CHAPTER 14

SELECTION OF ROADS FOR PRE-FEASIBILITY STUDY

14.1 SELECTION CRITERIA

Selection Criteria of roads for pre-feasibility study was established as follows;

a) Implementation priority shall be high, i.e. within the 10th ranking.

b) Roads shall be located in the areas with less security problems, so that various surveys necessary for pre-F/S can be safely undertaken.

c) Roads which can be a model project for the agri-fishery development support.

d) Road projects which can be implemented easily and fast, i.e. no ROW acquisition, no serious environmental impacts and easy for funding (or project scale shall be reasonable for funding).

14.2 PROPOSED ROADS FOR PRE-FEASIBILITY STUDY

Based on the selection criteria, the following two (2) roads were proposed for pre-feasibility study due mainly to criteria b) above;

- Pinaring - Simsiman Road
- Tamontaka-Tapian Road

Location of 2 roads is shown in **Figure 14.2-1**. Characteristics of two roads are as follows;

1) Pinaring - Simsiman Road

- Provincial Road with gravel surface. To convert a Provincial Road to a national road standard is one of the major strategies to improve road density in the area.
- Implementation priority is rated 8th among 36 projects.
- The road serves for wide rice fields, corn fields and other agricultural land use areas, thus this project can be a good model road development which vitally supports an agricultural development, particularly for rice and corn production increase.
- Project area has less security problem.
- No ROW and no relocation of families is required.

- Project cost was estimated at 513 Million Pesos which is reasonable scale for funding.

- Seven (7) sub-projects under ARMM Social Fund Project have been implemented along the road. Synergy effect of this road project with ARMM Social Fund Sub-projects can be expected.

2) Tamontaka-Tapian Road

- Provincial Road with gravel surface. To convert a Provincial Road to a national road standard is one of the major strategies to improve road density in the area.

- Implementation priority is ranked 9th among 36 projects.

- The road serves for wide corn and coconut fields. The project can be a good model of road development which vitally supports an agricultural development, particularly corn and coconut production increase.

- Project area has less security problems.

- No ROW acquisition and no relocation of families required.

- Project cost was estimated at 510 Million Pesos which is reasonable scale for funding.

- One sub-project under ARMM Social Fund Project was implemented.

- The road passes along the nice beach. Some beach resort facilities have been developed, thus the project provide access to beach leisure facilities for citizens of Cotabato City.

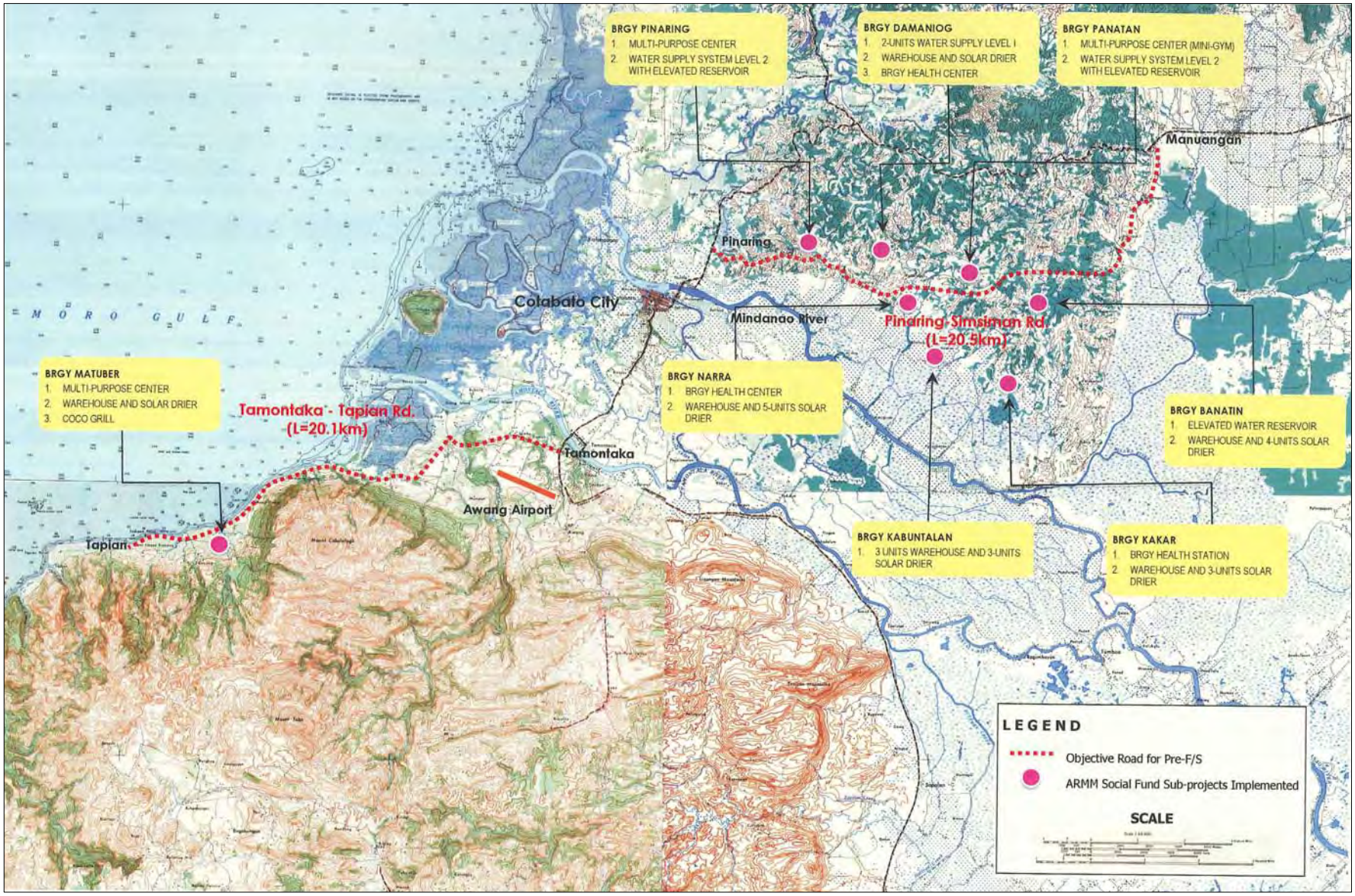


FIGURE 14.2-1 LOCATION MAP OF OBJECTIVE RODS FOR PRFE-F/S

CHAPTER 15

PRE-FEASIBILITY STUDY ON SELECTED PRIORITY ROAD

15.1 OBJECTIVES OF THE PROJECT

Pinaring-Simsiman Road

- To provide an all-weather road to assure transportation of people and agricultural in-puts and out-puts throughout a year for agricultural development.
- To provide an easier access to basic social and health facilities which are mostly located at Cotabato City.
- To provide an alternative route to Cotabato City – Davao City Road.
- To achieve higher agricultural production, particularly palay and corn which will increase farmers' income and eventually contribute to poverty reduction

Tamontaka-Tapian Road

- To provide an all-weather road to assure transportation of people and agriculture and fishery in-puts and out-puts throughout a year for agri-fishery development.
- To provide an easier access to basic social and health facilities which are mostly located at Cotabato City.
- To provide an easier access to beach resorts which are major recreation spots for Cotabato City citizens.

15.2 OUTLINE OF THE PROJECT

Pinaring-Simsiman Road

• Road length	:	20.1 km.
• Already paved section by PCC pavement	:	1.7 km.
• Section to be improved	:	18.4 km.
• Number of bridges	:	5 bridges
• Bridges to be maintained	:	4 bridges
• Bridge to be replaced	:	1 bridge (Salam Bridge No. 1, L = 23 m)
• Road condition	:	Gravel section becomes frequently impassable after heavy rain
• Barangay roads to be improved	:	13 Barangay Roads (L = 42 km.)

Tamontaka-Tapian Road

- Road length : 20.4 km.
- Already paved section by PCC pavement : 4.4 km.
- Section to be improved : 16.0 km.
- Number of bridges : 6 bridges
- Bridges to be maintained : 5 bridges
- Bridge to be replaced : 1 bridge (Salam Bridge No. 1, L = 25 m)
- Road condition : Gravel section becomes frequently impassable after heavy rain
- Barangay roads to be improved : 20 Barangay Roads (L = 24 km.)

15.3 DESIGN POLICIES

Design policies adopted were as follows;

- New road right-of-way acquisition shall be avoided as much as possible.

- Existing road alignment, both horizontal and vertical alignments, shall be followed as much as possible to achieve above policy. Design standards shall be relaxed where required to achieve this policy.

- Existing PCC pavement sections and bridges shall be utilized as much as possible when they are judged to perform their functions.

5.4 TOPOGRAPHIC AND GEOLOGICAL CONDITIONS

Pinaring-Simsiman Road is passing through rolling terrain with 34 m elevation difference at the maximum. As for the soil condition, it is primarily composed of loose alluvial clay to the depth of 30 m except for Boring No-4. (See **Figure 15.4-1**).

Tamontaka-Tapian Road is passing through a flood plane of Tamontaka River for the first 7 km and the rest is passing along Moro Gulf coastal line at bottom of Mt. Cabalalan. Terrain along the road is relatively that with elevation difference of 19 m at the maximum. According to boring tests conducted under the Study at the location of existing bridges, loose alluvium has been observed from the top to 25 to 30 m in depth (See **Figure 15.4-2**).

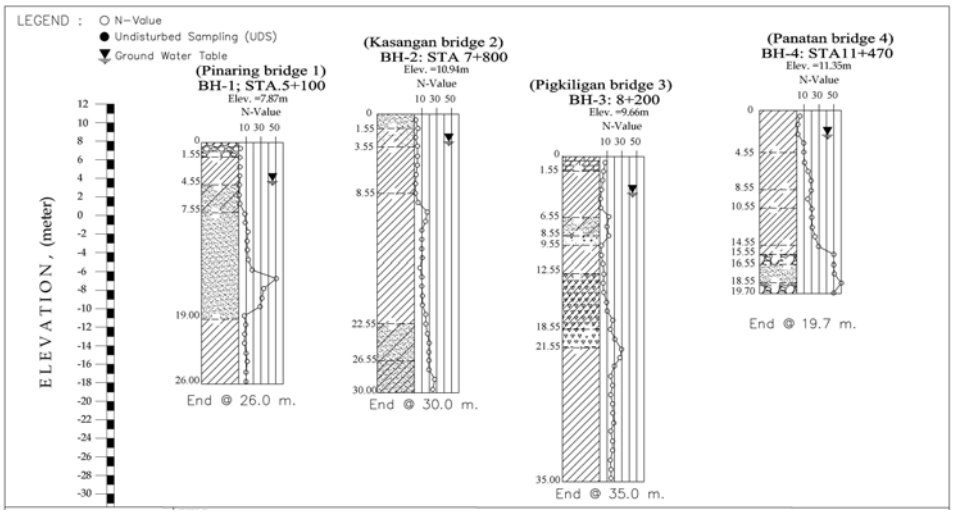


FIGURE-15.4-1 SOIL PROFILE OF PINARING-SIMSIMAN ROAD

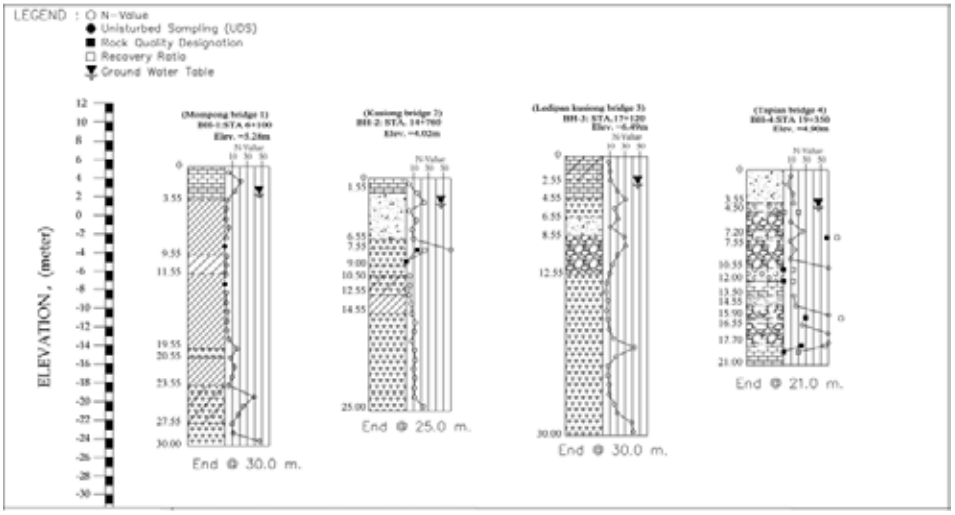


FIGURE-15.4-2 SOIL PROFILE OF TAMONTAKA-TAPIAN ROAD

15.5 DESIGN CRITERIA

15.5.1 Geometric Design Standards

Based on DPWH's Design Guidelines, Criteria and Standards, the geometric design standards were established as shown in **Table 15.5.1-1**.

