5.5 Kinanliman River Basin

5.5.1 Basin Conditions

(1) Natural Conditions

1) Existing River System and Structure

The catchment area of the Kinanliman River Basin is 10 km^2. Reflecting its small catchment area, total river length is about 5km. Kinanliman River is typical mountainous river. The gradient of the main stream is summarized as shown below.

Table 5.65 River Gradient of Kinanliman River

Reach	Slope
0 - 0.9 km	1/50
0.9 - 2.3 km	1/30
2.3 - 5.0 km	1/15

Sediment size of the riverbed is very large in general. Even in the most downstream reach, rock with more than 0.5m can be often observed in the riverbed.

The existing structures relating to flood control are, as follows:

- Kinanliman Bridge; and
- Revetment works constructed mainly around Kinanliman Bridge.

On the other hand, there is a water intake along Kinanliman River. This is one of main sources of portable water for Municipality of Real. Figure 5.26 shows the topographic map of the basin.

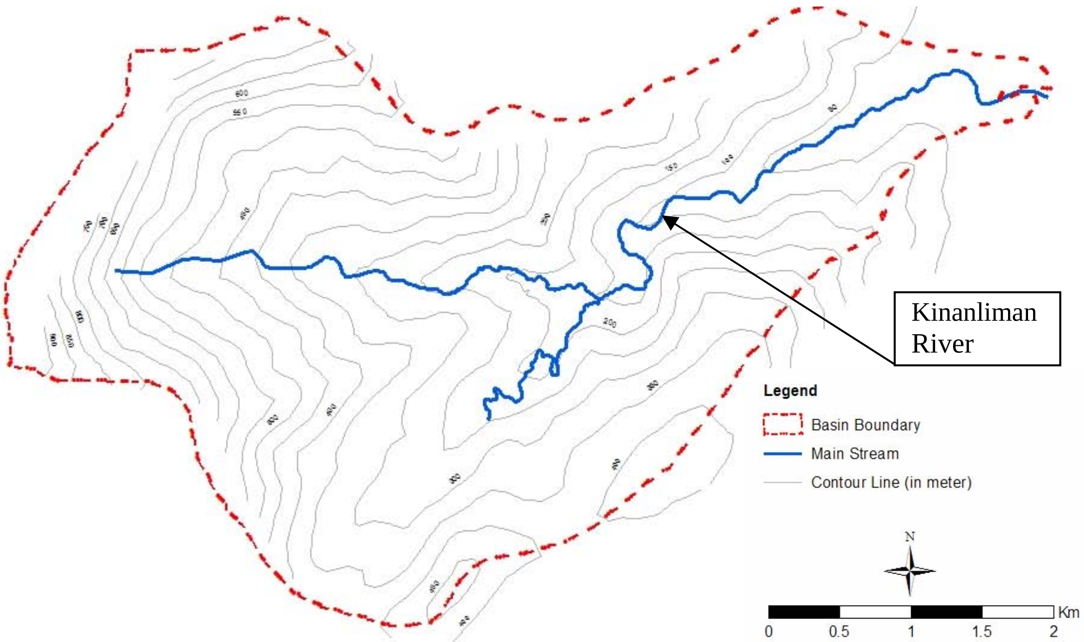

Figure 5.26 Topographic Map of the Kinanliman River Basin

2) Meteorology and Hydrology

The Kinanliman River Basin falls under Type IV of the modified Corona's climate classification. Rainfall is more or less evenly distributed throughout the year. This part of the country is exposed to the northeast monsoon, which brings strong winds and torrential rains during half of the year.

Because of small total catchment area and steep gradient of the river, time of concentration of flood is estimated at about 50 minutes. This hydrological characteristic can cause flash flood in the Kinanliman River Basin even in the most downstream reach.

(2) Social and Economic Conditions

1) Population and its Growth

The total population of the municipality based on the 2000 NSO Census is 30,684, in which about 63% is found in the rural areas. The population by 2020 is projected to reach 61,000 assuming the current growth rate of 2.11%. The aggregate population density for the urban area is 222 persons/km^2, while for the rural area, the population density is 38 persons/km^2.

2) Land Use

a) General Feature

In Municipality of Real, only 16% of the total land area is relatively flat and suitable for urban expansion. Further, the municipal territory of Real is covered by several presidential proclamations (Buriquela National Park, UP Land Grant, DAR Reservation Lot1, etc.) that reserve huge tract of land for specific purposes. Nearly half of the land area of Real falls under these proclamations. In terms of land uses, the Municipal Land Use Plan has identified four types of settlement areas for its urban growth areas: urban settlements; agrarian reform communities (ARC); non-ARC rural communities; and indigenous people's settlements.

b) Land Use in the Kinanliman River Basin

Figure 5.27 shows the land use map of the basin (2002/03). Share of each land use based on the above map is shown in Table 5.66. Based on this table, built-up area is 1.3% of the total catchment area and is located at around the most downstream reach of the river. More than 80% of the total catchment area is covered by broadleaved forest, while 10% is shrub land, which may have relatively high erosion risk.

