, accounts for the 6.67% of the population. Overall, there are 55 languages, dialects or ethnicity that are common within the two provinces covered by the Cluster 8 River Basin.

5.4.3 Land and House Tenure

Based on the 2015 statistics, there is about 57,083 residents within the cluster who own at least one land. Out of these residents, majority are from the Dipolog City accounting for the 14.74% or a total of about 8,415 land owners. It is followed by the Ozamiz City which has a 6,220 total number of land owners or about 10.90% of those who own at least land. Conversely, Concepcion, being one of the smallest municipalities inside the cluster, has the least number of land owners accounting for the other 1.00%.

Furthermore, out of the population who own their own houses, about 63.85% are purchased, while 20.97% are acquired through inheritance. Likewise, about 1.37% and 0.44% of these houses are acquired as gifts and as benefits from the company,

respectively. Moreover, among the purchased houses, about 89.20% are purchased through their own resources or through interest-free loans from their families or friends. These figures and numbers entail that the residents of the Cluster 8 River Basin tend to invest on houses rather than obtainingloans.

5.4.4 Energy Consumption

Majority (about 147,591 or ~78.26%) of the residents of the Cluster 8 River Basin rely on electricity for lighting. However, in 2010, roughly 39,600 (21%) of the population are still dependent on kerosene as their source of lighting. Further, almost about 0.48% of the entire population use either Liquefied Petroleum Gas (LPG), oil from vegetables and animals, or other energy sources to light their houses and establishments. Despite the good access to electricity inside the Cluster 8 River Basin, approximately about 85.27% of the entire cluster population is still dependent on wood and charcoal as their medium of cooking. Fuelwood and charcoal were perceived to be cheap and readily accessible resource in the watershed, thus, collection and production of these exerts pressures on the already scarce forest resources of the Cluster 8 River Basin. Meanwhile, almost about 22,541 residents or 11.95% already use LPG for cooking.

5.4.5 Literacy and Education

Within the Cluster 8 River Basin, majority of the residents are considered as literate. This means that the cluster has a very high literacy rate which entails a positive outlook for its residents. However, based on the 2015 Census, about 11,969 (1.63%) residents of Zamboanga del Norte and Misamis Occidental were identified as illiterate. Among this group, about 6,606 are males and 5,363 are females. On the other hand, the cluster has a relatively moderate level of education. Herein, about 70.63% of the population were able to finish elementary. Meanwhile, roughly around 41.95% of the population were able to finish secondary education. People within the cluster who were able to finish their tertiary education or college account for only about 21.28%.

5.4.6 Poverty Incidence

Between the two provinces covered by the Cluster 8 River Basin, Zamboanga del Norte recorded the highest poverty incidence (~60.30%) in 2006 and 2009. As a matter of fact, based on the official poverty statistics of the PSA, Zamboanga del Norte is actually one of the top ten provinces with the highest poverty incidence all throughout the Philippines. In 2015, the poverty incidence in Zamboanga del Norte declined from 48% in 2012 to 41.10%. On the other hand, the Misamis Occicental has a lower poverty incidence as compared to Zamboanga del Norte. The highest poverty incidence recorded in Misamis Occidental was in 2009 which is 37.9%.

5.4.7 Human Development Index

The mean HDI in the Cluster 8 River Basin provinces is highest in 2012. However, from 2006 to 2009, the HDI declined from, 0.45 to 0.43. This, therefore, implies the need for the government to further improve the delivery of basic services in order to improve the quality of life of people within the cluster.

5.4.8 Labor and Employment

Within the two regions encompassed by the Cluster 8 River Basin, about 5,920,000 individuals are part of the labor force which is about 60.35% of the total population. Among this, on the average, about 95.35% are employed. Meanwhile, out of the employed individuals, about 17.85% are said to be underemployed. Hence, the Regions IX and X, generally, have a good employment status.

5.4.9 Household Income and Expenditures

People within the Cluster 8 River Basin with an income of under PhP40,000 annually has an average income of PhP33,000 and an average expenditure of PhP23,000. Therefore, in this income class, there is a total savings of about PhP13,000 which is the lowest savings among the other income classes. Among all the income classes, people with income of PhP250,000 and over have the highest savings (~PhP319,000).

5.5 Infrastructure

5.5.1 Educational Facilities

According to the 2015 to 2016 statistics of the Department of Education (DepEd), there are about 646 public elementary schools within the municipalities and cities in the Cluster 8 River Basin. Additionally, there are around 104 public senior high schools within the cluster.