TABLE 15.5.1-1 GEOMETRIC DESIGN STANDARDS

			Unit	Main Road with ADT400-1000 at Rolling (at Mountainous)	Barangay Road with ADT 200 or less at Rolling (at Mountainous)
Design Speed			kph	60 (40)	40 (30)
No. of Lanes			Lane	2	1
Lane Width			M	3.05x2	4.0
Shoulder Width			m	1.0[*1]	1.0
Horizontal Alignment	Min. Radius		m	120 (50)[*2]	55 (30)
	Max. Super elevation		%	6 %	-
Vertical Alignment	Max. Gradient		%	6% (8%)[*3]	8% (10%)
	Min. Radius	Sag	m	1000 (450)	450 (250)
		Crest	m	1400 (450)	450 (250)
Min. Stopping Sight Distance			m	70 (40)	40 (40)
Pavement Cross Fall	PCC		%	1.5%	-
	Gravel		%	-	2.5%

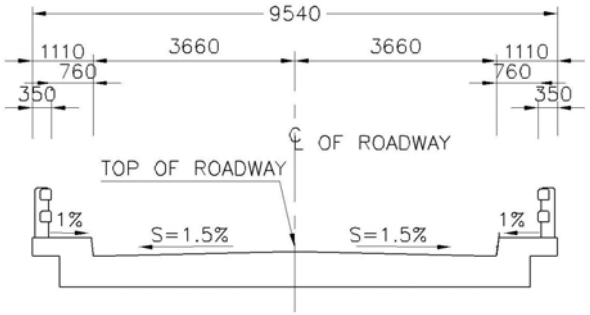
Source: Design Guidelines, Criteria and Standards, BOD, DPWH
*1: 0.5m as an exception was applied for residential area.
*2: Minimum R=30m as an exception was applied for the section where ROW was limited.
*3: i=9.75% as an exception was applied for the section where ROW was limited

15.5.2 Bridge Design Criteria

Bridge design criteria adopted were as follows;

(a) Typical Bridge Cross Section of the Bridge

DPWH Standard cross section of bridge shall be applied as below.



CROSS SECTION OF TWO-LANE BRIDGES

(b) Codes and Standards

- AASHTO Standard Specifications for Highway Bridges, Sixteenth Edition, 1996.
- National Structural Code of the Philippines, Volume II, Bridges, 2nd Edition, 1997.

- Specifications for Highway Bridges, Part IV, 2002, Japan Road Association.

- Seismic design shall be done in accordance with the provisions of Division I-A *"Seismic Design"* of the 1996 AASHTO Standard Specification for Highway Bridges and DPWH Department Order No. 75, Series of 1992, re: *DPWH Advisory for Seismic Design of Bridges*

(c) Design Loads and Loading Combinations

Dead Load

Reinforced Concrete	24.0	kN/m^3
Plain Concrete	23.0	kN/m^3
Steel	77.0	kN/m^3
Earth, compacted	19.0	kN/m^3

Superimposed Dead Load

Asphalt wearing course 22.5 kN/m^3.

Earth Pressure

Lateral Active Soil Pressures = by Mononobe-Okabe method
Max. Passive pressure = $239kN/m^2$ for seat type abutments
= $370kN/m^2$ for diaphragm type abutments

	Group I Load Combination	Group VII Load Combination (Earthquake)	
Soil internal * angle of friction	$\varphi = 30°$		
Wall to soil friction angle	$\delta = 0°$		
Active earth pressure	0.333	(A = 0.40)	0.493
		(A = 0.45)	0.518
		(A = 0.47)	0.529
		(A = 0.50)	0.546
		(A = 0.55)	0.575
Live load surcharge	0.6m of soil	None	

* - to be verified from soil laboratory test results

Live Load

Live loading shall be AASHTO MS18 (HS20-44) Standard Truck or Lane Loading as shown in **Figure 15.5.2-1**.

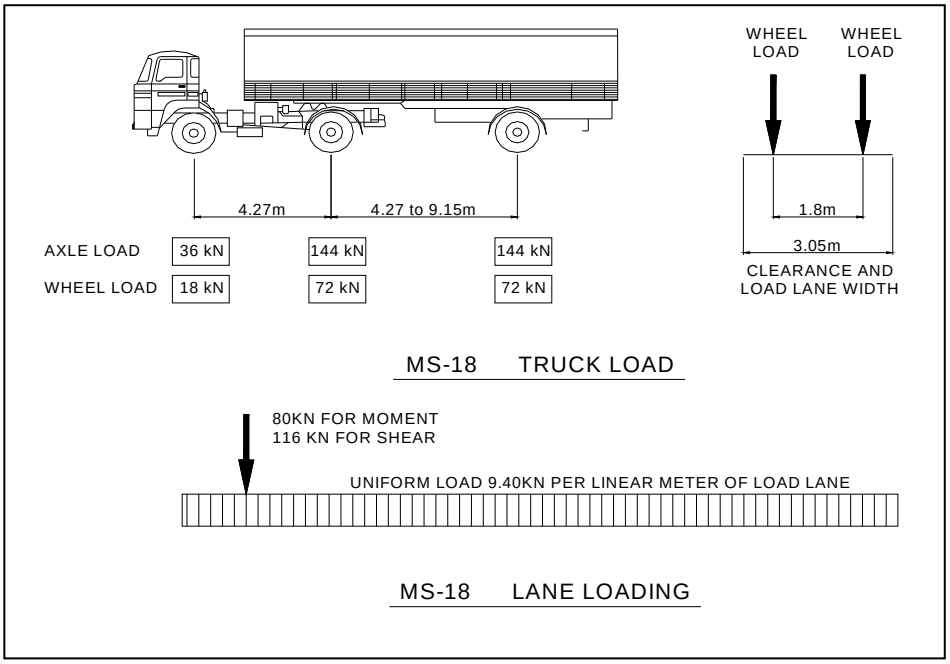


FIGURE 15.5.2-1 MS-18 LIVE LOAD

Sidewalk Loading

Sidewalks and deck girders = 4.07 kN/m^2 of sidewalk area.

Temperature Load

Thermal effects = ± 12.5°C

Stream Forces

$P = 515\ KV^2$

Where:

P = pressure in Pa from the flowing water
V = velocity of water in m/sec
K = 2/3 for circular piers

Accidental Loads

At bridge railings = 44.5 kN

Seismic Loads

In accordance with the AASHTO Standard Specifications for Highway Bridges, 17th Edition, 1996, Division I-A, Seismic Design, seismic

acceleration - adoption of **0.40g** in the design shall be mandatory as per Fig 21.3 Seismic Zone Map of the Philippines, NSCP, Volume 2 Bridges, 2nd Edition, 1997.

Material Properties

i) Structural Steel

All structural steel shall conform to JRA SMA 400W and SMA 490W with a minimum yield strength, fy = 248 Mpa, 355 Mpa, respectively.

ii) Concrete

Description	Concrete Class	fIc (MPa)	Max. Size of Aggregate (mm)
Thin Reinforced Sections, Parapet Railings, Posts, Curb and Sidewalk	C	21	12.5
Precast RC Pile	AA	28	20
Substructure and Superstructure	A1	21	20
PCDG Girders	P	28 (at transfer)	20
		35 (in service)	
Lean Concrete	-	17	38
Bored Piles, Concrete Slab on Steel Deck Girder	A2	24	20

iii) Reinforcing Steel

Minimum yield strength fy = 275 Mpa (Grade 40) ASTM A 615

iv) Prestressing Steel

Ultimate strength Fu = 1860 Mpa (Grade 270) ASTM A416

v) Elastomeric Bearing Pads

Elastomeric bearing pads = 100% virgin chloroprene, hardness 60

According to the requirements as prescribed in the Revised DPWH Standard Specification for Elastomeric Bearings, DPWH D.O. No. 25, Series of 1997.

Vertical Clearance (Free Board Allowance)

The vertical clearance (FBA) between the Maximum Flood Water Level (MFWL) and the soffit of the superstructure shall not be less than 1.00 meter (without debris) and 1.50 meter (with debris).

15.5.3 Design of Pavement

(1) Design Standard

The pavement design for this project was made for the design of rigid pavements (Portland Cement Concrete Pavement, PCCP). The design of pavement structures was based on the following design guides and standards:

- AASHTO Guide for Design of Pavement Structure, 1993 edition; and
- DPWH Design Guidelines Criteria and Standards for Public Works and Highways (Volume II).

(2) Traffic Loading

The structural design of the pavement is based on fatigue loads. Fatigue loading is taken as the cumulative number of passes of an Equivalent Standard Axle Load (ESAL) of 8,300 kgs (18 kips) per axle, to which the pavement structure will be subjected throughout its design life.

The loads imposed by cars, jeepneys, and other light vehicles is not considered in the pavement design due to its insignificant contributions to the cumulative structural damage caused to a pavement over its service life. Only bus and truck loads are converted into ESALs. Shown below is the assumed traffic load used in the design:

ASSUMED DESIGN TRAFFIC LOADS IN TERMS OF ESAL'S

Type of Pavement:	TRAFFIC LOAD (ESAL's)
Rigid (Portland Cement Concrete)	2,500,000

(3) Replacement of Soft Sub-grade

Soft sub-grade which is less than 3% in CBR, shall be replaced to borrowed material of which CBR is more than 8%. Based on the result of the CBR tests carried out under the Study, sub-grade shall be replaced as below.

TABLE 15.5.3-1 SUB-GRADE REPLACEMENT SECTIONS

Pinaring-Simsiman Road

STATION	PAVEMENT TYPE	CBR 95%	SOIL QUALITY	REPLACE SPAN and THICK	BOREHOLE LOG	SAMPLE DESCRIPTION	N-Value
0 + 0							
1 + 0	CONCRETE	1.60	CLAY				
+ 315				1+315			
+ 800		-		H=0. 6m			
2 + 0		32.0	SAND	1+800			
+ 700	GRAVEL	-					
3 + 0		1.10	CLAY	2+700			
4 + 0		1.00	CLAY	H=0.6m			
+ 200		-		4+200			
5 + 0		4.20	CLAY with Sand				
+ 50		-			SALAM BRIDGE1	Sandy GRAVEL	5
+ 800		-		5+800			
6 + 0		1.15	CLAY				
7 + 0		1.55	Sandy CLAY				
+ 800		-		H=0.6m	SALAM BRIDGE2	FINE SAND	3
8 + 0		1.15	CLAY				
+ 150		-			SALAM BRIDGE3	Coralline LIMESTONE	7
9 + 0		1.95	CLAY				
+ 800		-		9+800			
10 + 0		4.50	Sandy CLAY				
+ 200		-		10+200			
11 + 0		1.00	CLAY				
+ 150		-			SALAM BRIDGE3	Silty CLAY	4
12 + 0		0.95	CLAY				
13 + 0		1.40	CLAY	H=0.6m			
14 + 0		1.10	CLAY				
15 + 0		1.30	CLAY				
16 + 0		1.05	CLAY				
+ 500		-		16+500			
17 + 0		5.20	SAND and CLAY				
+ 500		-		17+500			
18 + 0		2.50	CLAY	H=0.6m			
19 + 0		1.70	CLAY				
+ 750				19+750			
20 + 0	CONCRETE	0.95	CLAY				
+ 69		-					
+ 113	GRAVEL			20+113			

Tamontaka-Tapian Road

STATION	PAVEMENT TYPE	CBR 95%	SOIL QUALITY	REPLACE SPAN and THICK	BOREHOLE LOG	SAMPLE DESCRIPTION	N-Value
0 + 0							
1 + 0		4.00	Sandy CLAY				
+ 500		-					
2 + 0		1.40	CLAY				
+ 500	CONCRETE	-					
3 + 0		4.70	Sandy CLAY				
4 + 0		6.80	CLAY with Sand				
+ 285							
5 + 0		5.60	CLAY with Sand				
+ 900		-		5+900			
6 + 0	GRAVEL	1.65	CLAY	H=0.6m	BRIDGE1	Coralline LIMESTONE	6
+ 100		-					
7 + 0		2.00	CLAY	7+500			
+ 500		-					
8 + 0		3.10	CLAY with Sand				
9 + 0		4.60	CLAY with Sand				
10 + 0		12.0	Sandy SILT				
11 + 0		10.6	LIMESTONE				
12 + 0		8.60	CLAY with Sand				
13 + 0		18.0	SAND				
14 + 0		25.0	SAND				
+ 750		-			BRIDGE2	LIMESTONE fragments	4
15 + 0		16.0	Gravelly SAND				
16 + 0		23.0	SAND and SILT				
17 + 0		37.0	SAND and GRAVEL				
+ 100		-			BRIDGE3	Coralline LIMESTONE	8
18 + 0		22.5	SAND				
+ 500		-		18+500			
19 + 0		2.20	CLAY				
+ 300		-		H=0.6m	BRIDGE4	Gravelly SAND	9
20 + 0		2.40	CLAY				
+ 435				20+435			

(4) Pavement Structural Design Parameters

Design parameters and variables used for pavement thickness calculations are shown in **Table 15.5.3-2**

TABLE 15.5.3-2 DESIGN PARAMETERS

1. Design Life	20 years
2. Design Traffic	2,500,000 ESAL
3. Serviceability Index	2.5
4. Reliability	80%
Standard Normal Deviate	-0.8416
Overall Standard Deviation	0.39
5. Subgrade Strength	
Design CBR	1% / 4%
Note: For road sections wherein subgrade CBR values are less than 4%, the weak subgrade material is proposed to be removed and then replaced by selected borrow for topping, having a minimum CBR value equal to 8% at 95% MDD. Thickness of the selected borrow for topping is 600 mm.	
6. Concrete Properties	
Compressive Strength	4000 psi
Flexural Strength / Modulus of rupture	630 psi
Elastic Modulus	3.6 E+06 psi
7. Drainage Coefficient	1.1
8. Load Transfer Coefficient	3.2

(5) Recommended Pavement Structures

Since DPWH-ARMM has less experience on maintenance of asphalt pavement, PCC pavement was recommended for the project. Recommended pavement thickness was as follows;