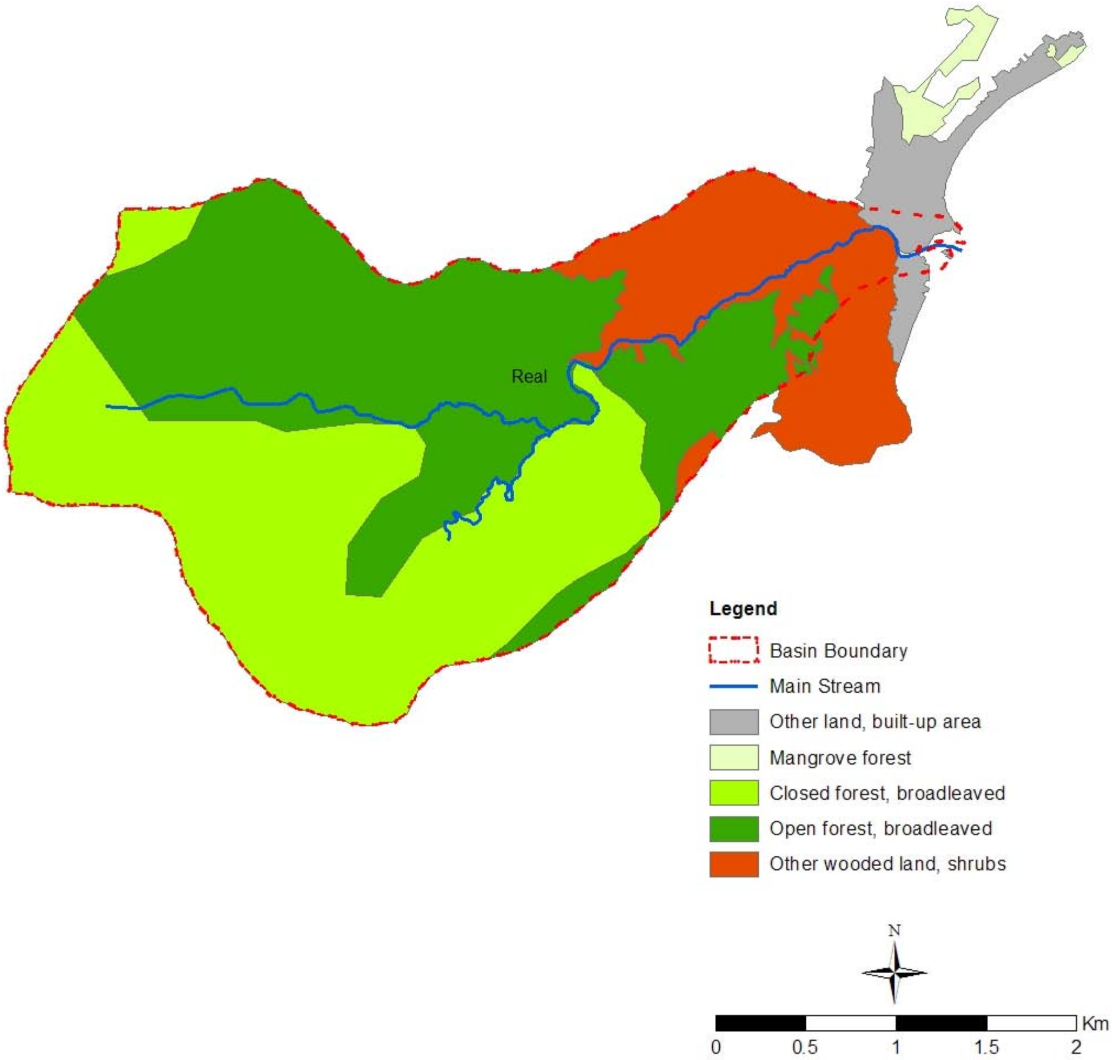

Figure 5.27 Existing Land Use in the Kinanliman River Basin

Table 5.66 Share of Land Use in the Kinanliman River Basin

Class	Area (km^2)	Percentage
Closed forest, broadleaved	4.24	41.9
Forest plantation, broadleaved	0.00	0.0
Inland water	0.00	0.0
Mangrove forest	0.00	0.0
Open forest, broadleaved	4.47	44.2
Other land, built-up area	0.13	1.3
Other land, cultivated, annual crop	0.00	0.0
Other land, cultivated, perennial crop	0.00	0.0
Other land, fishpond	0.00	0.0
Other land, natural, barren land	0.00	0.0
Other land, natural, grassland	0.00	0.0
Other wooded land, shrubs	1.27	12.6
Other wooded land, wooded grassland	0.00	0.0
Total	10.11	100.0

3) Local Economy

a) Agriculture

Agricultural production is focused mainly on rice (107 ha, irrigated), coconut, rootcrops and vegetables. There are 8 commercial broiler farms in the Municipality. On the other hand, the Municipality has fishponds of 282 ha. However, fishponds are economically unattractive due to difficulty in market outlets.

b) Commerce and Trade

A central business district, where most of the commercial establishments are located, can be found at the Poblacion and other three growth centers. Commercial activities include trading, banking and finance services, cottage industries and tourism. As per records gathered, there are about 205 convenience stores, 30 resorts and hotels, 10 construction/electronic supplies, 20 tourism and tourism-related business services.

c) Industry

Industrial activities in the Municipality consist of small-scale quarrying of sand and gravel. It also has a flourishing cottage industry.

d) Tourism

Tourism activity is one of the key economic drivers identified by the LGU in resource generation. Endowed with natural resource diversity, the LGU has numerous natural waterfalls, caves and other natural attraction.

(3) Floods and Flood Damage

1) Floods and Flood Damage

The Kinanliman River Basin experienced devastating flash flood damage at November 29, 2004. This is caused by typhoon Winnie and Yoyong. Summary of families with dead members by this disaster are shown below. In the Kinanliman River Basin, the causality is concentrated to Barangay Poblacion 01.

Table 5.67 Casualties by Flash Flood (November 29, 2004)

	No. of Families	No. of Dead Persons	Missing
Barangay Poblacion 01	30	58	1
Barangay Poblacion 61	1	1	0
Barangay Ungos	N/A	N/A	N/A
Total in Real	129	241	3

Source: "Profile of Real" provided by Municipality of Real

The daily rainfall amount was more than 400 mm at Infanta. It is said that the probability of the extreme event could be more than 100-year return period.

According to the interview, water level of Kinanliman River started to rise at around 7pm and reached to maximum at around 10pm. People could not evacuate because it was too rapid. Flood depth was about 150 cm in the inland area at the location of 50 m from the left riverbank. The floodwater overflowed from Kinanliman River reached to the center of the built-up area near the elementary school. However, duration was less than an hour. Around 1km upstream of the Kinanliman Bridge, there were houses of Purok Long Pond. However, almost all of the houses were washed out by floodwater and sediment.

In 2006, high water level around the Kinanliman Bridge appeared again, although damage was not so severe. It is still at risk for flood and debris flow in the Kinanliman River Basin.

2) Major Causes of Floods

Major causes of floods in the Kinanliman River Basin are heavy rainfall and consequent rapid runoff. Flood type is flash flood due to very short time of concentration of flood wave. Sudden and severe sediment load caused by landslides can happen in the Kinanliman River Basin. In this case, the flash flood may accompany with much sediment. This causes rapid aggradations of riverbed, which reduces flow capacity of the existing channel drastically. There is also risk of debris flow.

According to results of the interview in the field survey, formulation of natural dams caused by landslides and woody debris and those corruptions may bring about devastating flash flood. Actually, many people pointed out that it occurred during the 2004 flood.