Collectively, for the Academic Year (A.Y.) 2015-2016, there were about 138,118 students who are enrolled in public elementary schools within the cluster. Majority of these students are in Grade 4 (~16.73%). Likewise, Dipolog City has the most number of students enrolled in a public elementary school totaling to 20,328 or about 14.72% of the entire cluster. Moreover, there were about 514 (~0.37%) students who were enrolled in the Special Education (SPED) program. The SPED caters for students who have special educational needs due to learning difficulties, physical disabilities or behavioral problems.

5.5.2 Health Facilities

According to the Department of Health (DOH), the five major cities inside the Cluster 8 River Basin have the most number of health facilities. Ozamiz City has the most number of health facilities having 21 barangay health stations, six (6) hospitals, two (2) drug abuse treatment and rehabilitation centers, five (5) birthing homes, and a rural health unit. Meanwhile, the Oroquieta City, Tangub City, Dipolog City and Dapitan City have 23, 17, 33 and 26 total number of licensed health facilities.

Overall, there are about 283 licensed health facilities with the Cluster 8 River Basin municipalities. Majority (~71.83%) of these health facilities are barangay health stations. Meanwhile, there are about 25 rural health units, 20 hospitals, 18 birthing homes, 14 infirmaries, and three (3) drug abuse treatment and rehabilitation centers.

5.5.3 Roads and Bridges

The Cluster 8 River Basin provinces have a five District Engineering Offices (DEO). The Zamboanga del Norte has three DEOs, while the Misamis Occidental has two DEOs. Based on the 2017 statistics of the Department of Public Works and Highways (DPWH), there is a total of 920.8 kilometers of national roads within the cluster. Most (46.90%) of the national roads in the five DEOs are concrete. The rest of the national roads are asphalt roads which is about 36.29%. On the other hand, roads made of gravel and earth constitute the 16.81% of the national roads within the five DEOs. Furthermore, about 59.52% of these national roads were assessed to have a fair to good conditions. On the other hand, about 25.88% of these roads are in bad to poor conditions. However, 14.60% of these roads were assessed by the DPWH.

5.5.4 Dam and Irrigation

There is an estimated total irrigable area of 45,086 ha within the cluster provinces. Out of these irrigable areas, about 17,907.20 ha are actually irrigated. These irrigated areas are mostly communal irrigation systems accounting for the 88.59% of the total service area. On the contrary, there is no National Irrigation System (NIS) within the two Cluster 8 River Basin provinces.

Only the Dipolog and Dapitan watersheds have dams within the Cluster 8 River Basin. Both of these dams are operational. However, both of these dams have loans from LWUA to sustain their operations. The dam in the Dipolog watershed is located in Polanco, Zamboanga del Norte. On the other hand, the dam in the Dapitan watershed is situated in the Dapitan City, Zamboanga del Norte.

5.5.5 Waste and sanitation

Most of the population within the Cluster 8 River Basin have a water-sealed sewer septic tank used exclusively by the household. These people comprise about 57.36% of the total population. People who use the pail system as a sanitation facility constitute the least portion of the population accounting for only 0.80% of the total cluster population.

Proper waste disposal is important because improperly stored refuse can cause health, safety and economic problems. Within the Cluster 8 River Basin, only 22.84% of the population dispose their refuses picked up by a garbage truck. Herein, majority (39.05%) use burning as their primary method of disposal which is not advisable since burning induces toxic greenhouse gases (GHG) that may adversely affect the atmosphere. Thus, this results to improper waste management and environmental pollution.

5.5.6 Financial Institutions

Access to finance refers to the availability of financial services like deposits, credits, payments, or insurance to individuals or enterprises. Financial access typically centers on the presence of financial institutions. As of 2015, collectively, there are 122 banks inside the cluster. Overall, there is about PhP52.11 billion worth of bank deposit liabilities in 2015. This increased by about PhP16.24 billion since 2013. On top of these banks, there are also 190 pawnshops within the cluster.

5.5.7 Communication

Aside from the telecommunication services, another major form of communication nowadays is through the use of internet. Within the Cluster 8 River Basin, only about 15.30% of the households have access to the internet. Among these, 29.65% have internet access at home while 70.35% have it from somewhere else. Conversely, 84.70% of the total number of households within the cluster do not have internet access yet during the census.

5.5.8 Evacuation Centers

As preparation to a number of hazards present in the Cluster 8 River Basin, it is necessary to have evacuation centers available. In total, there are collectively 283 evacuation centers that can accommodate the people within the cluster based on the records of Department of Interior Local Government (DILG) as of November 2017. Majority (30.08%)of the evacuation centers are situated in Clarin. Conversely, Sergio Osmeña has only one evacuation center available.