PCC Pavement	- - - - - -	230 mm
Aggregate Sub-base Course	- - - - - -	200 mm

(6) Design Calculations

(a) Design CBR = 4

Design CBR=	**4%**		*: from TP results*
MR =	6,000		
w18 =	**2.50E+06**		*(W18 = predicted number of 80 kN (18,000 lb.) ESALs)*
log10 w18 =	**6.3979**		**Design Criteria*
R =	80.0%		*Reliability*
ZR =	**-0.8416**		*standard normal deviate*
So =	**0.39**		*Overall standard deviation, combined standard error of the traffic prediction and performance prediction*
ΔPSI =	**2.5**		*Difference between the initial design serviceability index, po, and the design terminal serviceability index,*
Pt =	**2.0**		
S'c =	630	(psi)	632 *modulus of rupture*
f'c=	4000	(psi)	*concrete compressive strength*
Ec =	**3.60E+06**	(psi)	*Elastic modulus of PCC*
Cd =	**1.1**		*drainage coefficient*
J =	**3.2**		*load factor efficiency*
k =	310	(pci)	*modulus of subgrade reaction*
L.S. =	1.0		
k eff.=	**130**	(pci)	*Effective modulus of subgrade reaction*

Equation

$$\log_{10}(W_{18}) = Z_R \times S_o + 7.35 \times \log_{10}(D+1) - 0.06 + \frac{\log_{10}\left(\frac{\Delta PSI}{4.5-1.5}\right)}{1+\frac{1.624\times 10^7}{(D+1)^{8.46}}} + (4.22 - 0.32 p_t) \times \log_{10}\left[\frac{(S'_c)(C_d)(D^{0.75}-1.132)}{215.63(J)\left[D^{0.75}-\frac{18.42}{\left(E_c/k\right)^{0.25}}\right]}\right]$$

D = **7.23** inches of PCCP
183.58 mm of PCCP

Determination of Subbase Thickness

Design Subgrade CBR =	4.0%	Subbase CBR =	25%
w18 =	**2.50E+06 (Assumed Traffic Load)**	w18 =	**2.50E+06 (Assumed Traffic Load)**
log w18 =	6.3979	log w18 =	6.3979
R =	80.0%	R =	80.0%
ZR =	**-0.8416**	ZR =	**-0.8416**
So =	**0.39**	So =	**0.39**
dPSI =	**2.0**	dPSI =	**2.0**
MR =	6,000	MR =	20,000
SN =	**3.8919**	**SN =**	**2.5209**

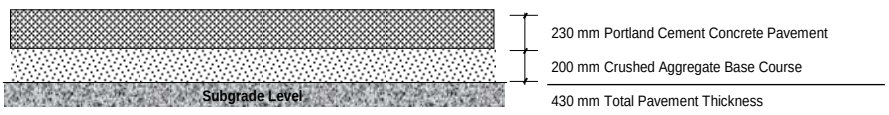
Original Subgrade SN = 3.8919
Subbase SN = 2.5209
ΔSN = 1.3710

Subbase Layer:
a = 0.11
D = 10.39 inches
263.82 mm.

use D = **265** mm.

230 mm PCCP, 200 mm Base Course

Item	D inches	D mm	a	m	SN	SN_f (required)	FINAL PAVEMENT STRUCTURE
New layer:							
PCCP Layer	9.06	230	0.44	1.0	3.9843		**230 mm**
Crushed Aggregate Base Course	0.00	0	0.14	1.1	0.0000		**0 mm**
Aggregate Subbase Course	5.91	150	0.11	1.1	0.7145		**200 mm**
Total	15				**4.6988**	**4.6988**	**430 mm**



Design Subgrade CBR = **4%**

(b) Design CBR = 1

Design CBR=	**1%**		*: Weak Soil Subgrade*
MR =	1,500		
w18 =	**2.50E+06**		*(W18 = predicted number of 80 kN (18,000 lb.) ESALs)*
$\log_{10}$ w18 =	**6.3979**		
R =	80.0%		*Reliability*
ZR =	**-0.8416**		*standard normal deviate*
So =	**0.39**		*Overall standard deviation, combined standard error of the traffic prediction and performance prediction*
ΔPSI =	**2.5**		*Difference between the initial design serviceability index, po, and the design terminal serviceability index,*
Pt =	**2.0**		
S'c =	630	(psi)	632 *modulus of rupture*
f'c=	4000	(psi)	*concrete compressive strength*
Ec =	**3.60E+06**	(psi)	*Elastic modulus of PCC*
Cd =	**1.1**		*drainage coefficient*
J =	**3.2**		*load factor efficiency*
k =	80	(pci)	*modulus of subgrade reaction*
L.S. =	1.0		
k eff.=	**0**	(pci)	*Effective modulus of subgrade reaction*

Equation

$$\log_{10}(W_{18}) = Z_R \times S_o + 7.35 \times \log_{10}(D+1) - 0.06 + \frac{\log_{10}\left(\frac{\Delta PSI}{4.5-1.5}\right)}{1+\frac{1.624\times10^7}{(D+1)^{8.46}}} + (4.22-0.32p_t)\times\log_{10}\left[\frac{(S'_c)C_d(D^{0.75}-1.132)}{215.63J\left(D^{0.75}-\frac{18.42}{\left(E_c/k\right)^{0.25}}\right)}\right]$$

D = **8.69** inches of PCCP
220.81 mm of PCCP

PRELIMINARY PAVEMENT STRUCTURE

225.00
use: PCCP 230 mm

Determination of Subbase Thickness

esign Subgrade CBR =	1.0%		Subbase CBR =	25%	
w18 =	**2.50E+06**	**(Assumed Traffic Load)**	w18 =	**2.50E+06**	**(Assumed Traffic Load)**
log w18 =	6.3979		log w18 =	6.3979	
R =	80.0%		R =	80.0%	
ZR =	**-0.8416**		ZR =	**-0.8416**	
So =	**0.39**		So =	**0.39**	
dPSI =	**2.0**		dPSI =	**2.0**	
MR =	1,500		MR =	20,000	
SN =	**6.0790**		**SN =**	**2.5209**	

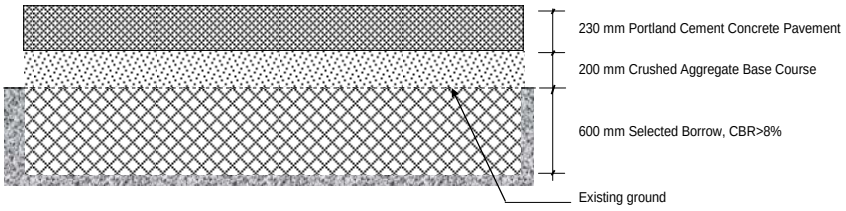
Original Subgrade SN = 6.0790
Subbase SN = 2.5209
ΔSN = 3.5580

Subbase Layer:
a = 0.11
D = 26.95 inches
684.65 mm.

use D = **685** mm.

200 mm PCCP, 200 mm Base Course

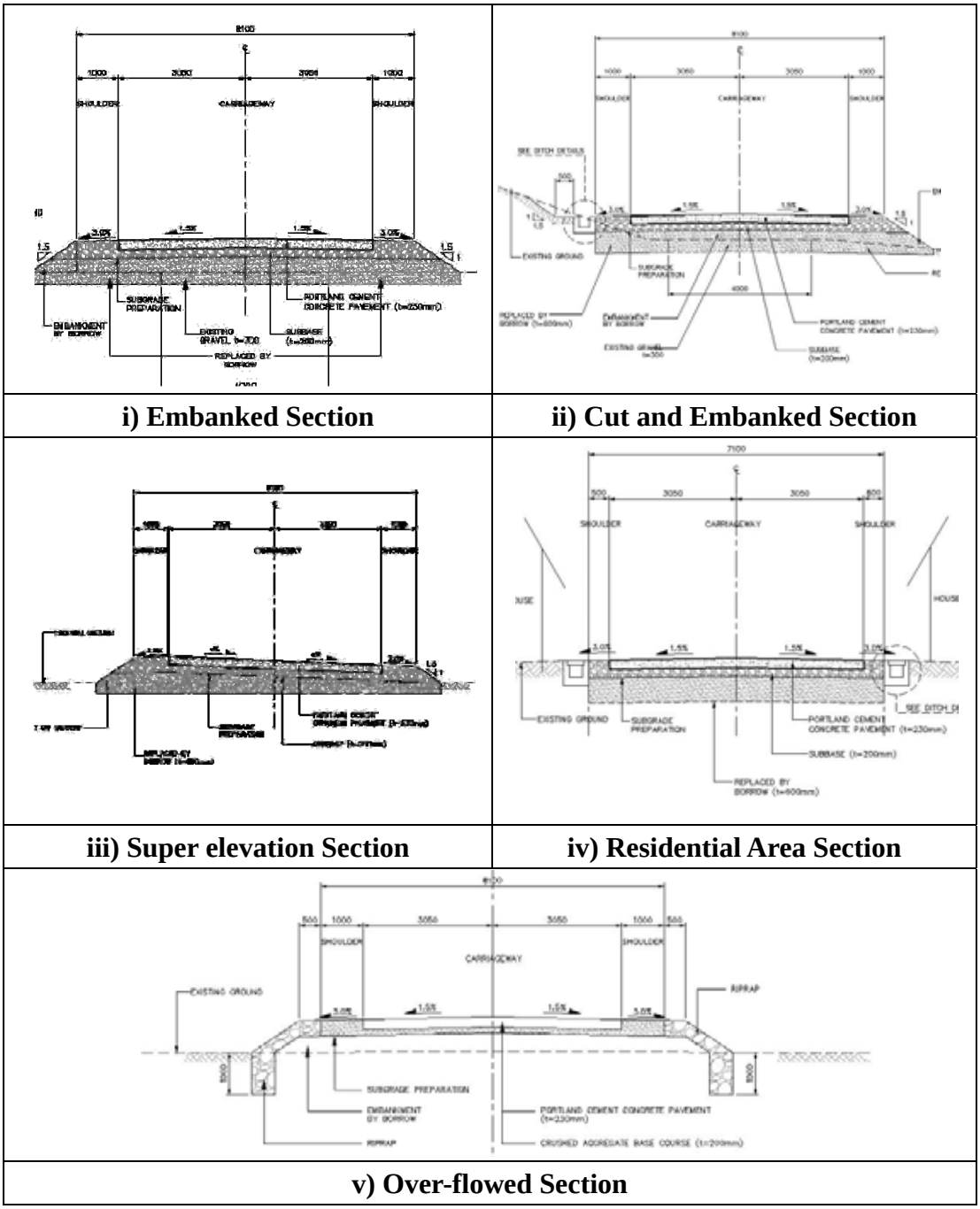
Item	D inches	mm	a	m	SN	SN_f (required)	FINAL PAVEMENT STRUCTURE
New layer:							
PCCP Layer	9.06	230	0.44	1.0	3.9843		**230 mm**
Aggregate Subbase Course	7.87	200	0.11	1.1	0.9528		**200 mm**
Selected Borrow (min. CBR=8%)	23.36	593	0.075	1.1	1.9272		**600 mm**
Total	40				**6.8642**	**6.8642**	**1030 mm**



15.5.4 Typical Cross Sections

A normal cross fall of 1.5% was used for the traveled way all throughout the PCC pavement and 3.0% shoulders. Superelevation was computed in accordance with the design guidelines used for this project.

The angles of slopes are based on the stability requirements but the designer used a slope 1.5:1 for embankment and cut considering there was a limited space. Typical cross-sections are shown in **Figure 15.5.4-1**.



i) Embanked Section	ii) Cut and Embanked Section
iii) Super elevation Section	iv) Residential Area Section
v) Over-flowed Section	

Note; Replacement of Sub-grade shall be applied only CBR<3.0%

FIGURE 15.5.4-1 TYPICAL CROSS-SECTIONS OF THE ROAD

15.6 DRAINAGE DESIGN

15.6.1 Hydrological Analysis

General Consideration

Rainfall patterns was based from the nearest PAGASA rainfall gauging station located at the General Santos Rainfall Station.

Run-off discharge was computed based on the Rational Equation (for drainage catchment area equal or less than 2.5 km^2 and with adjusted rainfall intensity I values for catchment area greater than 2.5 km^2).

Rational Method

The Rational Method was used to determine the design discharge run-offs necessary to determine the size of the drainage conveyance system. This method estimates the peak rate of runoff at any point in the system as a function of drainage area, land use and surface characteristics, and rainfall intensity. The method is expressed as a formula:

Q = 0.278 CIA

Where;

Q : Maximum rate of runoff, m^3/s
C : Runoff coefficient representing the ration of runoff to rainfall, dimensionless
I : Average rainfall intensity for a duration equal to the time of concentration, mm/hr
A : Drainage area contributing to the drainage location, km^2

Rainfall Intensity (I)

The rainfall data used for the project was those of the General Santos and South Cotabato Station obtained from PAGASA's published RIDF values. The RIDF data was used for the entire stretch of the project segment. The Rainfall Intensity-Duration Frequency Data is shown in **Table 15.6.1-1**.

The RIDF values were transformed into usable form as an equation to directly be substituted in a formula. The rainfall intensity is expressed in general form as:

$$I = A / (t + b)^n$$

where:

I = Rainfall intensity in mm/hour
t = Duration of rainfall equal to the time of concentration in minutes
A, b and n are constants derived either by graphical analysis or by analytical method.