Another important point is that woody debris accumulated at the Kinanliman Bridge caused backwater toward upstream of the bridge, resulting in overflow from Kinanliman River to the built-up area.

(4) Previous Related Study

After the very severe flood damage in 2004, FCSEC conducted the “Detailed Design Report for the Pilot Project for Kinanliman River, Real, Quezon, March 2007”. Based on the study, training dike in the left bank of Kinanliman River, 490m in total length from the Kinanliman Bridge toward upstream, was proposed as urgent measures, and detailed design has been completed. The location and plan of the proposed dike are shown in Figure 5.28. The necessity of sabo dam was also preliminary examined and typical drawing of the sabo dam was prepared during the study, although it is not included in the implementation of the urgent works.

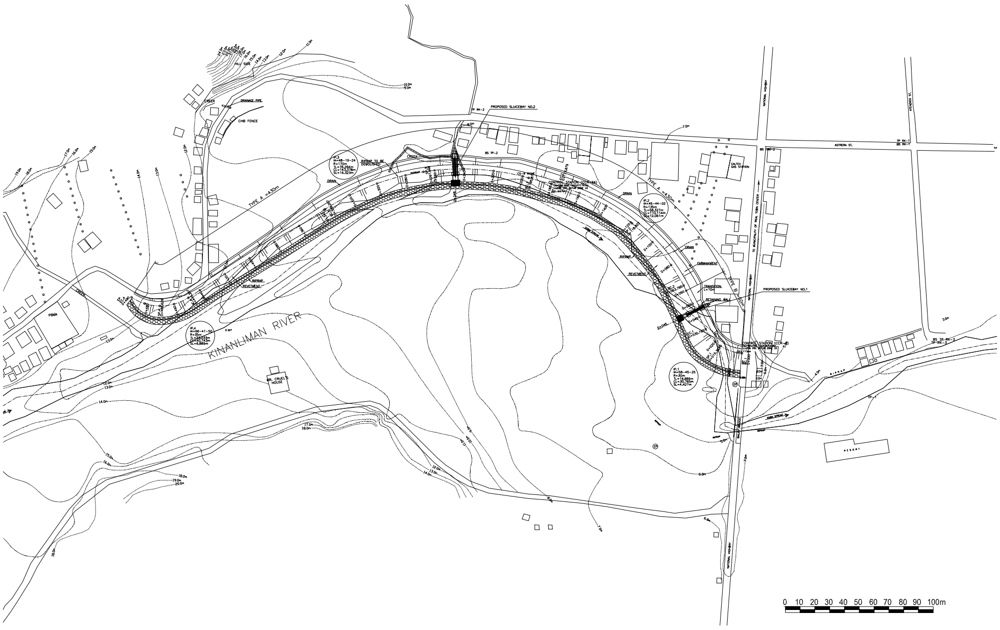

Figure 5.28 Proposed Training Dike by FCSEC Study in 2007

5.5.2 Hydrologic Analysis

(1) Design Flood Discharge

The design flood discharge is set with reference to the study in 2007 by FCSEC, in which rational formula is applied. Furthermore, since this river is a debris flow stream, the design flood discharge is increased 1.5 times. Distribution of design flood discharge for 25-year return period is shown in Figure 5.29.

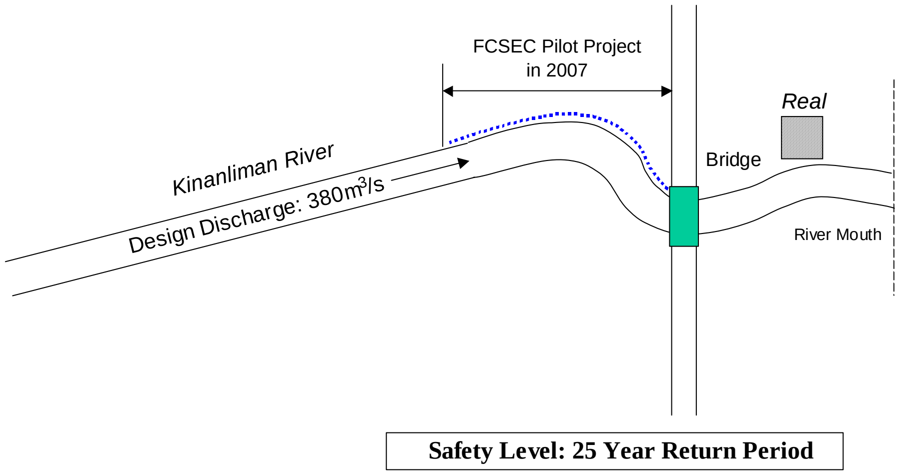

Figure 5.29 Design Discharge Distribution in the Kinanliman River Basin

5.5.3 Flood Inundation Analysis

(1) Flow Capacity

The flow capacity of the existing river channel is analyzed with HEC-RAS using the river cross sections newly obtained in the survey. The flow capacity of Kinanliman River at the Kinanliman Bridge is estimated as shown below.

Table 5.68 Flow Capacity of Existing River Channel in the Kinanliman River Basin

Location of Calculation	Flow Capacity (m^3/sec)
Kinanliman River (Kinanliman Bridge)	190

(2) Flood Inundation Area

Flood inundation area is analyzed with HEC-RAS and HEC-GeoRAS using the river cross sections newly obtained. In the analysis, the altitude data of SRTM is adjusted by comparison with the river cross sectional survey data. As a result, the floods over flow around the Kinanliman Bridge, and the floods flow into the built-up area of Real. The total inundation area is estimated at 13 ha with 25-year return period flood, as tabulated below. Figure 5.30 shows the inundation area of the basin.