5.6 Land Capability Assessment

In the Cluster 8 River Basin, the protection buffer predominates among the land capability zones. This land capability zone comprises the 61.2% of the entire cluster, or about 117,236.5 hectares. The land capability zones output for the current rainfall scenario summarizes the basis for the allocation of lands. The strict protection in ARB comprises 1.38%, which is about 2,649.8 hectares. Further, areas under the unlimited production comprises 29.9% or 57,338.8 hectares. Agroforestry production covers 5.84%; limited production is 0.11%.

In the 2050 scenario, there is a significant increase in the areas classified as production buffer. From the zone with the second least area of coverage, it becomes the second most common land capability zone in the Cluster 8 River Basin. This zone increases by about 30% in 2050. Likewise, all other land capability zones other than the limited production changed – either increased or decreased. The limited production zone remained the same in terms of hectarage.

Furthermore, land capability zones for the 2085 rainfall scenario has minimal changes on the area covered per classification. There is a decrease of area covered under the unlimited production. This land capability zone has diminished about 1.76% land area. Conversely, agroforestry production has increased by 1.76%. Aside from these two land capability zones, all other zones remain the same comes 2085.

5.7 Stakeholder Analysis

There are 40 identified stakeholders for the Cluster 8 River Basin. Majority (60%) of these stakeholders are identified as the mediating institutions. On the other hand, the user groups and external interest groups constitute the 22.50% and 17.50% of the total number of stakeholders, respectively. Trying to coordinate with all of these stakeholders

In order to implement a watershed management program would be very difficult and would entail huge costs and logistics. It would also be very difficult to obtain a consensus from such a large group. These may result to inefficiencies that may result to unnecessary

delay of policy and management decisions. Thus, there is a need to identify key stakeholders within the watershed in order to stream line the procedures involved in the participatory process.

Six identified general categories of issues or motives create and cement stakeholder alliances in the Cluster 8 River Basin. These are resource access, power generation and distribution, water extraction and distribution, agriculture, forestry and fisheries, economic purposes, natural resource conservation, and environmental protection. Economic purposes, or reasons and motives that are directly economic in nature, are the main driving forces behind many of the alliances formed in the watershed

There are 12 stakeholders that are considered as very important with high influence. These include the water districts within the Cluster 8 River Basin, LGUs, DPWH, DA-BFAR, NIA, DSWD, PCA, AFP-PNP, coast guards and several local energy service providers. Any management or development plans should try to include these stakeholders in the implementation of river basin interventions to not only increase its chances of success but also increase its impacts.

5.8 Policy and Institutional Assessment

Many policies encompass the management of the river basin, including the Sustainable Development Goal (2015-2030), Philippine Development Plan (2017-2022), Mindanao Strategic Development Framework (2015-2045), National Climate Change Action Plan (2011-2028), Philippine Strategy for Sustainable Development (1999), etc. These policies have a single goal—to improve the quality of life through 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 Integrated Water Resources Management by Global Water Partnership whose main objective is to promote sustainable development of water resources at all levels and sectors. Was 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 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. The three main points in river basin governance: a) organizational structure of

River Basin Organizations, b) decentralization, relation of government units and ownership, and c) financing of River Basin Organizations must be regarded as requirements in their institutionalization.

6 Vulnerability Assessment

6.1 Hazard Vulnerability

The overall vulnerability was determined by integrating the sensitivity, exposure and adaptive capacity of each barangay per municipality in Cluster 8.

6.1.1 Flood

Result showed that most portions of the Cluster 8 River Basin is under low vulnerability to flooding. About 150,964 ha or 79% of the area of the river basin is under this category. Meanwhile, around 15,659 ha is under low vulnerability; 19,871 ha under the moderate; and 5,033 ha under high vulnerability. The assessment also shows that around 78 barangays of Cluster 8 have high vulnerability to flooding.

Provincial-wide, around 3,321 ha of Misamis Occidental that is inside the river basin have high vulnerability to flooding. Consequently, 10,109 ha is under the moderate vulnerability; 90, 358 ha under the low vulnerability; and 14, 427 ha under the very low vulnerability. On the other hand, in Zamboanga del Norte, around 1,232 ha is the very low vulnerability; 60,606 under low vulnerability; 9,762 ha under the moderate vulnerability; and 1,712 ha under the high vulnerability to flooding.