The rainfall magnitudes werre based on design rainfall occurrences of 2 years for ditches, 5 years for culverts and cross drains and 50 years for bridges. The rainfall intensities for these return periods were based on the succeeding equations derived from the RIDF prevalent over the area. The followings were the resulting equations:

i) 2-years Return Period

$$I_2 = \frac{396.90}{(t + 10.0)^{0.6632}}$$

ii) 5-years Return Period

$$I_5 = \frac{555.97}{(t + 10.0)^{0.6555}}$$

iii) 50-years Return Period

$$I_{50} = \frac{892.91}{(t + 10)^{0.6481}}$$

The preceding equations of the rainfall intensity can readily be substituted to solve the discharge in the Rational Formula. These take away the graphical estimation of the intensity value from a prepared data curve.

TABLE 15.6.1-1 RAINFALL INTENSITY-DURATION FREQUENCY DATA

RAINFALL INTENSITY-DURATION FREQUENCY DATA
GENERAL SANTOS CITY
Based on 31 years of record

COMPUTED EXTREME VALUE (in mm) OF PRECIPITATION

Return Period (years)	5 mins	10 mins	15 mins	20 mins.	30 mins.	45 mins.	60 mins.	80 mins.	100 mins.	120 mins.	150 mins.	3 hrs.	6 hrs.	12 hrs.	24 hrs.
2	5.8	8.9	11.4	13.5	16.9	20.1	22.5	26.4	29.8	32.4	35.8	38.7	50.1	60.9	68.9
5	8.3	12.7	16.4	19.5	24.3	29.1	32.5	38.2	43.1	47.1	52.2	56.6	74	90.4	102.7
10	10	15.3	19.7	23.4	29.3	35.1	39.1	45.9	52	56.8	63	68.4	89.8	109.9	125.1
15	11	16.7	21.6	25.6	32.1	38.5	42.8	50.3	57	62.3	69.2	75.1	98.8	120.9	137.7
20	11.6	17.7	22.9	27.2	34	40.8	45.4	53.4	60.5	66.1	73.4	79.8	105	128.6	146.5
25	12.1	18.5	23.9	28.4	35.5	42.6	47.4	55.7	63.2	69.1	76.7	83.4	109.8	134.5	153.4
50	13.7	20.9	27	32.1	40.2	48.2	53.6	63	71.4	78.2	86.9	94.5	124.7	152.8	174.3
100	15.3	23.3	30.1	35.8	44.8	53.8	59.8	70.2	79.7	87.2	97	105.5	139.4	170.9	195.2

EQUIVALENT AVERAGE INTENSITY (in mm/hr) OF COMPUTED EXTREME VALUES

Return Period (years)	5 mins	10 mins	15 mins	20 mins.	30 mins.	45 mins.	60 mins.	80 mins.	100 mins.	120 mins.	150 mins.	3 mins	6 mins	12 mins	24 mins
2	69.6	53.4	45.6	40.5	33.8	26.8	22.5	19.8	17.9	16.2	14.3	12.9	8.4	5.1	2.9
5	99.6	76.2	65.6	58.5	48.6	38.8	32.5	28.7	25.9	23.6	20.9	18.9	12.3	7.5	4.3
10	120	91.8	78.8	70.2	58.6	46.8	39.1	34.4	31.2	28.4	25.2	22.8	15	9.2	5.2
15	132	100.2	86.4	76.8	64.2	51.3	42.8	37.7	34.2	31.2	27.7	25	16.5	10.1	5.7
20	139.2	106.2	91.6	81.6	68	54.4	45.4	40.1	36.3	33.1	29.4	26.6	17.5	10.7	6.1
25	145.2	111	95.6	85.2	71	56.8	47.4	41.8	37.9	34.6	30.7	27.8	18.3	11.2	6.4
50	164.4	125.4	108	96.3	80.4	64.3	53.6	47.3	42.8	39.1	34.8	31.5	20.8	12.7	7.3
100	183.6	139.8	120.4	107.4	89.6	71.7	59.8	52.7	47.8	43.6	38.8	35.2	23.2	14.2	8.1

Prepared by:
The HYDROMETEOROLOGICAL INVESTIGATIONS and SPECIAL STUDIES SECTION
Flood Forecasting Branch, PAGASA

Time of Concentration (t_c)

5 minutes (min.) or length/velocity or through Kirpich's empirical formula given as follows:

$$t_c = 0.0196\ L^{1.15} * (dH)^{-0.385}$$

where:

t_c	=	Time of Concentration
L	=	Length of Channel
dH	=	Difference in elevation between the outlet and the most distant point in the watershed

In the delineation of the drainage tributaries or basins, topographic maps from NAMRIA were used.

Land Use

It was assumed that no major land use changes would occur within the project site and on sources of offsite inflows that would invalidate the hydrologic presumptions made for the area.

Run-off Coefficient

The run-off coefficients used for the project were **0.5** for steeped or rolling grassed areas and **0.4** for forested land (sandy to clay).

Catchment Areas Delineation

The drainage areas of each watershed were delineated from the 1: 50,000 NAMRIA / JICA maps.

Catchment delineation is shown in **Figure 15.6.1-1** for Pinaring-Simsiman Road and **Figure 15.6.1.2** for Tamontaka-Tapian Road.

FIGURE 15.6.1-1 PINARING-SIMSIMAN ROAD: CATCHMENT AREA

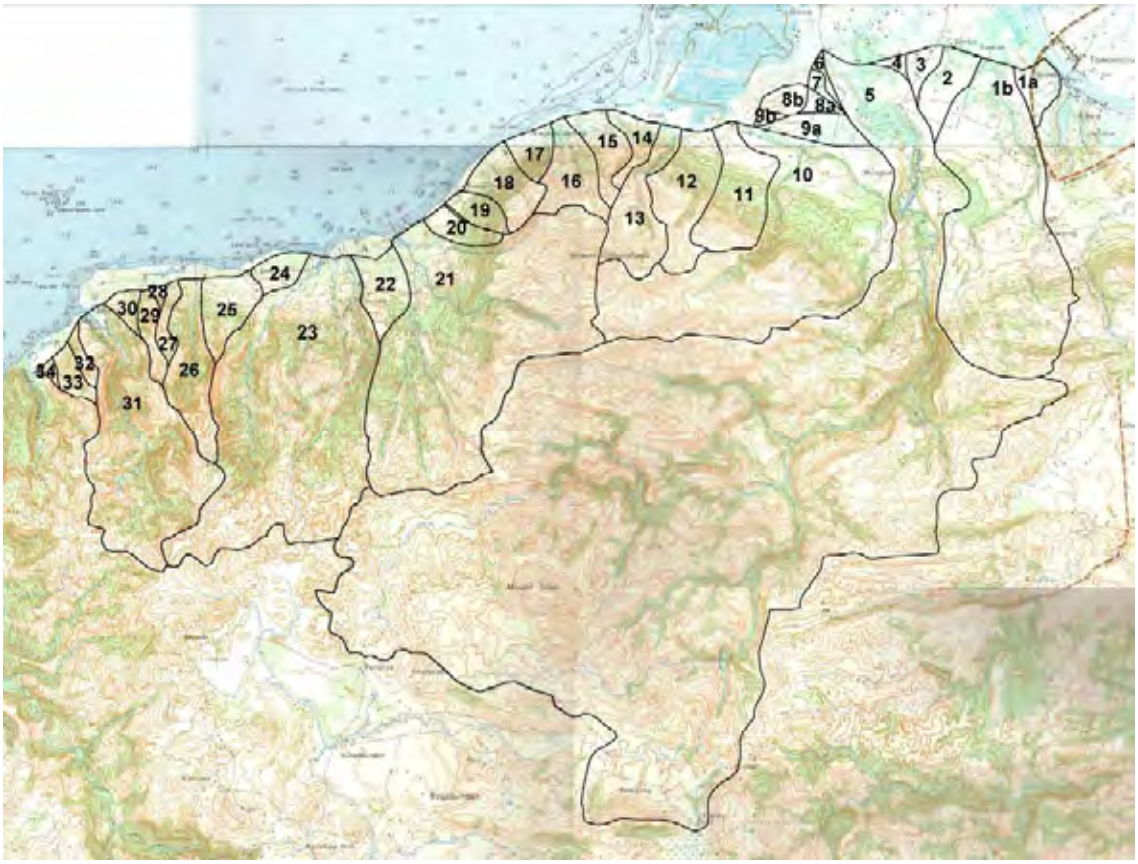


FIGURE 15.6.1-2 TAMONTAKA-TAPIAN ROAD: CATCHMENT AREA

The hydrological computations are shown in **Table 15.6.1-3** and **Table 15.6.1-4**. The tables show the different hydrological characteristics of the watersheds and related discharges.

TABLE 15.6.1-3 HYDROLOGICAL COMPUTATION FOR PINARING-SIMSIMAN ROAD

BASIN NUMBER	STATIONS		DISCHARGE		
	BEGINNING	END	2 year	5 year	50 year
			m^3/sec	m^3/sec	m^3/sec
1	0 + 000	2 + 560	7.20	10.38	17.13
2	2 + 560	5 + 600	15.45	22.50	37.49
3	5 + 600	6 + 240	7.95	11.51	19.08
4	6 + 240	6 + 870	3.90	5.60	9.22
5	6 + 870	7 + 550	1.01	1.45	2.38
6	7 + 550	8 + 000	13.39	19.47	32.39
7	8 + 000	8 + 880	39.48	57.55	96.02
8	8 + 880	10 + 060	4.21	6.08	10.04
9	10 + 060	10 + 550	3.86	5.58	9.21
10	10 + 550	10 + 770	1.74	2.51	4.13
11	10 + 770	10 + 950	1.07	1.53	2.53
12	10 + 950	11 + 100	0.70	1.00	1.64
13	11 + 100	12 + 400	15.78	23.07	38.60
14	12 + 400	12 + 820	3.51	5.07	8.39
15	12 + 820	13 + 360	0.79	1.14	1.88
16	13 + 360	14 + 240	1.38	1.98	3.26
17	14 + 240	14 + 740	3.09	4.46	7.37
18	14 + 740	15 + 360	5.73	8.28	13.69
19	15 + 360	16 + 080	8.37	12.10	20.04
20	16 + 080	16 + 800	3.09	4.44	7.30
21	16 + 800	17 + 640	8.85	12.83	21.28
22	17 + 640	18 + 600	1.58	2.27	3.73
23	18 + 600	19 + 160	1.96	2.81	4.62
24	19 + 160	19 + 420	0.49	0.70	1.16
25	19 + 420	19 + 700	1.89	2.72	4.48
26	19 + 700	20 + 110	1.51	2.16	3.54

TABLE 15.6.1-4 HYDROLOGICAL COMPUTATION FOR TAMONTAKA-TAPIAN ROAD

BASIN NUMBER	STATIONS		DISCHARGE		
	BEGINNING	END	2 year	5 year	50 year
			m^3/sec	m^3/sec	m^3/sec
1	0 + 000	1 + 300	14.46	21.16	35.41
2	1 + 300	1 + 700	4.22	6.08	10.04
3	1 + 700	2 + 300	2.13	3.07	5.05
4	2 + 300	3 + 000	0.91	1.30	2.14
5	3 + 000	4 + 000	111.80	163.15	272.50
6	4 + 000	4 + 420	0.66	0.95	1.56
7	4 + 420	4 + 800	0.73	1.05	1.74
8	4 + 800	5 + 500	3.47	4.99	8.21
9	5 + 500	6 + 000	3.14	4.54	7.51
10	6 + 000	6 + 400	34.92	50.57	83.86
11	6 + 400	6 + 800	13.28	19.09	31.41
12	6 + 800	7 + 400	12.77	18.36	30.22
13	7 + 400	7 + 800	10.83	15.58	25.66
14	7 + 800	8 + 750	4.45	6.38	10.47
15	8 + 750	9 + 500	6.57	9.43	15.49
16	9 + 500	9 + 700	9.48	13.61	22.37
17	9 + 700	10 + 850	5.14	7.35	12.06
18	10 + 850	12 + 000	8.57	12.30	20.20
19	12 + 000	12 + 300	4.34	6.22	10.21
20	12 + 300	12 + 700	4.13	5.92	9.72
21	12 + 700	13 + 500	46.23	66.72	110.28
22	13 + 500	14 + 300	7.05	10.12	16.64
23	14 + 300	14 + 800	45.02	65.14	107.90
24	14 + 800	16 + 200	3.30	4.74	7.80
25	16 + 200	17 + 000	8.37	12.00	19.71
26	17 + 000	17 + 400	10.42	15.00	24.73
27	17 + 400	17 + 600	2.48	3.56	5.85
28	17 + 600	18 + 050	0.69	0.99	1.62
29	18 + 050	18 + 150	4.47	6.39	10.48
30	18 + 150	19 + 100	2.63	3.76	6.17
31	19 + 100	19 + 600	27.59	39.85	65.90
32	19 + 600	19 + 850	1.99	2.85	4.67
33	19 + 850	20 + 250	3.40	4.87	7.99
34	20 + 250	20 + 600	0.89	1.27	2.09

15.6.2 Drainage Design

(1) Drainage System

The scheme used in conveying runoff across the road was by cross drains. The use of box culverts was not preferred due to limitations of the site conditions. Side ditches were designed to intercept and to take water away from the road as quickly as possible, thus protecting the pavement structure and subgrade.