Table 5.69 Area of Flood Inundation of the Kinanliman River Basin

(Unit: ha)

Land Use	Flood Scale (Return Period)
	25-year
Built-up Area	8.4
Fishpond	0.0
Cultivated, Annual Crop	0.0
Other	4.2
Total	12.6

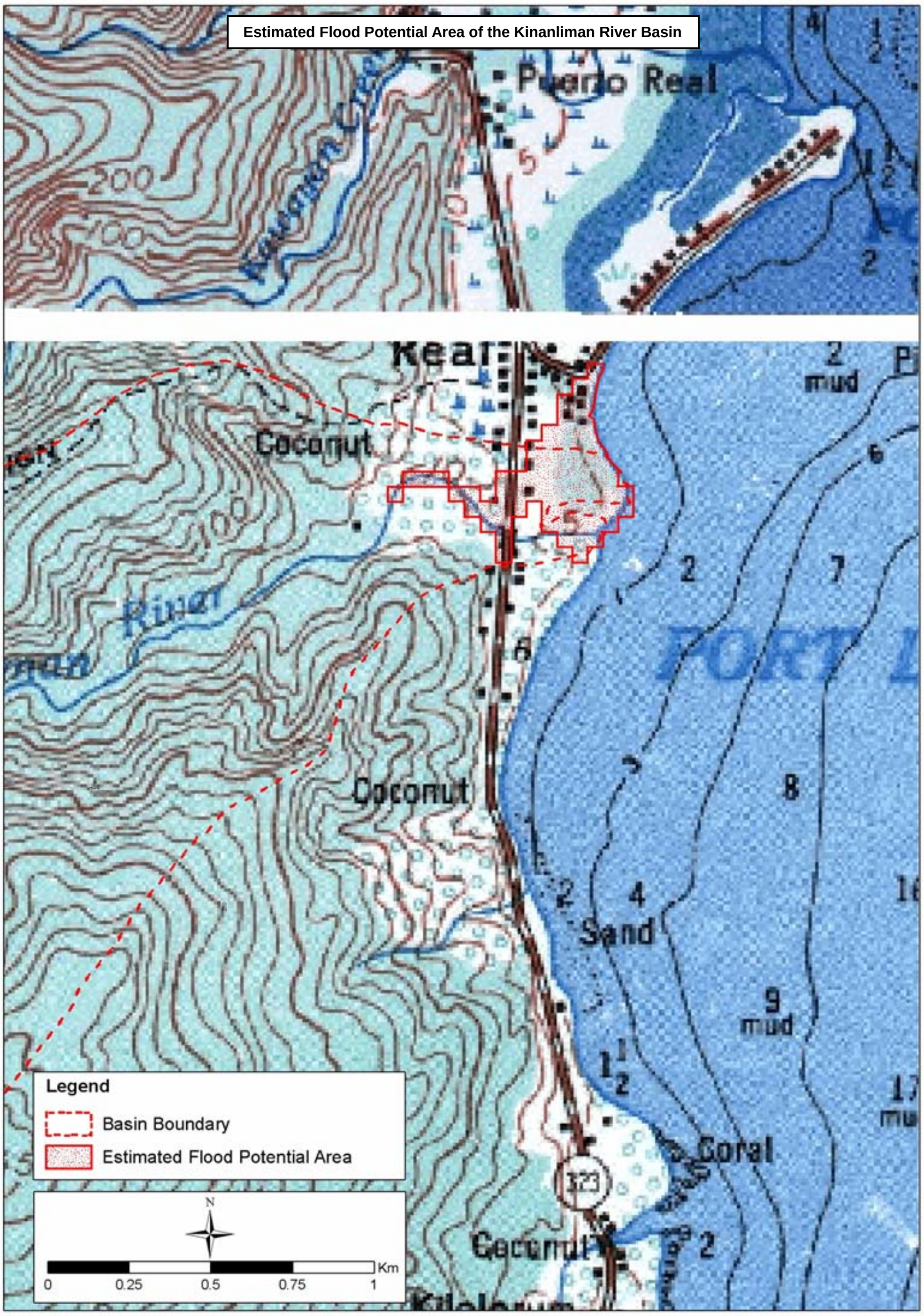

Figure 5.30 Flood Inundation Area of the Kinanliman River Basin

5.5.4 Basic Layout of Main Structural Measures

(1) Applicable Structural Measures

The flood type of the Kinanliman River Basin is F+O+I+B/F+I (Group 4). Comparing with the flood type of this basin, the following structural measures are considered as the applicable ones:

Table 5.70 Basic Applicable Structural Measures for Flood Type in the Kinanliman River Basin

Flood Type	Applicable Measures				
	River Channel Improvement	Dam and Reservoir and/or Sabo dam	Retarding Basin	Diversion Channel	Drainage Facilities
Flash Flood (F)	O	O			
Over Flow (O)	O	O	O	O	O
Inland Flooding (I)	O				O
Bank Erosion (B)	O				

Judging from the river basin conditions, among these applicable measures, the flood control dam, retarding basin, diversion channel and drainage facilities are not applicable or not necessary to the basin considering the topographic and land use conditions. Hence, applicable measures are the river channel improvement and sabo dam as described below.

Table 5.71 Applicable Structural Measures in the Kinanliman River Basin

Flood Type	Applicable Measures				
	River Channel Improvement	Sabo dam	Retarding Basin	Diversion Channel	Drainage Facilities
F+O+I+B	O	O			

(2) Basic Idea of Structural Measures

1) Target Area of Flood Mitigation

Target area of flood mitigation is a potential flood area along the most downstream reach of Kinanliman River, in which built-up area of Real exists along the river. Based on the ocular observation during the filed survey and the result of workshop, the target reach has been set at 0 – 1.05km: 0.4km downstream from the Kinanliman Bridge and 0.65km upstream from the Bridge.

2) Safety Level

Study by FCSEC has already set the safety level for Kinanliman River to 1/25, although it is said that the probability of the 2004 flood, which may be the past maximum flood, is at more than 1/100. The present Study basically follows the idea by the FCSEC study. Therefore, the safety level is set at 1/25.

3) Relationship between the Present Study and the FCSEC study

The study by FCSEC focused on only very urgent measures considering limitation of budget. In the present Study, more comprehensive measures for longer-term implementation is planned considering the urgent work proposed by FCSEC.

4) River Channel Improvement

On the left bank of Kinanliman River, construction of new dike was proposed by the FCSEC study as urgent measures. Detailed design has been completed and construction work will start soon. In addition to the urgent measures proposed by FCSEC study, it is judged that the following river channel improvement is necessary to ensure more safety condition for the target area for long-term perspective.

a) Extension of dike

- It is proposed to extend the dike about 160m toward upstream to protect residential area there;
- Along right bank, construction of dike, which starts from the Kinanliman Bridge toward upstream to connect existing road, is proposed; and
- At the downstream portion of the Kinanliman Bridge to river mouth, construction of new dike for both banks is proposed.

b) Spur dike

Along the dike proposed by FCSEC study, it is recommended to set a series of spur dikes to protect the dike and to make channel alignment straighter so that flood flow can pass smoothly.

c) Excavation

To keep necessary flow capacity and to make channel alignment more straight, excavation of sand bar is proposed

d) Bridge

The existing Kinanliman Bridge makes significant contraction effect for flow because of its small cross-section area for flow. It is clearly understood that the bridge is obstacle for smooth flow during flood. It is recommended to reconstruct the bridge with widening and heightening in order to reduce future risk for flood, especially for flood caused by clogging of woody debris.