6.1.2 Landslide

The assessment shows that 22,673 ha of Cluster 8 River Basin are under the high vulnerability zone. Integrating the adaptive capacity and exposure data to the sensitivity of the Cluster shows that areas that could be affected by landslide decreased. Most of the barangays with high vulnerability to landslide are those with high sensitivity with low to moderate exposure, and moderate to high exposure.

In Misamis Occidental, those with high sensitivity, low adaptive capacity, moderate exposure, hence with high vulnerability are: Dapacan Alto, Calamba; Bagong Nayon, Maligubaan, and Pogan in Concepcion; Nueva Vista in Don Victoriano Chiongbian; and Buenavista in Oroquieta City. On the other hand, those with high vulnerability to landslide in Zamboanga del Norte are barangay Poblacion in Mutia; Masidlakon in Dapitan City; Mauswagon and Poblacion in La Libertad; Biayon and Poblacion Alto in Sergio Osmena; and Magsaysay and Sipaloc in Sibutad. These barangays are highly vulnerable because of their high sensitivity, low adaptive capacity, and moderate to high exposure.

6.1.3 Storm Surge

The assessment of the vulnerability of Cluster 8 to storm surge shows that about 2, 107 ha of Cluster 8 is highly vulnerable. In Misamis Occidental, Barangays with high vulnerability to storm surge are: Tuburan in Aloran; Lusot, Punta Miray, Punta Sulong and Sinian in Baliangao; Mialen and Poblacion I in Clarin; Butuay, Palilan, and Tabo-o in Jimenez; Pines, Poblacion I, San Vicente Bajo, Taboc Norte, Taboc Sur, and Talic in

Oroquieta City; Punta in Panaon; Bato, Looc Proper, Panalsalan, Southern Looc, Southern Poblacion, and Usocan in Plaridel; and Barra, Cabol-anonan, and Centro Napu in Tudela.

Meanwhile, in Zamboanga del Norte, only Dapitan City and Dipolog City have high vulnerability to storm surge. The covered barangays are Banonong, Dawo, Polo, Potol, San Pedro, and Sulangon in Dapitan City; and Barra, Biasong, Estaca, Minaog, Sicayab, and Turno in Dipolog City.

6.2 Participatory Risk and Vulnerability Assessment

Based from the data gathered from a series of Focus Group Discussions, it was found out that the Dipolog and Dapitan PRBs both have very high likelihood of experiencing flood and landslide. Likewise, these risk events are perceived to have a high impact on these principal river basins. In the case of the Clarin PRB, the risk events that were identified are heavy rains and flooding. These risk events are perceived to have a very high likelihood and a high impact on the Clarin PRB. Moreover, the same risk events with the Clarin PRB were identified in the Langaran PRB. However, the only difference is that the flooding herein has high consequence or impact on the Langaran PRB. In the case of the Oroquieta PRB, the risk events identified were heavy rains, flooding and drought. All these risk events are said to have a high likelihood of occurrence and a moderate impact on the PRB. Finally, for the Palilan PRB, landslide and flooding both have high likelihood and moderate impact on the PRB. Aside from these risk events, drought was also identified which is perceived to have a moderate likelihood of occurrence and a low impact on the people living therein.

6.3 Vulnerability of Water to Climate Change

For the projection of available water, the water demand projections were subtracted from the water supply projections for years 2030 and 2050. The surface water supply projection for the cluster was based on the 80% dependable flow of the six rivers. It will be assumed that the domestic and industrial water demands will be sourced mainly from groundwater with some secured from bulk water supply, while the agricultural water demands will be sourced largely from the surface water supply. The water demand within the Cluster 8 River Basin can be sufficiently provided by the six rivers based on 80% dependable flow estimate. In fact, the Dapitan River alone has enough flow (467 MCM/yr) to provide for the estimated agricultural water demands up to 2050 of Cluster 8. Similarly, the domestic and industrial water demands can adequately be provided without mining the groundwater storage in the cluster.

Overall, the watershed has an ample amount of water to provide for the domestic, industrial, and agricultural water demand projections for 2030 and 2050. To sustain the long term benefits to the farmers and communities, it is not too early to plan for sustainable use of land and water resources within the cluster.

6.4 Drought Analysis

The Standard Precipitation Index (SPI) was designed to quantify the precipitation deficit for multiple timescales. These timescales reflect the impact of drought on the availability of different water resources. Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow and reservoir storage reflect the longer-term precipitation anomalies. For the drought analysis of Cluster 8, 1-, 6-, and 12-month timescale were used.