(2) Drainage Structure

(a) Pipe Sizing

The principles/parameters that was used in the sizing of the pipes and drainage ditches is the Manning's equation for open channel flow. The equation was used to compute pipe capacities:

$$V = (1/n)\, R^{0.67}\, s^{0.5}$$

where:

V = mean velocity normal to the flow cross-section, in m/s
n = Manning's roughness coefficient, dimensionless.
R = A/P = hydraulic radius equal to the ratio of flow area to the wetted perimeter, meter.
A = the flow area is the cross-sectional area normal to the flow direction, m2
P = the wetted perimeter is the length of line of intersection of the wetted surface with a cross-sectional plane normal to the direction of flow, in meter.
s = slope of the energy grade line.

Manning's equation is an empirical formula used to compute uniform flow in open channels. Since uniform flow is assumed, s = the bottom slope.

(b) Design Parameter

The design parameters used for the appurtenances were as follows:

i. Minimum pipe sizes = ϕ900 mm for laterals.
   ϕ900mm for cross-drains
ii. Maximum pipe sizes = 1200mm for drainage mains
iii. Minimum pipe cover = 0.6 meter
iv. Minimum slope = 0.50%

(c) Materials

The design will consider concrete as the material for the pipelines as well as the appurtenances. The Manning's roughness coefficient (**n**),

which is a parameter that determines pipe properties, varies with the description of the surface. Representative values for Manning's roughness coefficient are given for various surface descriptions:

Concrete	0.010 to 0.017
Man-made earth ditch	0.017 to 0.025
Lined Ditch – grouted riprap	0.017 to 0.03

(g) <u>Size of Culvert for Drainage</u>

Based on the computation of discharge, size of road crossing pipe culverts werre determined as shown in **Table 15.6.2-1** and **Table 15.6.2-2**.

TABLE 15.6.2-1 HYDRAULIC CALCULATION FOR PINARING-SIMSIMAN ROAD

BASIN NUMBER	DISCHARGE	STATION	MANNING'S FORMULA			
			RCPC DIA mm Φ	SLOPE	CAPACITY	LENGTH
	m^3/sec	(km)			m^3/sec	(m)
1	17.13	0 + 213.41	Bridge	-	-	-
		1 + 044.91	1 - 900	0.065	4.59	12.00
		1 + 420.00	1 - 900	0.005	1.27	12.00
		1 + 600.00	1 - 900	0.005	1.27	12.00
		1 + 940.00	1 - 900	0.005	1.27	12.00
		2 + 350.00	1 - 900	0.005	1.27	12.00
2	37.49	2 + 750.00	1 - 900	0.005	1.27	12.00
		3 + 600.00	1 - 900	0.005	1.27	12.00
		4 + 040.00	1 - 900	0.005	1.27	11.00
		4 + 400.00	1 - 900	0.005	1.27	12.00
		4 + 700.00	1 - 900	0.005	1.27	12.00
		5 + 066.82	Bridge	-	-	-
		5 + 450.00	1 - 900	0.005	1.27	12.00
3	11.51	5 + 906.30	2 - 1200	0.0190	10.71	11.00
		6 + 134.40	1 - 1000	0.0240	3.70	12.00
		6 + 142.44	1 - 1300	0.0047	3.30	12.00
		6 + 144.31	1 - 1000	0.0033	1.38	12.00
4	5.60	6 + 464.33	2 - 1000	0.0051	3.41	12.00
		6 + 760.00	2 - 1200	0.005	5.49	12.00
5	1.45	7 + 050.00	1 - 900	0.005	1.27	12.00
		7 + 500.00	1 - 900	0.005	1.27	12.00
6	32.39	7 + 758.74	1 - 900	0.0025	0.90	12.00
		7 + 802.55	Bridge	-	-	-
		7 + 908.98	1 - 900	0.005	1.27	12.00
7	96.02	8 + 010.41	1 - 900	0.005	1.27	12.00
		8 + 152.36	Bridge	-	-	-
		8 + 431.98	1 - 900	0.005	1.27	12.00
		8 + 554.56	1 - 900	0.0949	5.55	12.00
		8 + 606.68	1 - 900	0.0506	4.05	12.00
		8 + 692.22	1 - 900	0.0079	1.60	12.00
8	6.08	8 + 978.03	1 - 1000	0.0333	4.36	12.00
		9 + 226.65	1 - 1000	0.0176	3.17	12.00
		9 + 468.80	1 - 1200	0.1240	13.67	12.00
		9 + 748.98	1 - 1000	0.0415	4.86	11.00

9	5.58	10 + 338.06	2 - 1200	0.006	6.02	12.00
10	2.51	10 + 662.30	1 - 1000	0.0303	4.15	12.00
11	1.53	10 + 900.00	1 - 1000	0.005	1.69	12.00
12	1.00	11 + 036.19	1 - 900	0.005	1.27	12.00
13	38.60	11 + 250.00	1 - 900	0.005	1.27	12.00
		11 + 363.22	1 - 900	0.0036	1.08	12.00
		11 + 472.09	Bridge	-	-	-
		11 + 740.00	1 - 900	0.005	1.27	12.00
		12 + 040.00	1 - 900	0.005	1.27	12.00
14	5.07	12 + 506.62	1 - 1200	0.005	2.75	12.00
		12 + 800.00	1 - 1200	0.005	2.75	12.00
15	1.14	13 + 050.00	1 - 900	0.005	1.27	12.00
		13 + 300.00	1 - 900	0.005	1.27	12.00
16	1.98	13 + 650.00	1 - 900	0.005	1.27	12.00
		14 + 011.80	1 - 900	0.005	1.27	12.00
17	4.46	14 + 450.00	2 - 1200	0.005	5.49	12.00
18	8.28	14 + 860.00	2 - 1200	0.005	5.49	11.00
		15 + 140.96	1 - 1300	0.0539	11.16	12.00
19	12.10	15 + 561.57	1 - 1000	0.0128	2.70	12.00
		15 + 626.11	1 - 1000	0.0219	3.53	12.00
		15 + 721.99	1 - 1000	0.0143	2.85	12.00
		15 + 755.94	1 - 1000	0.005	1.69	12.00
		15 + 900.00	1 - 1000	0.005	1.69	12.00
20	4.44	16 + 317.95	1 - 1000	0.002	0.98	12.00
		16 + 385.24	1 - 1000	0.0077	2.09	12.00
		16 + 600.00	1 - 1000	0.005	1.69	12.00
21	12.83	16 + 900.00	2 - 1200	0.005	5.49	12.00
		17 + 451.66	1 - 900	0.0536	4.17	12.00
		17 + 560.00	2 - 1200	0.005	5.49	12.00
22	2.27	17 + 758.72	1 - 900	0.040	3.59	12.00
		18 + 050.00	1 - 900	0.005	1.27	12.00
		18 + 209.83	1 - 900	0.0005	0.40	12.00
		18 + 463.55	2 - 1200	0.000	0.00	12.00
23	2.81	18 + 609.91	1 - 900	0.005	1.27	12.00
		18 + 768.65	1 - 900	0.005	1.27	11.00
		18 + 906.06	1 - 1000	0.0250	3.77	12.00
24	0.70	19 + 282.84	1 - 1000	0.0417	4.87	12.00
		19 + 382.70	1 - 900	0.0225	2.70	12.00
25	2.72	19 + 515.46	1 - 1000	0.0260	3.85	12.00
		19 + 624.34	1 - 1000	0.0730	6.45	12.00
26	2.16	19 + 748.77	1 - 1000	0.0289	4.06	12.00
		19 + 831.88	1 - 1000	0.0233	3.64	12.00

TABLE 15.6.2-2 HYDRAULIC CALCULATION FOR TAMONTAKA-TAPIAN ROAD

BASIN NUMBER	DISCHARGE	STATION	MANNING'S FORMULA			
			RCPC DIA mm Φ	SLOPE	CAPACITY m³/sec	LENGTH (m)
	m³/sec	(km)				
1	35.77	0 + 512.02	Bridge	-	-	-
		0 + 922.23	1 - 1000	0.0637	6.02	11.77
2	6.08	1 + 355.91	1 - 1000	0.0166	3.07	11.48
		1 + 357.66	1 - 600	0.0144	0.73	11.77
		1 + 359.44	1 - 600	0.0160	0.77	10.65
		1 + 489.59	3 - 1000	0.0109	7.47	8.25
3	3.07	1 + 712.38	1 - 600	0.0344	1.13	13.35
		2 + 228.43	1 - 900	0.0193	2.50	11.90
4	1.30	2 + 393.68	1 - 900	0.0227	2.71	12.31
5	278.07	3 + 855.05	Bridge	-	-	-
6	0.95	4 + 152.93	1 - 900	0.0000	0.00	11.57
		4 + 400.00	1 - 900	0.0050	1.27	12.00
7	1.05	4 + 651.46	1 - 900	0.0050	1.27	12.00
8	4.99	4 + 850.00	1 - 900	0.0050	1.27	12.00
		5 + 083.48	1 - 1000	0.0821	6.84	12.00
		5 + 261.48	1 - 1000	0.0828	6.87	12.00
		5 + 423.10	1 - 1000	0.0212	3.47	12.00
9	4.54	5 + 773.85	2 - 1200	0.0050	5.49	12.00
10	85.58	6 + 100.26	Bridge	-	-	-
11	19.09	6 + 496.57	2 - 1200	0.0070	6.50	12.00
		6 + 499.74	2 - 1200	0.0070	6.50	12.00
		6 + 800.00	2 - 1200	0.0070	6.50	12.00
12	18.36	7 + 000.00	2 - 1200	0.0150	9.51	12.00
		7 + 214.12	2 - 1200	0.0150	9.51	12.00
13	15.58	7 + 425.68	1 - 1200	0.0110	4.07	12.00
		7 + 535.22	1 - 1200	0.0272	6.40	12.00
		7 + 581.96	2 1200	0.0050	5.49	12.00
14	6.38	7 + 850.00	1 - 1200	0.0050	2.75	12.00
		8 + 618.15	2 - 1200	0.0050	5.49	12.00
15	9.43	9 + 050.00	2 - 1200	0.0050	5.49	12.00
		9 + 284.30	2 - 1200	0.0050	5.49	12.00
16	13.61	9 + 356.91	2 - 1200	0.0050	5.49	12.00
		9 + 435.40	2 - 1200	0.0050	5.49	12.00
		9 + 568.33	2 - 1000	0.1273	17.03	12.00
17	7.35	9 + 900.00	1 - 900	0.0050	1.27	12.00
		10 + 300.00	1 - 900	0.0050	1.27	12.00
		10 + 558.92	1 - 1000	0.0390	4.71	12.00
		10 + 771.18	1 - 900	0.0586	4.36	12.00
18	12.30	11 + 031.15	2 - 1200	0.0260	12.52	12.00
19	6.22	11 + 500.00	1 - 1000	0.0050	1.69	12.00
		11 + 750.00	1 - 1200	0.0050	2.75	12.00
		12 + 097.13	1 - 1200	0.0050	2.75	12.00
20	5.92	12 + 550.00	2 - 1200	0.0060	6.02	12.00
21	91.80	13 + 040.00	2 - 1200	0.0850	22.64	12.00
		13 + 270.33	5 - 1200	0.1300	70.00	12.00
22	10.12	13 + 648.34	1 - 1200	0.0500	8.68	12.00
		13 + 850.00	1 - 1200	0.0050	2.75	12.00
		14 + 100.00	2 - 1200	0.0050	5.49	12.00
23	108.99	14 + 550.00	1 - 900	0.0050	1.27	12.00

		14 + 754.47	Bridge	-	-	-
24	4.74	15 + 035.87	1 - 900	0.0050	1.27	12.00
		15 + 530.00	1 - 900	0.0050	1.27	12.00
		15 + 689.24	1 - 900	0.0050	1.27	12.00
		15 + 861.68	1 - 1000	0.0081	2.15	12.00
25	12.00	16 + 400.00	1 - 1200	0.0050	2.75	12.00
		16 + 650.00	2 - 1200	0.0050	5.49	12.00
		16 + 850.00	2 - 1200	0.0050	5.49	12.00
26	24.73	17 + 129.70	Bridge	-	-	-
27	3.56	17 + 500.00	2 - 1200	0.0050	5.49	12.00
28	0.99	17 + 800.00	1 - 900	0.0050	1.27	12.00
29	6.39	18 + 050.00	2 - 1200	0.0070	6.50	12.00
30	3.76	18 + 350.00	1 - 900	0.0050	1.27	12.00
		18 + 650.00	1 - 900	0.0050	1.27	12.00
		18 + 950.00	1 - 900	0.0050	1.27	12.00
		19 + 300.00	1 - 900	0.0050	1.27	12.00
31	66.56	19 + 354.67	Bridge	-	-	-

15.6.3 High Water Level at River Crossing Points

The flood levels were verified through computation and then compared to the observed flood height which was confirmed through interview to residents living near the rivers. The flood levels were then evaluated to come up with the appropriate design flood level for each area.

As the result of above computation, Design High Water Level was determined as shown below. In case the computed HWL is below the observed one, the observed HWL is considered as Design High Water Level.

PINARING-SIMSIMAN ROAD

	Observed HWL	Computed HWL (50y)	Flow Velocity	D.H.W.L
Salam Bridge 1	6.37 m.	5.24m	0.90	6.37 m
Salam Bridge 2	9.60 m	8.65m	1.39	9.60 m.
Salam Bridge 3	5.72 m.	4.44m	3.34	5.72 m
Salam Bridge 4	9.76 m	9.66m	1.50	9.76 m

TAMONTAKA-TAPIAN ROAD

	Observed	Computed HWL (50y)	Flow Velocity	D.H.W.L
Salam Bridge 1	4.72 m.	4.72m	1.78 m/s	4.72 m
Salam Bridge 2	1.97 m	1.74m	2.57 m/s	1.97m
Salam Bridge 3	1.97 m	1.97m	10.98m/s	1.97 m
Salam Bridge 4	2.59 m	2.71m	3.08m/s	2.71 m

Based on the above examination, it was concluded that Salam Bridge No.1 at Tamontaka-Tapian Road has not sufficient freeboard between said HWL and bottom of bridge girder. In this regard, the Salam Bridge No.1 at Tamontaka-Tapian Road needs to be replaced to accommodate appropriate freeboard on HWL and other bridges are currently satisfying the requirement for the freeboard.