5) Sabo dam

In many cases, flash floods and/or debris flows cause severe damages including loss of human lives although its damage area is limited.

For the river basins like Kinanliman, where debris flow was occurred or is expected, it is necessary to provide countermeasures such as sabo dams against sediment discharges.

The effects of sabo dam are to reduce risks for:

- Sediment disaster due to debris flows;
- Flooding caused by severe aggradation of river bed due to heavy and sudden sediment load; and
- Flooding caused by backwater at structures such as bridges due to clogging of woody debris, etc.

In the previous study conducted by FCSEC in 2006, the transportable sediment in the Kinanliman River Basin was estimated at 215,836 m^3. In principle, it is desirable to construct necessary sabo works, which total capacity is corresponding to the total sediment discharges, in order to eradicate the sediment disasters. For this achievement, it is required to construct a number of sabo dams, and it will cost considerably.

In this regard, the minimum number of sabo dam, one sabo dam, is preliminary proposed in this plan. The main purposes of this sabo dam are to catch the front of debris flow, the most dangerous portion of debris flow, in order to weaken its destructive power, and to reduce the risk of clogging at the downstream bridge by the control of woody debris at the sabo dam.

Actually in this Study, estimation of benefit does not include intangible damages such as casualties because of difficulty of counting value of human lives. This is another aspect of planning the minimum number of sabo dam. However, in the further studies, the number of sabo dams will be increased so as to make the plan more safety, if this will be judged to be necessary from the viewpoint of the stability of communities and others. On the other hand, it is also important to improve the accuracy of planning by the monitoring of sediment discharges and others.

As for the maintenance of the sabo dam, it is necessary to remove rocks and/or woody debris after floods.

(3) Recommended Structural Measures

1) Recommended Structural Measures

Based on the basic idea above mentioned, the recommended structural measures are the river channel improvement and the sabo dam, as shown in Table 5.72 and Figure 5.31.

Table 5.72 Summary of Recommended Structural Measures in the Kinanliman River Basin

	Components	Work Item	Description	Quantity
1	Kinanliman River Improvement	Revetment, Foot protection Embankment, Excavation	Embankment: 1.0～3.5m high	Left: 1,045m Right: 565m
2	Spur Dike	Hydraulic jump spur dike	Length: 10m Height: 3m	6 sites
3	Re-Construction of Bridge	Concrete bridge	Length: 60m Width: 7m	1 site
4	Sabo Dam	Permeable Type Dam	Width: 85m Effective height: 3m	1 site

The proposed flood discharge distribution is shown in Figure 5.32.

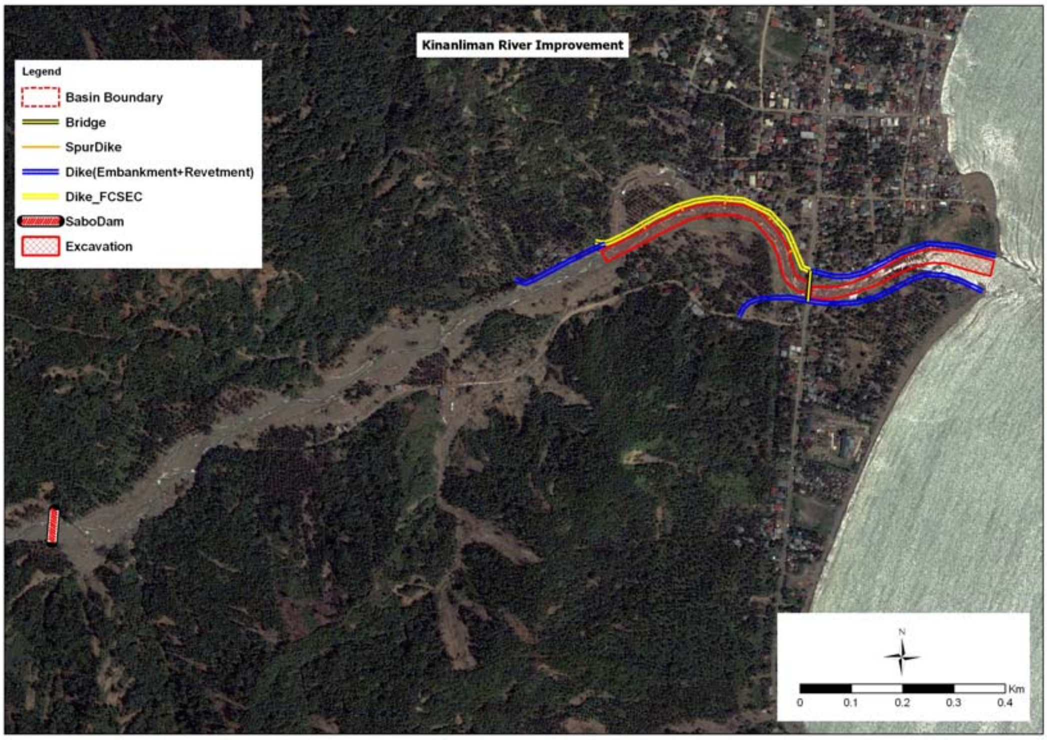

Figure 5.31 Recommended Structural Measures in the Kinanliman River Basin

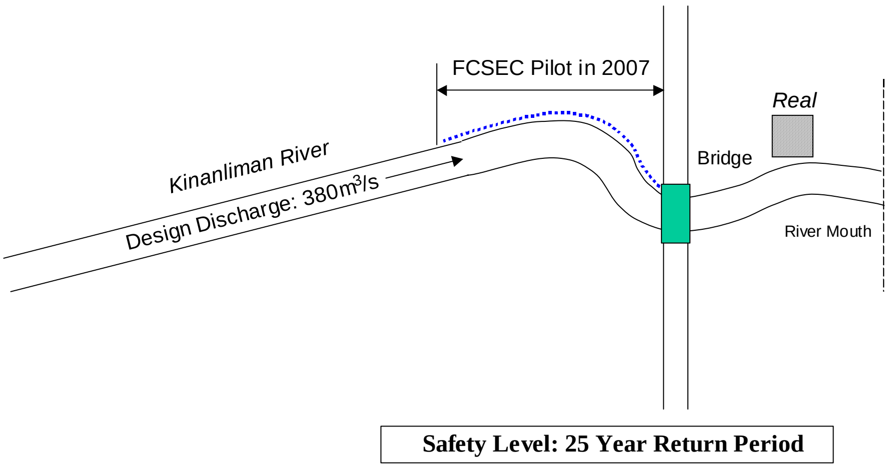

Figure 5.32 Design Discharge Distribution with Proposed Structural Measures in the Kinanliman River Basin