Cluster 8 experienced moderate drought events with peak SPI value of -1.21 and an average SPI value of -0.54 for 6 months duration starting October 1993 to April 1994. This moderate drought recurred for 12 months duration starting November 1994 up to start of December 1995 having a peak SPI value of -1.74 and an average of -0.96. On June 1997 to January 1999, Cluster 8 experienced 19 months duration of extreme drought having a peak SPI value of -2.36 and an average of -1.63. This is the highest computed SPI value recorded for Cluster 8. The extreme drought event recurred with a duration of 21 months from January 2015 to October 2016 having a peak SPI value of -2.32 and an average value of -1.36.

6.4.1 2050 Meteorological Drought Forecast using 1-month SPI

Cluster 8 is expected to have nearly normal to moderately dry condition having an SPI value from -0.48 to 0.05. Cluster 8 will experience this condition for the entire year 2050 with a mild wet condition during the month of April 2050. This should be taken into consideration specially when dealing with crop production. This indicates that proper water management and soil moisture conservation should be observed to alleviate the effect of the prolong mild dryness.

6.4.2 2050 Agricultural Drought Forecast using 6-month SPI

Cluster 8 is expected to experience near normal to moderate dryness with SPI values ranging from -0.97 to -0.31. It can be seen that the mild to moderate agricultural drought will be predominant for the whole year of 2050 with peak SPI values on October.

6.4.3 2050 Hydrological and Socioeconomic Drought Forecast using 12-month SPI

Cluster 8 is expected to experience mild to moderate drought with SPI values ranging from -0.87 to 0.23. It can be seen that the mild to moderate hydrological and socioeconomic drought will start to be experienced from month of May and will last until December 2050.

7 Management and Development Plan

7.1 Vison

Several focus group discussions with stakeholders from multiple government agencies, peoples' organization, academe, regional and local government units were conducted to affirm the previously crafted vision, mission, and goals of the Cluster 8 River Basin. The vision statement for the Cluster 8 was made in accordance to the context of Integrated River Basin Management Strategy and was revised during the inter-agency focus group discussion. The stakeholders agreed to the following vision statement:

> "The Cluster 8 River Basin is envisioned to have a productive and healthy watershed, forest, and coastal resources managed by a resilient community together with well-equipped and empowered LGUs and environmental personnel to protect and conserve the resources towards sustaining the needs for the present and future generation."

7.2 Thematic Goals and Objectives

Similar to the updating of the vision, the mission statement for the Cluster 8 River Basin

was made in accordance to the context of Integrated River Basin Management Strategy and was revised during the inter-agency focus group discussion. The stakeholders agreed to the following thematic objective statements:

Table 1. Objective statement set by Cluster 8 River Basin stakeholders during several stakeholder meetings.

Thematic Area	Objective Statement
Water	A cluster of watersheds with sound water quality and reliable water supply.
Forest Ecosystem and Biodiversity	A stable and productive cluster of watersheds amidst the dynamicity of climate, and other natural and anthropogenic factors.
Wetland	Improved, sustainable, and resilient wetlands to sustain wetland and coastal resources.
Disaster Risk Reduction and Management	Reduced and well-managed disaster risks within the Cluster 8 River Basin and an empowered community towards climate change adaptation and mitigation.
Economic	A sustainable and well-equipped cluster of watersheds that promotes inclusive economic growth and development.

7.3 Integrated River Basin Management and Development

Formulated by RBCO in 2007, the Integrated River Basin Management and Development (IRBMD) Framework is the basic system used for all strategies in the Philippines on sustained river basin ecosystem management. It is further composed of four principal frameworks and development strategies, namely Integrated Water Resources Management, Integrated Watershed Management, Wetland Management, and Flood Mitigation (Figure 2).

Figure 2. The Integrated River Basin Management and Development Framework.

7.4 Development Issues and Challenges

7.4.1 Water Resources

Based on the data gathered from the conducted series of focus group discussions (FGDs), the stakeholders identified the depletion or degradation of water resources, both in terms of quality and quantity, as the one of the major issues of the Cluster 8 River Basin

Tracing down the root cause of the issue regarding the water supply degradation, the increasing temperature and more intense El Niño Southern Oscillation Cycles are the two hydrometeorological factors that primarily cause the insufficiency of water supply during dry seasons. Aside from these hydrometeorological factors, lack of awareness, financial constraints, and increasing population also contributes to the abovementioned issue which results to inefficient water use, underdeveloped or untapped water resources and increasing water demand, respectively.