15.7 BRIDGE DESIGN

15.7.1 Evaluation of Existing Bridges

PINARING-SIMSIMAN ROAD

No.	Bridge Name	Existing Bridge Length (m)	Type	Station No	Structural Condition	Situation	Measures to be undertaken
1	LIMBO Br.	18.3	RCDG (2-Lane)	0+222	Fair	• Less damage • Close by houses	None
2	SALAM Br.-1	27.4	Bailey (1-Lane)	5+080	Fair	• Constructed in 2001. • Old concrete box culvert is • Bridge width is 3.5m (1-Lane) only.	Reconstruction of the Bridge
3	SALAM Br.-2	21.5	Bailey (2-Lane)	7+813	Fair	• Constructed in 2001. • Abutment protection is damaged	Rehabilitation of Abutment Protection
4	SALAM Br.-3	36.8	Bailey (2-Lane)	8+170	Fair	• Constructed in 2001. • Abutment protection is damaged	Rehabilitation of Abutment Protection
5	SALAM Br.-4	24.6	Bailey (2-Lane)	11+436	Fair	• Constructed in 2001. • Abutment protection is damaged	Rehabilitation of Abutment Protection

TAMONTAKA-TAPIAN ROAD

No.	Bridge Name	Existing Bridge Length (m)	Type	Station No	Structural Condition	Situation	Measures to be undertaken
1	SPDA Br.	15.5	RCDG (2-Lane)	0+520	Fair	• Less damage • Close by houses	None
2	LINEK Br.	30.2	RCDG (2-Lane)	3+870	Fair	• Less damage	None
3	SALAM Br.-1	21.6	Bailey (2-Lane)	6+111	Fair	• Constructed in 2001. • Insufficient Freeboard on H.W.L	Reconstruction of the Bridge
4	SALAM Br.-2	52.1	Bailey (2-Lane)	14+780	Fair	• Constructed in 2001. • River bank at up-stream of the bridge is suffering from erosion.	River bank protection to prevent from erosion
5	SALAM Br.-3	12.5	Bailey (2-Lane)	17+135	Fair	• Constructed in 2001. • Abutment protection is damaged	Rehabilitation of Abutment Protection
6	SALAM Br.-4	33.8	Bailey (2-Lane)	19+370	Fair	• River bank at up-stream of the bridge is suffering from erosion.	River bank protection to prevent from erosion

15.7.2 Comparative Study for Alternative Bridge Type

(a) Span Arrangement and Superstructure Type for Salam Bridge # 1, Length = 22.80 m (Pinaring Simsiman Road)

Since bridge length is short at 22 m, the following 3 schemes were compared (refer to **Table 15.7.2-1**).

	Bridge Length	Span Arrangement	Superstructure Type
Scheme A	22.0 m	1 span	PCDG
Scheme B	22.0 m	1 span	Steel H Girder
Scheme C	22.0 m	3 spans (6+10+6)	RC Slab

(b) Span Arrangement and Superstructure Type for Salam Bridge # 1, Length = 24.80 m (Tamontaka-Tapian Road)

Since bridge length is short at 24 m, the following 3 schemes were compared (refer to **Table 15.7.2-2**),

	Bridge Length	Span Arrangement	Superstructure Type
Scheme A	24.0 m	1 span	PCDG
Scheme B	24.0 m	1 span	Steel H Girder
Scheme C	24.0 m	3 spans (6+12+6)	RC Slab

TABLE 15.7.2-1 SUPERSTRUCTURE TYPE FOR SALAM BRIDGE # 1 (PINARING-SIMSIMAN ROAD)

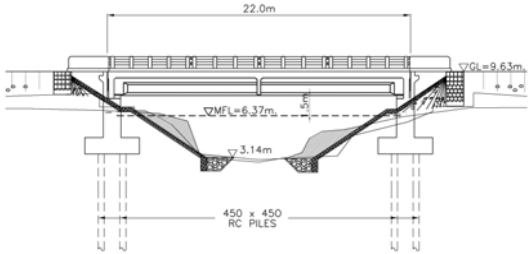
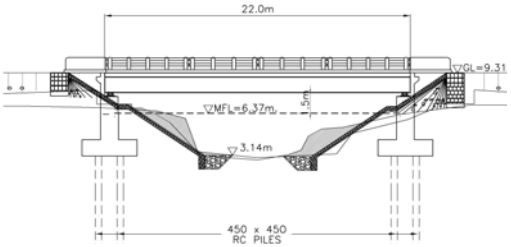
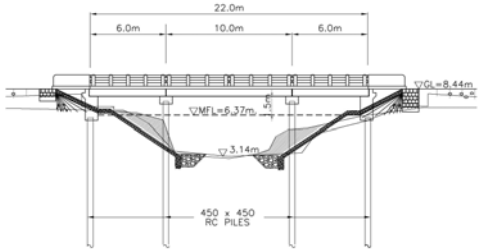
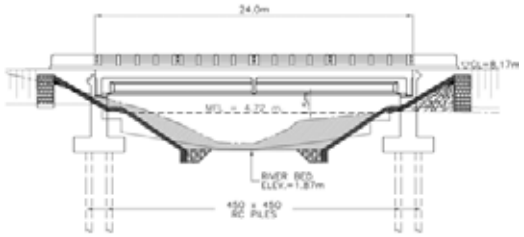
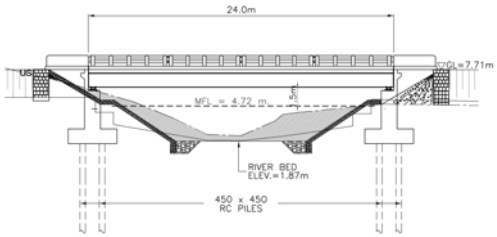
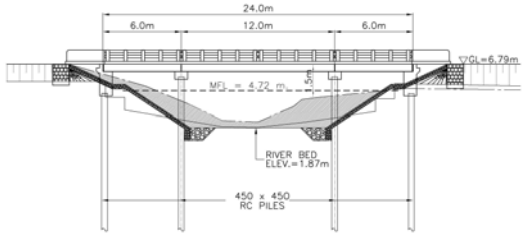
	Scheme A PC Girder Bridge	**Scheme B** Steel H Girder Bridge	**Scheme C** Reinforced Concrete Deck Slab Bridge
ELEVATION	 Height of the girder: 1.6m	 Height of the girder : 1.25m	 Height (Thickness) of the slab : 0.6m
OVERVIEW	• This scheme has the highest finished grade elevation required. (+1.9m from existing level) • Advantageous where it is impossible to put the formworks for superstructure construction. • One span bridge having no piers will pose no threat of obstruction to free flow of water.	• The finish grade elevation will be 1.6m higher than existing elevation. • Advantageous where it is impossible to put the formworks for superstructure construction. • One span bridge having no piers will pose no threat of obstruction to free flow of water.	• This scheme has the least finished grade elevation required. (+0.7m from existing level) • The kind of soil strata as per geotechnical survey suggests possible settlement, so that a multi-span bridge designed as not continuous is best suited for this bridge to avoid affect of settlement. • Scouring around piers is to be considered.
CONSTRUCTION	• Bigger crane capacity will be required for girder erection. • Least Construction Period.	• Heavy vehicle will be required for transportation of the steel girders. • Coating will be carried out at the site.	• Formworks required in the superstructure construction. This requires longer construction period than other schemes.
MAINTENANCE	• Easy and the least maintenance cost	• Expensive and frequent maintenance is required for steel members.	• Maintenance work for crack on the concrete slab is required.
CONSTRUCTION COST	PhP 22.06 M	PhP 23.93 M	PhP 13.80 M
EVALUATION	-	-	**RECOMMENDED**

TABLE 15.7.2-2 SUPERSTRUCTURE TYPE FOR SALAM BRIDGE # 1 (TAMONTAKA-TAPIAN ROAD)

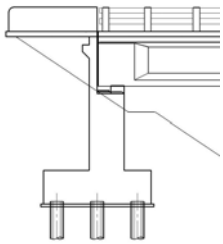
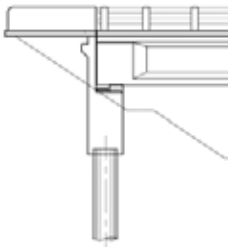
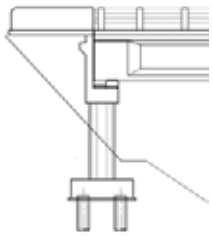
	Scheme A PC Girder Bridge	**Scheme B** Steel H Girder Bridge	**Scheme C** Reinforced Concrete Deck Slab Bridge
ELEVATION	 Height of the girder: 1.75m	 Height of the girder: 1.4m	 Height (Thickness) of the slab : 0.6m
OVERVIEW	• This scheme has the highest finished grade elevation required. (+2.6m from existing level) Houses at the vicinity of the bridge will be affected. • Advantageous where it is impossible to put the formworks for superstructure construction. • One span bridge having no piers will pose no threat of obstruction to free flow of water.	• The finish grade elevation will be 2.3m higher than existing elevation. • Advantageous where it is impossible to put the formworks for superstructure construction. • One span bridge having no piers will pose no threat of obstruction to free flow of water.	• This scheme has the least finished grade elevation required. (+1.4m from existing level) • The kind of soil strata as per geotechnical survey suggests possible settlement, so that a multi-span bridge designed as not continuous is best suited for this bridge to avoid affect of settlement. • Scouring around piers is to be considered.
CONSTRUCTION	• Bigger crane capacity will be required for girder erection. • Least Construction Period.	• Heavy vehicle will be required for transportation of the steel girders. • Coating will be carried out at the site.	• Formworks required in the superstructure construction. This requires longer construction period than other schemes.
MAINTENANCE	• Easy and the least maintenance cost	• Expensive and frequent maintenance is required for steel members.	• Maintenance work for crack on the concrete slab is required.
CONSTRUCTION COST	PhP 24.06 M	PhP 26.10 M	PhP 15.04 M
RECOMMENDATION	-	-	**RECOMMENDED**

15.7.3 Substructures

(a) Abutments

A substructure unit which supports the end of a single span or extreme end of a multi-span superstructure, and which usually retains or supports the approach fill. Based on said comparison, Pile Bent Type was selected.

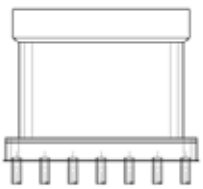
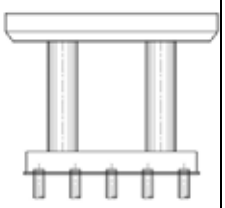
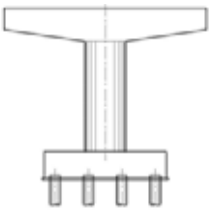
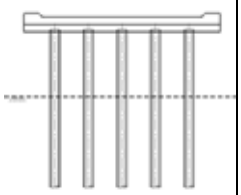
TABLE 15.7.2-3 TYPES OF ABUTMENTS

Closed or Wall Type	Pile Bent Type	Spill Thru Type
		
This type is applicable for high embankment approaches. This type will aid in retaining high earth fill and is most practical to use when the existing soil that will be retained is not stable. The footing can either be on spread footing or piled foundation.	This type is used for short span bridges built integral to the superstructure like RC Flat Slab or RC Deck Girder. These substructures are used where the pile exposure above natural ground is not more than two meters.	This type maybe two column or multiple column bent and are used when the fill at the approach is more than three meters high and when the river bank is stable.
-	**Recommended**	-

(b) Piers

Bridge piers transmit the load from the superstructure to the foundation material and provide intermediate supports between abutments. Based on said comparison, Pile Bent Type was selected.

TABLE 15.7.2-4 TYPES OF PIERS

Wall Type	Multi-Column	Single Column Type	Pile Bent Type
			
This type is used in river crossings where debris is present and the flow of stream is fast. The pier should be built parallel to the flow of stream to avoid much soil erosion.	When the river crossing has no debris or when debris amount is negligible, this type can be used.	This type of Pier is used to avoid skewed piers or in elevated highways where location of foundation is limited or restricted.	This type can be used for short span bridges usually the RC Slab type. The maximum height of pier bent shall be 4.00 m from the river bed to the top of top of bridge seat.
-	-	-	**Recommended**

15.7.4 Preliminary Design of Bridges

Preliminary design drawings are presented in **Annex 15-1**.

15.8 BARANGAY ROAD

15.8.1 Subject Barangay Road to be Improved

There are 13-barangay road in Pinaring-Simsiman Road (Total Length=42km) and 20-Barangay Road (Total Length =24 km) in Tamontaka-Tapian Road. The target roads to be improved were selected through following considerations.

1) To contribute to agricultural production.
2) To contribute to fishery production.

Following tables are showing existing length of the Barangay roads and target road to be improved.