2) Preliminary Design of Main Structural Measures

The preliminary design of the river channel improvement and sabo dam is presented below.

a) River Channel Improvement

The length and section for the improvement are tabulated in Table 5.73. On the other hand, longitudinal profile and typical cross sections of the improvement are shown in Fig.5-5.

Table 5.73 Improvement Plan of Kinanliman River

Stretch	Station Number		Design Discharge (m3/s)	Length (km)	Width (m)
	From	To			
1	0	0.39	380	0.39	55
2	0.39	0.54	380	0.15	155
3	0.54	0.74	380	0.20	115
4	0.74	1.05	380	0.31	45
Total				1.05	

b) Sabo Dam

Referring to the FCSEC study, the salient features of the sabo dam is summarized, as shown below:

Table 5.74 Salient Features of Sabo Dam

Dimension	Design Value
Dam Type	Permeable Type Dam
Storage Capacity (Thousand m^3)	16.2
Dam Height (m)	5.5
Dam Width (m)	85.0

Based on the above design, the basic layout of the main structures is presented in Figure 5.33.

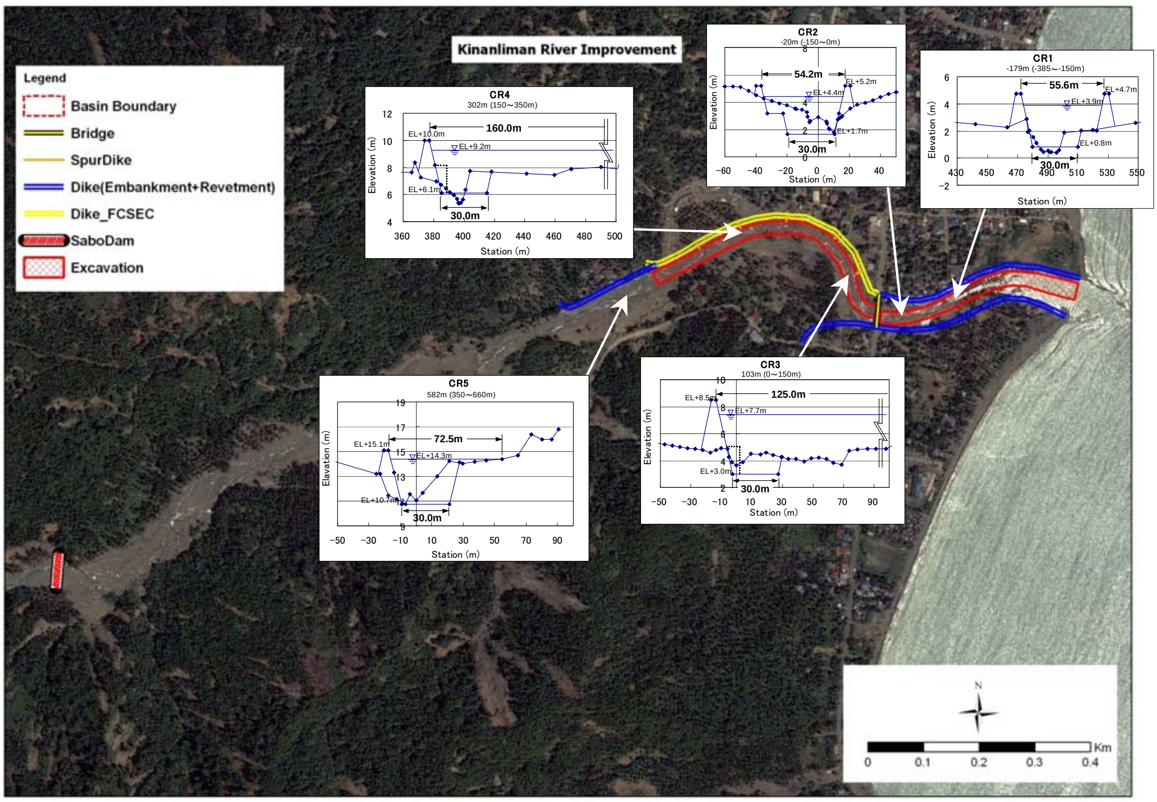

Figure 5.33 Proposed Works of the Kinanliman River Basin

(4) Estimation of Cost for Structural Measures

1) Construction Cost of Structural Measures

The construction cost of the recommended structural measures is estimated at 97.232 million pesos as shown below.

Table 5.75 Main Construction Cost for Structural Measures of the Kinanliman River Basin

Work Item	Unit	Quantity	Unit Cost (Pesos)	Amount (thousand Pesos)
1. Channel Excavation	m^3	55,954	150	8,393
2. Embankment	m^3	22,952	130	2,984
3. Concrete	m^3	4,908	6,000	29,447
4. Revetment	m^2	8,424	1,100	9,266
5. Sodding	m^2	5,176	30	155
6. Foot protection (Gabion)	m^3	490	3,350	1,642
7. Foot protection for sabo dam	m^3	635	3,200	2,032
8. Bridge	m^3	420	50,000	21,000
9. Urgent Works Proposed by FCSEC	m^2			22,314
Total				97,232

2) Project Cost

The project cost is estimated at 146.369 million pesos as shown below.