On the other hand, the degradation of the water quality within the Cluster 8 River Basin is mainly caused by anthropogenic factors. These include unsustainable mining and quarrying (i.e. quarrying of sand and gravel), unsustainable agricultural practices (e.g. rampant kaingin), and illegal resource extraction activities (e.g. timber poaching and logging).

7.4.2 Forest Ecosystem and Biodiversity Management

In terms of the forest ecosystem and biodiversity management within the Cluster 8 River Basin, the core problem identified is the rampant degradation of the watershed resources. Watershed degradation can either be directly or indirectly caused by land conversion, increasing soil erosion and environmental pollution.
The same with the issues on water resources management, the environmental pollution that contributes on the watershed resources degradation is primarily caused by improper waste management due to lack of waste disposal facilities. Increasing soil erosion, on the other hand, may be caused by land conversion and unsustainable livelihood practices (e.g. mining, quarrying, *kaingin*, deforestation, etc.). These unsustainable practices, based from the stakeholders of the Cluster 8 River Basin, are caused by a weak implementation of environmental laws and plans. Aside from these, soil erosion is also elevated with the increasing rainfall intensity. Finally, the land conversion may be caused by several things – improper land use zoning, population displacement, upland migration and human-induced grass and forest fires. Improper land use zoning, on the one hand, may be a result of the absence of a River Basin Management Council and of the poor management of the watershed. Upland migration, on the other hand, may be caused by the increasing population within the Cluster 8 River Basin, inadequate livelihood opportunities and lack of capacity development of the IPs and POs. Finally, the human-induced wildfires are mainly caused by the rampant *kaingin* practices within the Cluster 8 River Basin which is amplified by the increasing temperature and increasing incidences of drought and dry spells.

7.4.3 Wetland Management

Wetland degradation is the major problem identified by the stakeholders of the Cluster 8 River Basin based on the series of FGDs conducted and the secondary data gathered. The three direct causes of this problem are wetland conversion, sedimentation and siltation of rivers, and environmental pollution.

In effect, the degradation of wetlands and wetland resources primarily leads to eutrophication which is the enrichment of water by nutrient salts that causes structural changes to the ecosystem such as: increased production of algae and aquatic plants, depletion of fish species, general deterioration of water quality and other effects that reduce and preclude use. Ergo, eutrophication, if not mitigated, may lead to a decrease in the fishery production. Likewise, wetland degradation may also result to the deterioration of the ecosystem health and resilience which will further lead to the wetland diversity loss.

7.4.4 Disaster Risk Reduction and Management

Inadequacy in the disaster risk reduction and management (DRRM) is one of the identified major problems within the Cluster 8 River Basin. Results from the series of FGDs and vulnerability assessments show that there are two reasons behind this issue. First, the Cluster 8 River Basin is inadequately resilient to climate risks. This is because of three reasons which include insufficient LGU or community resilience to climate change, insufficient hazard-mitigating structures, and insufficient climate resilient measures for climate-dependent economic activities. The underlying problem among these causes of lack in climate resilience of the Cluster 8 River Basin is the insufficiency of government funding and programs.

7.4.5 Economic Development

In terms of the economic development thematic area of the Cluster 8 River Basin, the core problem identified was the low economic growth and development in both Zamboanga del Norte and Misamis Occidental. This particular problem was brought about by different economic difficulties also being faced by the whole country. One of the causes is the heavy reliance on primary economic sector activities or those livelihoods highly dependent on the extraction and utilization of natural resources within the Cluster 8 River Basin. Consequently, even the agricultural, fishery, forestry and aquaculture productivity of the cluster are adversely affected. These contributing factors are mainly caused by the inadequate skills and technology development, infrastructure (e.g. farm-to-market roads), and climate-resilient measures for economic activities of the Cluster 8 River Basin. Uncovering the root cause of these problems through FGDs and community consultations points to the insufficiency in government funding and programs.

7.4.6 Institutional Development

The institutional foundation and linkages of the Cluster 8 River Basin is one of the thematic areas that need to be focused on. This thematic area dictates whether or not the plans and projects to address the problems in other themes will be implemented.

In the Cluster 8 River Basin, the core institutional problem identified was the weak implementation of the plans and policies. One of the factors that contribute to this problem is the lack of community consultation. This factor was traced down to the apathy of the Cluster 8 River Basin's stakeholders, low engagement capacity of the communities, and lack of engagement capacity of POs and NGOs.