TABLE 15.8.1-1 SUBJECT BARANGAY ROAD AT PINARING-SIMSIMAN ROAD

NO.	STATION	ROAD NAME	LENGTH (km)	TARGET (km)
1	01+254	BRGY. UNGAP - RICEFIELD	0.50	
2	05+342	BRGY. PINARING - TANGUISAN	1.10	1.10
3	05+484	BRGY. PINARING - BRGY. LADIA	5.50	
4	08+304	BRGY. IBOTIGEN - BRGY. NARA	3.20	3.20
5	08+900	BRGY. IBOTIGEN - BRGY. DAMANIOG	6.00	
6	11+130	BRGY. PINARING - BRGY. BANATIN	2.20	2.20
7	11+130	BRGY. PANATAN - BRGY. ALAMADA	6.50	
8	11+970	BRGY. DATU BINASING - BRGY. LOWER BAGUER	2.80	2.80
9	14+823	BRGY. SIMSIMAN - BRGY. LIBUNGAN TORRETA	8.70	8.70
10	15+380	BRGY. MALAGAKIT - RICEFIELD	0.20	
11	16+362	BRGY. MALAGAKIT - CENTRAL PANATAN	4.10	
12	16+468	BRGY. MALAGAKIT - RICEFIELD	0.75	0.75
13	19+240	BRGY. SOUTH MALAGAKIT - MANGO PLANTATION	0.20	
		TOTAL	41.75	18.75

TABLE 15.8.1-2 SUBJECT BARANGAY ROAD AT TAMONTAKA-TAPIAN ROAD

NO.	STATION	ROAD NAME	LENGTH (km)	TARGET (km)
1	00+069	BRGY. TAMONTAKA - SITIO BROCE	0.55	
2	00+262	BRGY. TAMONTAKA - SITIO TINAGO	0.25	
3	00+302	BRGY. TAMONTAKA - UPPER TAMONTAKA	0.63	
4	00+684	BRGY. SEMBA - SITIO SAWAN	0.40	
5	01+088	BRGY. SEMBA SUBDIVISION ROAD	1.24	
6	01+088	BRGY. SEMBA - BRGY. AWANG	1.20	
7	02+908	BRGY. DINAIG PROPER - QUARRY SITE	0.88	
8	03+907	BRGY. DINAIG PROPER - SITIO TULUGAN	0.68	
9	04+116	BRGY. DINAIG PROPER - SITIO DINAIG	0.90	
10	05+377	BRGY. DINAIG PROPER - BRGY. AWANG	2.60	2.60
11	05+848	BRGY. MOMPONG - SITIO TAMBER	1.20	1.20
12	06+176	BRGY. MOMPONG - MOMPONG PROPER	0.30	0.30
13	08+494	BRGY. LINEK - SITIO LASDAN	2.20	2.20
14	08+854	BRGY. LINEK - SITIO GAGADIAW	0.92	0.92
15	12+967	BRGY. BADAK - SITIO SIRINGANAN	2.00	2.00
16	14+465	BRGY. BADAK - SITIO SILONGKIF	1.40	1.40
17	15+459	BRGY. KUSHIONG - SITIO PINUTULAN	1.60	1.60
18	17+194	BRGY. KUSHIONG - BRGY. TAPIAN	2.50	2.50
19	19+048	BRGY. TAPIAN - SITIO PARAMAN	0.60	0.60
20	19+747	BRGY. TAPIAN - SITIO BIDEK	1.80	1.80
		TOTAL	23.85	17.12

15.8.2 Typical Cross Sections

A normal crossfall of 2.5% was used for the traveled way all throughout the base course pavement and 4.0% shoulder were adopted. A two (2) lane width of 2.0m and 1.0m shoulder.

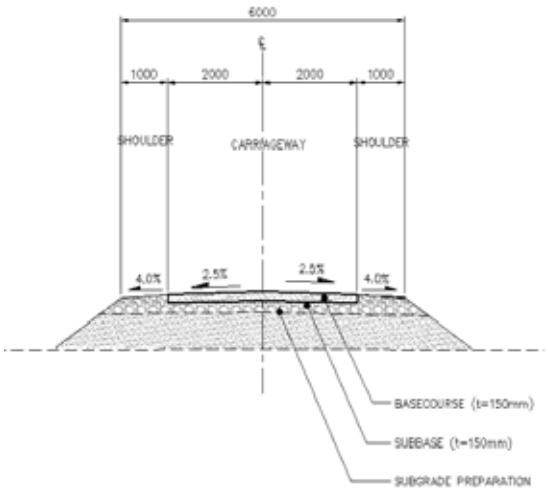


FIGURE 15.8.2-1 TYPICAL CROSS – SECTIONS OF BARANGAY ROAD

15.9 PROJECT COST ESTIMATE

15.9.1 Construction Cost

(1) Price Level

The price level adopted was December 2009.

(2) Unit Price

Unit prices determined based on the unit price analysis (refer to **Annex 15-2**) are shown in **Table 15.9.1-1**.

TABLE 15.9.1-1 UNIT PRICE LIST ((1/2)

ITEM NO.	DESCRIPTION	UNIT	CONPONENTS, (%)			UNIT COST (Php)	CONPONENTS, Php		
			Foreign	Local	Taxes		Foreign	Local	Taxes
	PART A: FACILITIES FOR THE ENGINEER	%	---	---	---	3.00%	---	---	---
	Cost = ratio x total of Part C,D,E,F and G								
	PART B: OTHER GENERAL REQUIREMENT	%	---	---	---	3.00%	---	---	---
	Cost = ratio x total of Part C,D,E,F and G								
	PART C: EARTHWORKS								
100.2.1	Clearing and Grubbing	ha	56.00%	26.00%	18.00%	202,500.00	113,400.00	52,700.00	36,400.00
101.1.1	Removal of Existing Bridge	ls	56.00%	26.00%	18.00%	150,000.00	84,000.00	39,000.00	27,000.00
101.2.2	Removal of Existing Concrete Structure	cum	56.00%	26.00%	18.00%	3,300.00	1,800.00	900.00	600.00
101.2.4	Removal of Existing Concrete Pavement	sqm	56.00%	26.00%	18.00%	710.00	400.00	180.00	130.00
102.2.9	Roadway Excavation and Disposal (Including Section with CBR < 3)	cum	58.00%	16.00%	26.00%	410.00	240.00	70.00	100.00
103.1	Bridge Excavation Common Above O.W.L	cum	52.00%	30.00%	18.00%	490.00	250.00	150.00	90.00
103.2	Bridge Excavation Common Below O.W.L	cum	50.00%	33.00%	17.00%	990.00	500.00	330.00	160.00
103.3	Structural Backfill	cum	53.00%	19.00%	28.00%	790.00	420.00	150.00	220.00
103.4	Excavation for Pipe Culverts and Headwall Type F Inletes/Outlets Including Side Ditch	cum	53.00%	19.00%	28.00%	510.00	270.00	100.00	140.00
104.2.1	Selected Fill from Roadway Excavation	cum	53.00%	19.00%	28.00%	600.00	320.00	110.00	170.00
104.2.2	Selected Fill from Borrow Pit	cum	55.00%	29.00%	16.00%	1,080.00	590.00	310.00	180.00
104.2.4	Selected Fill for Replacement of Span with CBR < 3	cum	55.00%	29.00%	16.00%	1,080.00	590.00	310.00	180.00
105.3	Sub-grade Preparation	sqm	56.00%	26.00%	18.00%	50.00	30.00	10.00	10.00
	PART D: SUBBASE AND BASE COURSE								
200	Aggregate Subbase Course	cum	53.00%	31.00%	16.00%	900.00	480.00	280.00	140.00
202	Crushed Aggregate Base Course	cum	53.00%	31.00%	16.00%	940.00	500.00	290.00	150.00
	PART E: SURFACE COURSE								
311	Portland Cement Concrete Pavement (230mm thick)	sqm	61.00%	22.00%	17.00%	2,150.00	1,300.00	500.00	350.00

TABLE 15.9.1-1 UNIT PRICE LIST ((2/2)

ITEM NO.	DESCRIPTION	UNIT	CONPONENTS, (%)			UNIT COST (Php)	CONPONENTS, Php		
			Foreign	Local	Taxes		Foreign	Local	Taxes
	PART F: STRUCTURES								
400.1	Pre-Cast Concrete Piles, 450mm x 450mm, Furnished	lm	51.00%	27.00%	22.00%	11,500.00	5,900.00	3,100.00	2,500.00
400.2	Pre-Cast Concrete Piles, 450mm x 450mm, Driven	lm	51.00%	27.00%	22.00%	300.00	200.00	100.00	0.00
400.3	Test Piles, 450mm x 450mm, Furnished and Driven	lm	51.00%	34.00%	15.00%	19,900.00	10,100.00	6,800.00	3,000.00
401	Concrete Railing	lm	37.00%	48.00%	15.00%	500.00	200.00	200.00	100.00
404	Reinforcing Steel Bars, Grade 40	kg	49.00%	36.00%	15.00%	100.00	50.00	40.00	10.00
405.1	Structural Concrete, 28 MPa	cum	33.00%	49.00%	18.00%	6,700.00	2,200.00	3,300.00	1,200.00
405.2	Structural Concrete, 21 MPa	cum	33.00%	49.00%	18.00%	5,800.00	1,900.00	2,800.00	1,100.00
405.4	Lean Concrete, 17MPa	cum	42.00%	36.00%	22.00%	5,100.00	2,100.00	1,800.00	1,200.00
406	Elastomeric Bearing Pads	each	54.00%	29.00%	17.00%	6,700.00	3,600.00	1,900.00	1,200.00
407	Pre-formed Expansion Joint Filler with Sealant, 12mm thick	lm	54.00%	29.00%	17.00%	10,900.00	5,900.00	3,200.00	1,800.00
	PART G: DRAINAGE AND SLOPE PROTECTION STRUCTURES								
500(1)a	RCPC, 610mm diameter	lm	56.00%	27.00%	17.00%	6,000.00	3,400.00	1,600.00	1,000.00
500(1)b	RCPC, 910mm diameter	lm	56.00%	27.00%	17.00%	10,500.00	5,900.00	2,800.00	1,800.00
500(1)c	RCPC, 1000mm diameter	lm	56.00%	27.00%	17.00%	16,800.00	9,400.00	4,500.00	2,900.00
500(1)e	RCPC, 1220mm diameter	lm	56.00%	27.00%	17.00%	19,700.00	11,000.00	5,300.00	3,400.00
500(2)1	RC Side Ditch, Type Cs-concrete Lined Ditch	lm	37.00%	46.00%	17.00%	3,400.00	1,300.00	1,600.00	500.00
500(2)2	RC Side Ditch, Type Bm-masonry Lined Ditch	lm	37.00%	46.00%	17.00%	1,300.00	480.00	600.00	220.00
500(2)3	RC Side Ditch, Type UD-C Ditch with Cover	lm	37.00%	46.00%	17.00%	9,600.00	3,600.00	4,400.00	1,600.00
500(2)a	Inlet/Outlet Headwall, 610mm diameter, Type F	each	27.00%	56.00%	17.00%	14,400.00	3,900.00	8,100.00	2,400.00
500(2)b	Inlet/Outlet Headwall, 910mm diameter, Type F	each	27.00%	56.00%	17.00%	25,900.00	7,000.00	14,500.00	4,400.00
500(2)c	Inlet/Outlet Headwall, 1000mm diameter, Type F	each	29.00%	54.00%	17.00%	32,200.00	9,300.00	17,400.00	5,500.00
500(2)e	Inlet/Outlet Headwall, 1220mm diameter, Type F	each	30.00%	53.00%	17.00%	38,800.00	11,600.00	20,600.00	6,600.00
504	Grouted Riprap	cum	38.00%	45.00%	17.00%	3,500.00	1,300.00	1,600.00	600.00
506	Hand Laid Rock Embankment (Loose Boulder Apron)	cum	38.00%	45.00%	17.00%	2,300.00	870.00	1,040.00	390.00
508	Stone Masonry	cum	54.00%	29.00%	17.00%	3,000.00	1,600.00	900.00	500.00
509	Gabion Mattress, 1.0m x 2.0m x 0.5m (Including Geotextile)	cum	50.00%	33.00%	17.00%	5,700.00	2,900.00	1,900.00	900.00
	PART H: MISCELLANEOUS	km	57.00%	26.00%	17.00%	1,500,000.00	855,000.00	390,000.00	255,000.00
	PART I: DAYWORKS	%	---	---	---	2.00%	---	---	---
	Cost = ratio x total of Part C,D,E,F and G								
	PART J: PROVISIONAL SUMS	%	---	---	---	2.00%	---	---	---
	Cost = ratio x total of Part C,D,E,F and G								
	PART K: PHISICAL CONTINGENCIES	%	---	---	---	15.00%	---	---	---
	Cost = ratio x total of Part C,D,E,F and G								

(3) Estimated Construction Cost

Estimated construction cost for Pinaring-Simsiman Road and Tamontaka-Tapia Road is shown in **Table 15.9.1-2** and **15.9.1-3**, respectively.