Table 5.76 Project Cost for Structural Measures of the Kinanliman River Basin

No.	Description	Amount (thousand Pesos)
1	Construction Cost	111,817
(1)	Preparatory Works	14,585
(2)	Main Construction Cost	97,232
2	Administration Cost	3,355
3	Engineering Services	17,891
4	Compensation Cost	Negligible
5	Physical Contingency	13,306
	Total	146,369

3) Economic Cost

The economic project cost is estimated as shown below.

Table 5.77 Financial and Economic Costs of the Project of the Kinanliman River Basin

	Financial (mil. Pesos)	Economic (mil. Pesos)
Project Cost	146.4	106.9

(5) Estimation of Benefit of Structural Measures

1) Estimation of Flood Damage

Inundation areas under the project scale are calculated in the flood inundation analysis, and are applied to estimate the flood damage. The flood damage is estimated considering with and without project conditions as shown below.

Table 5.78 Flood Damage in the Kinanliman River Basin

Item		Area Inundated (ha)	Assets Inundated (mil. Pesos)	Flood Damage (mil. Pesos)
I.	Direct Damage			29.8
	Built-up Area	8.4	76.4	22.9
	Infrastructure			6.9
II.	Indirect Damage			6.0
III.	Total			35.8

2) Annual Average Benefit

Based on the estimated flood damage, the annual average benefit under present condition is computed at 12.9 million pesos. The future benefit is shown in Tab.5-7.

5.5.5 Non-Structural Measures

(1) General

Non-structural measures are examined on the basis of filed survey and preliminary studies on flood warning system and soil loss related to reforestation. The methodology and detailed results of the study are described in Supporting Report H. It should be reminded that the Study is preliminary level because of limited time frame and resources. The Study concentrated to discuss general direction of flood mitigation using currently available information. Further detailed study toward implementation of flood mitigation measures is recommended at the next stage such as feasibility study. The recommended non-structural measures at this stage are summarized below.

(2) Recommendation on Non-Structural Measures

1) Recommended Flood Warning System

Community Based Flood Early Warning System (CBFEWS), which PAGASA is now introducing, is recommended. Almost same scheme as the PAGASAs system can be applied into the Kinanliman River Basin. Because time of concentration of flood wave is very small (lees than an hour), it is very difficult to get benefit by reduction of tangible damage by introducing the flood warning system. Disaster management should consider more on “response” including information dissemination and evacuation than “forecast” in order to reduce causality when the flood warning system is introduced.

After initial introduction of the warning system, it is recommended to refine the system every 3 years using the accumulated data and knowledge. Equipment introduced should also be checked at the same time.

2) Recommendation on Baseline Activities on Watershed Management

Watershed management includes many aspects than flood mitigation. In the present Study, it is recommended that at least minimum necessary activities related to flood mitigation be implemented as baseline activities on watershed management. The following activities are recommended.

- To prepare watershed characterization and watershed management plan
  - There is no watershed characterization and management plan in the Kinanliman River Basin. However, a devastating flood caused by accumulation of woody debris at Kinanliman Bridge occurred at 2004. There is a potential danger the similar woody debris happens. As a first step of watershed management, watershed characterization and watershed management plan should be prepared. Then, critical location should be identified and monitored.
  - Watershed Management Plan for the Agos River Basin can be referred.
  - The watershed characterization and watershed management plan should be reviewed and revised every 5 years to reflect the watershed situation properly.
- Reforestation with at least same rate as current national average
  - In order to keep at least current condition of watershed so that sediment load from catchment will not increase drastically in future, reforestation should be continued with at least same rate as current national average, e.g., reforestation of grass land (Total area in 26 years = 5.7% of land without forest in the basin).
- Supporting of River Basin Council
  - River Basin Council for the region including the Agos River Basin has been established. To enhance more communication within a basin, it is recommended to prepare budget to support activities of river basin council.

3) Recommendation on Other Measures

Issues and recommendations for further improvement for disaster management activity for the Kinanliman River Basins based on the result of field survey are summarized.

General recommendations are, as follows:

- Enhancement of disaster management activities at community level;
- Necessity of periodical refinement of disaster management plan; and
- Necessity of preparation and dissemination of hazard map for excess flood after completion of structural measures.

Recommended other measures for the Kinanliman River Basin are, as follows:

- Enhancement of disaster management activities at community level
  - After 2004 disaster, municipality of Real has been very active for disaster management. This activity at municipality level should be continued. Activity at

more local level within a barangay should be more enhanced. For example, information, education campaign and evacuation drill should be considered.

- Installation of water level gauge
  - ➢ After 2004 disaster, municipality of Real has already introduced its own rain gauge. In addition to this, installation of water level gauge at Kinanliman River is recommended.
- Preparation against excess flood and debris flow
  - ➢ Hazard map to show dangerous area for very severe flood (more than 1/25) and for debris flow should be prepared and disseminated to the people.

(3) Rough Estimation of Cost and Benefit for Reference

As a reference, rough cost estimation is made for the flood warning system and the baseline activity on watershed management.

Cost for flood warning system is roughly estimated as follows. O&M cost for 26 years includes 1) cost for refinement of the system every 3 years and 2) cost for observer.

Table 5.79 Rough Cost Estimation for Flood Warning System for 26 years in the Kinanliman River Basin (2009 to 2034)

Cost for Initial Setting (mil. Pesos)	Total Cost for O&M for 26 years (mil. Pesos)	Total Cost for 26 years (mil. Pesos)
0.3	1.2	1.5

Cost for recommended baseline activities on watershed management for 26 years (2009 to 2034) is roughly estimated as shown in the following table.

Table 5.80 Rough Cost Estimation for Recommended Baseline Activities on Watershed Management for 26 years in the Kinanliman River Basin (2009 to 2034)

Cost			
Preparation of Watershed Characterization & Watershed Management Plan (mil. Pesos)	Reforestation (mil. Pesos)	Supporting of River Basin Council (mil. Pesos)	Total Cost (mil. Pesos)
3.00	0.18	2.6	5.78

The breakdown of the estimated costs is shown in Supporting Report H.

Possible benefit by flood forecasting and warning system is preliminary estimated to examine appropriate flood forecasting and warning system in this river basin. Based on it, the above-mentioned flood warning system is recommended. The detail discussion is presented in Supporting Report H.

5.5.6 Initial Environmental Examination

(1) Result of the IEE

The IEE for the structural measures was carried out based on the information and data collected during this Study and consultation with concerned government and stakeholders.