7.5 Implementation Plan

Based on the identified problems and issues within the Cluster 8 River Basin, there is a total of 12 programs and 48 projects that were proposed by a panel of experts. These programs and projects are mainly based on the objectives set per thematic area of the Master Plan. For the Forest Ecosystem and Biodiversity Management, there is one (1) program which consisted of 3 projects under restoration and another project on ecosystem assessment and monitoring. The Wetland Management theme, on the other hand, has two (2) programs with 5 projects. For the Disaster Risk Reduction and Management theme, there are two (2) proposed programs with seven (7) projects. For the fifth thematic area, the Economic Development, there are three (3) proposed programs which are comprised of 12 projects.

Table 2. Different Projects per Thematic Area

Thematic Area	Objective	Measure	Program/ Project
Forest and Biodiversity Management	Stable and Productive River Basin	Forest Ecosystem Restoration	Forest Restoration Program • Conservation Forest Villages Project • Conservation Farming Villages Project • Adaptive FORESTORE Project
			Terrestrial Ecosystem Assessment and Monitoring Project
Water Resources Management	Reliable Water Supply	Demand-side Management	Water Supply Rehabilitation and Improvement Project
		Supply-side Management	Urban and Rural Rainwater Harvesting (RWH) Project
			Agricultural Rainwater Harvesting (RWH) Project
			Deep Wells Installation Project
	Sound Water Quality	Water Quality Monitoring and Management	Wastewater Management Project
			Water Quality Monitoring Project
		Effective Ecological Solid Waste Management	Ecological Waste Management Project
Wetland Management	Improved, sustainable, and resilient wetlands	Strengthen protection and implement wetland restoration	Wetland Restoration Program • Inland Wetland Biodiversity and Ecological Assessment Project • Inland Wetland Ecosystem Restoration Project • Integrated Coastal Resources Management Project
			Wetland Protection Program • Harmonized Wetland

Thematic Area	Objective	Measure	Program/ Project
			Conservation Project • Integrated Wetland Protection Project
Disaster Risk Reduction and Management	Reduced and well-managed disaster risks	Hydrometeorological Hazard Management	Resilient Disaster Mitigation Infrastructure Program • Resilient Evacuation Centers Project • Slope Stabilization Project • Climate-Adaptive Flood Management Project • Early Warning System Enhancement and Establishment Project
		Reduced Vulnerability to Climate Change	**Integrated Climate Change Adaptation and Resilience Program** • Community-based Disaster Preparedness and Climate Change Adaption Project • Integrated Project on DRR and CCA in Local Planning and Development • Climate Change and Disaster Human Mobility Project
Economic Development	Inclusive Economic Growth	Enhancement of value chain systems	Sustainable Climate-Resilient Livelihood Program • Sustainable Fisheries Development Project • Climate-Adaptive Agriculture Project • Post-Harvest, Value Addition and Marketing Enhancement Project
			Tourism Development Program • Tourism Resources Assessment and Planning Project • Community-based Ecotourism Project • Tourism Product Development and Promotion Project
			Business, Industry and Enterprise Development Program • Alternative Livelihood and Skills Development Project • Cooperative Development Project

Thematic Area	Objective	Measure	Program/ Project
			• MSME Support and Development Project
			Infrastructure Development Program • Renewable Energy Project • Infrastructure Enhancement Project • Communication Facilities Development Project
Institutional Development	A collaborative and institutionally capacitated cluster of watersheds		River Basin Monitoring and Information Program • PES Development Project • Results-Based Monitoring and Evaluation and MIS Development • Watershed Instrumentation Project
			Policy Implementation and Institutionalization Program • Feasibility Assessment of the Implementation of the Cluster 8 River Basin Master Plan • River Basin Coordinating Council Formation • Establishment of a River Basin Office • Strict Implementation of Laws and Policies Institutionalizing Collaborative and Integrated ENR Management
			Social Engagement Program • Capacity Building and Development Interventions • Gender and Social Development Project • Cultural Impact Assessment Project • Cluster 8 River Basin Master Plan Caravan/Roadshow Project • Development of Curricula for DepEd and CHED

7.6 Investment Plan

The total investment requirement of the plan over a 15-year period is about PHP56.34 billion. The Water Resources theme has the highest funding requirement among the six themes at PHP24.6 billion (44% of total), followed by Economic Development (PHP11.78

billion or 21% of total), Forest Ecosystems and Biodiversity Management (PHP9.76 billion or 17% of total), Wetland Management (PHP6.49 billion or 12% of total), Disaster Risk Reduction and Management (PHP3.53 billion or 6% of total), and Crosscutting Projects (PHP 169.99 million or 0.3% of total).