In the Matrix (refer to Tab.5-8), the major environmental resources are shown in the horizontal line, and the activities for implementation of the proposed plan are shown in the vertical line. The assessment of impacts was made in terms of magnitude (e.g., significant, moderate, and negligible) of the negative or positive affecting the environmental elements.

Positive impacts are not considered in the cumulative quantification of the environmental impact score for each alternative since they would not lead to any hindrance in decisions of whether or not to proceed with the project. On the other hand, negative environmental impacts remain critical in so far as decisions in the proper selection of project alternatives.

Table 5.81 Activities for Each Project Phase in the Kinanliman River Basin

Phase	Project Activity
Pre-construction Phase	Resettlement of Project affected Persons/Families
	Land Acquisition
	Project Mobilization
Construction Phase	Construction of Concrete Dike
	Installation / Construction of Gate
	Construction of Spur Dike
	Widening of Kinanliman River at the section of Kinanliman Bridge towards the river mouth
	Construction of the Sabo Dam
O & M Phase	Dredging and Excavation
	Watershed Management
	Installation of Flood Warning System

As the result of the assessment, it is evaluated that the construction of the Sabo Dam, demolition of Kinanliman Bridge and construction of new bridge and channelization are considered to cause the potential adverse impact for this area. The particular evaluations for these impacts are described below (for details, refer to Supporting Report I).

1) Social Environment

a) Disruption of local transport

With the demolition and reconstruction of Kinanliman Bridge the local transport will be disrupted together with the water pipeline situated on the bridge crossing. This can be mitigated with the implementation of a traffic management plan that is prepared in collaboration with the local traffic bureau. Also, the unavailability of domestic water in areas affected by the project can be addressed by means of proper coordination with the local water district of Real, Quezon.

b) Resettlement

In terms of the need for resettlement of displaced community, this will not be an issue since there are no PAPs/PAFs at the vicinity of the proposed flood control structures. Thus, the proposed project is socially acceptable with mostly beneficial outcomes rendering the LGU with advantage upon the completion of the flood control facilities.

2) Natural Environment

a) Removal of vegetation

The result of the IEE shows there is a long-term and irreversible effect resulting from altered terrain and topography at the vicinity of the dam as well as the permanent removal of vegetation. However removal of fruit bearing trees, ornamental plants and natural vegetation (patches of grasses, banana, ferns, etc.) is done only in the areas within the right-of-way required to construct the dike. The estimated adverse impacts of plant/vegetation removal are the loss of natural aesthetic and the decrease in source of natural resource from timbers and fruit bearing trees. On the other hand, there is a beneficial effect of plant/vegetation removal due to the construction of the dike. Upon completion of the proposed facilities, it is expected that unimpeded flood water flow to the sea and controlled deposition of silts and debris will ensue. Hence, it is necessary to remove some of the vegetation found along the proposed site for dike construction, however, equally important that the contractor will have a tree cutting permit from the Philippine Coconut Authority (PCA) when the trees are uprooted. For mitigation, the implementing agency may also adopt the replanting of trees within the river channel’s buffer strip zone (varies from 10–25 meters for tributaries).

For the flora, uprooting and replanting of trees/plants should be scheduled throughout the course of construction. The effect on fauna may be minimal since the access roads and the proposed project will be implemented only in portions. Animals simply migrate to the other reaches of the forested catchment area. It is important to identify how much the forested region will be affected by the proposed activity so as to determine the optimum area needed for the removal of vegetation. Presence of endangered species must also be immediately addressed, thus it is recommended to have a field biologist/forester, who will identify and prevent the unnecessary injuring of local fauna (especially the endangered species), present during the pre-construction and construction phase. Captured endangered species must be deposited to a wildlife protection agency, and will be re-introduced to its original habitat after the construction.

3) Pollution

a) Disposal of dredge materials and spoils

Unavoidable impact which has moderate effect is the generation of dredged materials/spoils due to the channelization at the site proposed for the construction of the spur dike.

Short-term physico-chemical impacts (e.g., increase in turbidity in the river water and the increase in noise level from the operation of dredging equipment) related with the construction of the spur dike can be mitigated following the EMP described in the Supporting Report I.

Overall, the result of the IEE study can satisfy the requirement of the Philippine EIS System for the project to secure the needed ECC.

(2) Management/Mitigation Plan

Overall, environmental management and mitigation plan shall be closely exercised during the development phase of these major project components in order to minimize if not totally eradicated the negative environmental impacts. Several potential adverse impacts identified in the evaluation were concluded that the Environmental Impact Assessment (EIA) is required in the succeeding study period.

5.5.7 Project Evaluation

(1) Technical Feasibility

The Philippines has experienced the construction of river channel improvement and sabo dam many times. Thus, no difficulty would be encountered in the actual construction work. The recommended non-structural measures have also been experienced in the country. This project is, therefore, evaluated to have a technical feasibility.

(2) Economical Viability

The economic viability is assessed based on the economic cost and benefit stream of the proposed structural measures. As for the assessment of the non-structural measures, this is not carried out based on the situation as discussed before.

Tab. 5-7 shows the economic cost and benefit stream. As the results, the economic viability is figured out as follows:

Table 5.82 Economic Viability of the Proposed Plan in the Kinanliman River Basin

Viability Index	
EIRR (%)	17.3
NPV (mil. Pesos)	10.9
B/C	1.18

Based on the above results, EIRR becomes higher than the opportunity cost of capital of 15%. Therefore, the project is evaluated to have an adequate economic viability.

(3) Environmental and Social Acceptance

As the social environmental impacts, the transportation will be disturbed due to the construction of Kinanliman Bridge for certain period. However, this environmental issue can be settled down through the coordination with local authorities as well as stakeholders. As the natural environmental impacts, no significant issue is expected except minor cutting of vegetation, which can be accepted judging from the magnitude of impact. As the public hazard, the disposal of dredge materials and spoils for the channel improvement is expected. This issue can be settled down through preparation of the appropriate disposal site prior to construction work.

Overall, environmental management and mitigation plan shall be closely exercised during the development phase of these major project components in order to minimize if not totally eradicated the negative environmental impacts. The project plan was explained and discussed with the stakeholders through the stakeholder meetings at each end of the field survey and workshop in the site. Through these experiences and activities, it is concluded that, at this stage, implementation of this project is socially and environmentally accepted by the stakeholders.