Table 3. Total cost of proposed programs and projects for the Cluster 8 River Basin Master Plan

Program and Project	Target Year	Total
Forest and Biodiversity Management		
Forest Restoration Program		
Conservation Farming Villages Program	1-15	5,725,284,337
Conservation Forest Villages Program	1-15	10,405,000
Adaptive FORESTORE Project	1-15	4,005,964,800
Terrestrial Ecosystem Monitoring	1-15	20,012,880
Subtotal (Theme)		***9,761,667,017***
Water Resources Management		
Water Supply Rehabilitation and Improvement Project	1-15	60,000,000
Urban and Rural Rainwater Harvesting Project	1-15	3,800,000,000
Agricultural Rainwater Harvesting Project	1-15	750,000,000
Deep wells installation Project	4-7	70,000,000
Wastewater Management Project	1-12	12,800,000,000
Water Quality Monitoring Project	1-7	7,000,000,000
Ecological Solid Waste Management Project	1-3	120,000,000
Subtotal (Theme)		***24,600,000,000***
Wetland Management		
Wetland Restoration Program		
Inland wetland biodiversity and ecological assessment Project	1-15	33,829,017
Inland wetland Ecosystem Restoration Project	1-15	3,267,509,584
Integrated Coastal Resources Management Project	1-15	3,089,000,000
Wetland Protection Program		
Harmonized wetland conservation Project	1-15	33,829,017
Integrated Wetland Protection Project	1-15	67,658,034
Subtotal (Theme)		***6,491,825,652***
Disaster Risk Reduction and Management		
Resilient Disaster Mitigation Infrastructure Program		
Resilient Evacuation Centers Project	1-15	625,000,000
Slope Stabilization Project	1-15	140,664,000
Climate-Adaptive Flood Management Project	1-15	396,233,200
Early Warning System Enhancement and Establishment Project	1-15	40,000,000
Integrated Climate Change Adaptation and Resilience Program		
Community-based Disaster Preparedness and Climate Change Adaption Project	1-15	122,700,000
Integrated Project on DRR and CCA in Local Planning and Development	1-3	250,000,000
Climate Change and Disaster Human Mobility Project	1-15	1,969,000,000
Subtotal (Theme)		***3,543,597,200***
Economic Development		
Sustainable Climate-Resilient Livelihood Program		
Sustainable Fisheries Project	1-15	240,900,000
Climate-Adaptive Agriculture Project	1-15	3,424,980,000
Post-Harvest, Value Addition and Marketing Enhancement Project	1-15	253,000,000
Tourism Development Program		
Tourism Resources Assessment and Planning Project	1-5	15,000,000
Community-based Ecotourism Project	1-15	68,000,000
Tourism Product Development and Promotion	1-5	20,000,000
Business, Industry and Enterprise Development Program		
Alternative Livelihood and Skills Development Project	1-15	409,000,000
Cooperative Development Project	1-15	91,250,000

Program and Project	Target Year	Total
MSME Support and Development Project	1-15	1,492,850,000
Infrastructure Development Program		
Renewable Energy Project	1-15	465,000,000
Infrastructure Enhancement Project	1-15	5,286,145,200
Communication Facilities Improvement Project	1-15	15,300,000
Subtotal (Theme)		***11,781,425,200***
Crosscutting Programs and Projects		
River Basin Monitoring and Information Program		
PES Development Project	1-15	20,000,000
Result-Based Management System Development and MIS Development Project	1-15	10,000,000
Watershed Instrumentation Project	1-15	20,012,880
Policy Implementation and Institutionalization Program		
Feasibility Assessment of the Implementation of the Cluster 8 River Basin Master Plan	0	25,000,000
River Basin Coordinating Council Formation	1-3	700,000
Establishment of the River Basin Office	1-7	7,000,000
Strict Implementation of Laws and Policies	1-3	9,500,000
Institutionalizing Collaborative and Integrated ENR Management	1-15	8,300,000
Social Engagement Program		
Capacity Building and Development Interventions	1-15	15,000,000
Gender and Social Development Project	1-15	7,480,000
Cultural Impact Assessment Project	1-15	15,000,000
Cluster 8 River Basin Master Plan Caravan/Roadshow Project	1-3	12,000,000
Development of Curricula for DepEd and CHED	6-8	20,000,000
Subtotal (Theme)		***169,992,880***
GRAND TOTAL		**56,168,507,949**