TABLE 15.9.1-2 ESTIMATED CONSTRUCTION COST (PINARING-SIMSIMAN ROAD)

(Unit: Million PhP)

ITEM/DESCRIPTION		Total	Foreign	Local	Unskilled Laborer	Taxes
Part A	Facilities for the Engineer	13.95	7.89	3.69	0.48	2.37
Part B	Other General Requirement	13.95	7.89	3.69	0.48	2.37
Part C	Earthworks	99.25	55.52	23.77	1.18	19.96
Part D	Subbase and Base Course	20.14	10.74	6.27	0.06	3.13
Part E	Surface Course	298.06	175.93	73.77	13.36	48.36
Part F	Structures	16.08	7.60	6.00	0.58	2.48
Part G	Drainage & Slope Protection Structure	31.48	13.18	13.13	0.81	5.17
Part H	Miscellaneous	27.66	15.77	7.19	0.43	4.70
Part I	Dayworks	9.30	5.26	2.46	0.32	1.58
Part J	Provisional Sums	9.30	5.26	2.46	0.32	1.58
Part K	Physical Contingencies	69.76	39.45	18.44	2.40	11.87
	Grand Total	608.93	344.49	160.87	20.42	103.57

TABLE 15.9.1-3 ESTIMATED CONSTRUCTION COST (TAMONTAKA-TAPIAN ROAD)

(Unit: Million PhP)

ITEM/DESCRIPTION		Total	Foreign	Local	Unskilled Laborer	Taxes
Part A	Facilities for the Engineer	11.98	6.73	3.25	0.41	2.00
Part B	Other General Requirement	11.98	6.73	3.25	0.41	2.00
Part C	Earthworks	64.65	36.06	16.43	0.73	12.16
Part D	Subbase and Base Course	17.03	9.08	5.30	0.05	2.65
Part E	Surface Course	255.83	150.77	63.56	11.30	41.50
Part F	Structures	26.08	12.60	9.25	0.85	4.23
Part G	Drainage & Slope Protection Structure	35.84	15.89	13.94	0.86	6.01
Part H	Miscellaneous	23.25	13.25	6.05	0.36	3.95
Part I	Dayworks	7.99	4.49	2.17	0.28	1.33
Part J	Provisional Sums	7.99	4.49	2.17	0.28	1.33
Part K	Physical Contingencies	59.91	33.66	16.27	2.07	9.98
	Grand Total	522.53	293.75	141.64	17.60	87.14

15.9.2 ENGINEERING SERVICES COST

The cost for engineering services is estimated as shown in **Table 15.9.2-1** and **15.9.2-2**, on the basis of the proposed manning schedule (refer to **Annex 15-3**).

TABLE 15.9.2-1 ENGINEERING SERVICES COST: PINARING-SIMSIMAN ROAD

(Unit: Million PHP)

DESCRIPTION	Total	Foreign	Local		Taxes
				Unskilled Laborer	
Detailed Design	25.37	12.64	10.99	1.10	1.74
Tender Assistance	10.74	6.80	3.42	0.56	0.52
Construction Supervision	60.84	24.78	31.43	3.67	4.63
Grand Total	96.95	44.22	45.84	5.33	6.89

TABLE 15.9.2-1 ENGINEERING SERVICES COST: TAMONTAKA-TAPIAN ROAD

(Unit: Million PHP)

DESCRIPTION	Total	Foreign	Local		Taxes
				Unskilled Laborer	
Detailed Design	25.37	12.64	10.99	1.10	1.74
Tender Assistance	10.74	6.80	3.42	0.56	0.52
Construction Supervision	56.69	23.45	28.97	3.37	4.27
Grand Total	92.80	42.89	43.38	5.03	6.53

15.10 PROJECT IMPLEMENTATION PLAN

15.10.1 Overall Implementation Schedule

Overall implementation schedule is shown in **Table 15.10.1-1** for Pinaring-Simsiman Road and in **Table 15.10.1-2** for Tamontaka-Tapian Road.

TABLE 15.10.1-1 IMPLEMENTATION SCHEDULE FOR PINARING-SIMSIMAN ROAD

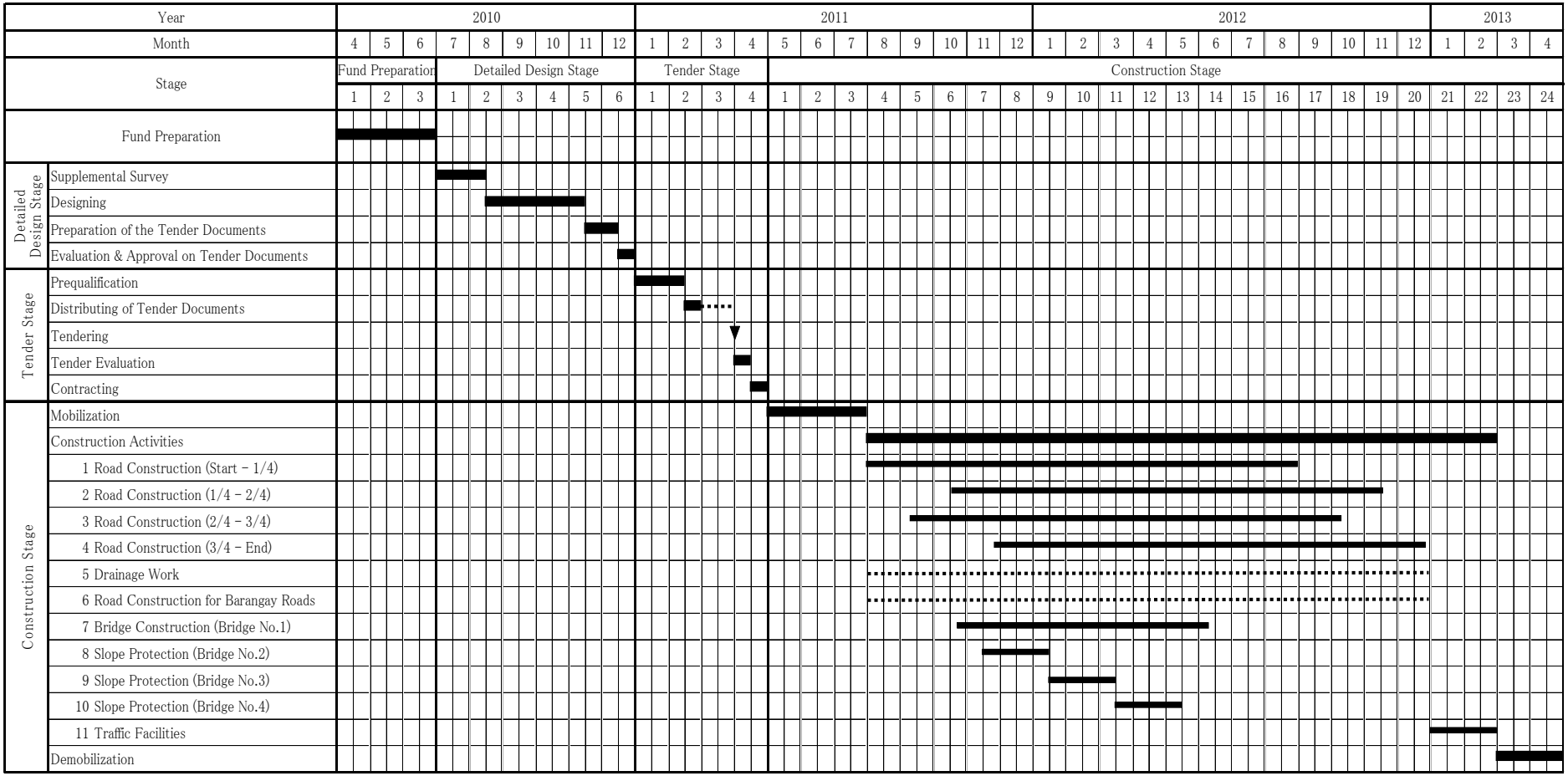
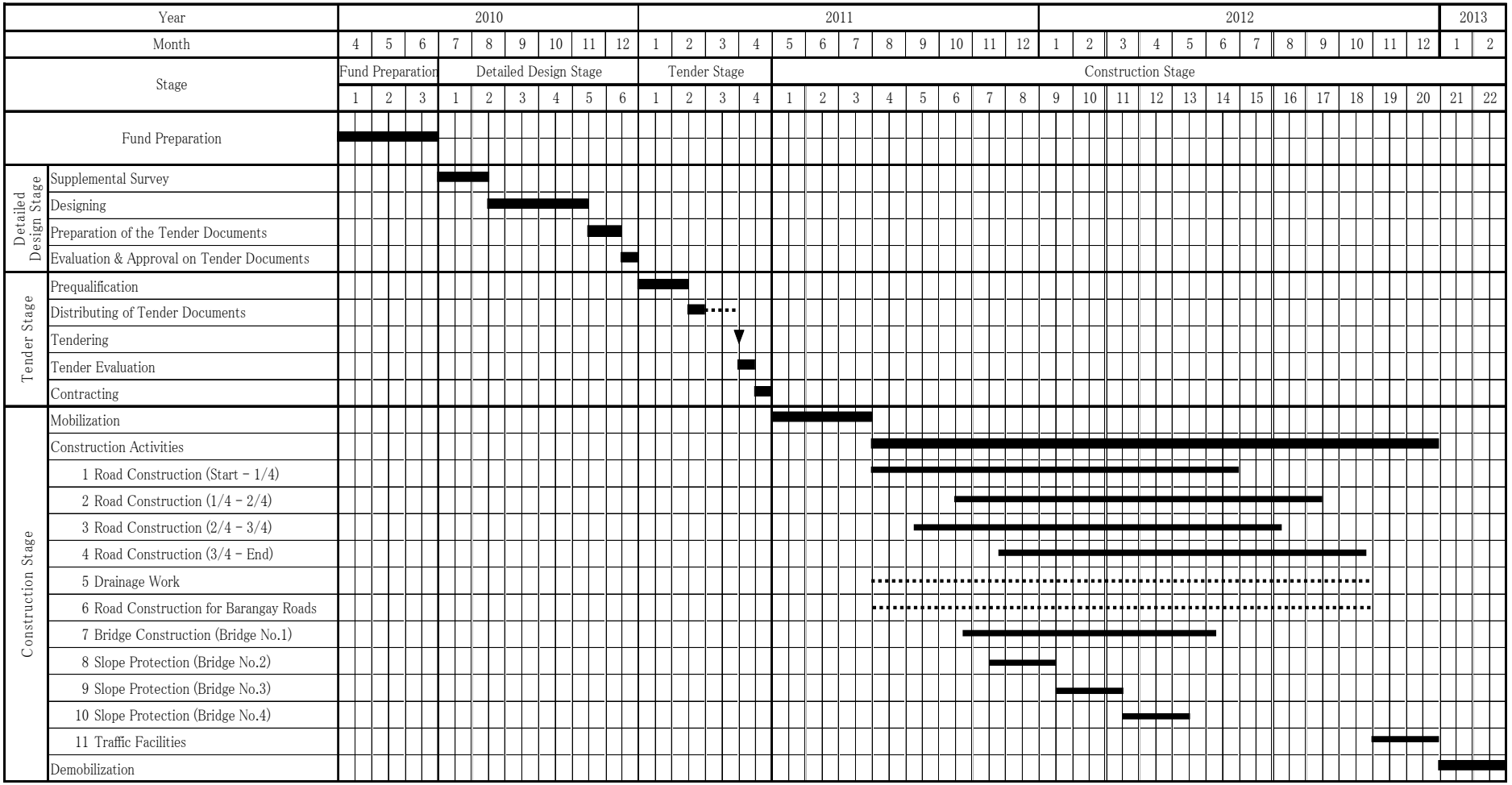


TABLE 15.10.1-2 IMPLEMENTATION SCHEDULE FOR TAMONTAKA-TAPIAN ROAD



(1) Detailed Design Stage

In addition to the survey data prepared in the preliminary design stage, the following supplemental surveys are to be carried out during the detailed design stage:

- Cross-Sectional Survey at 20 m interval,
- Geotechnical Survey (Boring, Penetration Test and Sampling) at 500 m interval and
- Geotechnical Survey (Boring, Penetration Test and Sampling) at the locations of bridges

To be prepared in the detailed design stage are the tender documents, including the tender drawings and specifications for the construction works, which will be used mainly for the bidding and contracting procedures. The major construction work items are as listed below:

- Road construction including earthworks, pavement works and traffic facilities;
- Drainage construction including pipe culverts; and
- Bridge construction.

The detailed design stage is estimated to be six (6) months, as shown in **Table 15.10.1-3**.

TABLE 15.10.1-3 DETAILED DESIGN PERIOD

Items of Work	Estimated Period
1. Supplemental Survey including Reporting	1.5 months
2. Designing	3.0 months
3. Preparation of the Tender Documents	1.0 months
4. Evaluation and Approval of Tender Documents	0.5 months
Total	6.0 months

(2) Tender Stage

Fast-truck tendering was assumed as shown in **Table 15.10.1-4**.

TABLE 15.10.1-4 PERIOD OF TENDERING STAGE

Items of Work	Estimated Period
1. Prequalification of Bidders/Contractors	1.5 months
2. Distribution of Tender Documents	1.5 months
3. Tender Evaluation	0.5 months
4. Contracting	0.5 months
Total	4.0 months

(3) Construction Stage

The construction stage is basically divided into three (3) phases; namely, Mobilization, Construction and Demobilization. Each phase is roughly estimated, as shown in **Table 15.10.1-5**.

TABLE 15.10.1-5 PERIOD OF CONSTRUCTION STAGE

Items of Work	Estimated Period
1. Mobilization	3.0 months
2. Construction Activities	See Subsection 15.10.2
3. Demobilization	2.0 months

15.10.2 Construction Planning

(1) Road Construction

Other than the objective road, no other road is available as detour road in the neighborhood of the objective road during the road construction work. Hence, road construction is to be executed with the alternate traffic control of existing traffic, as shown in **Figure 15.10.2-1**.

Considering the above situation, the paving work (cement concrete pavement) is assumed to be executed as shown in **Figure 15.10.2-2**, and the road construction work is roughly estimated, as shown in **Table 15.10.2-1**.

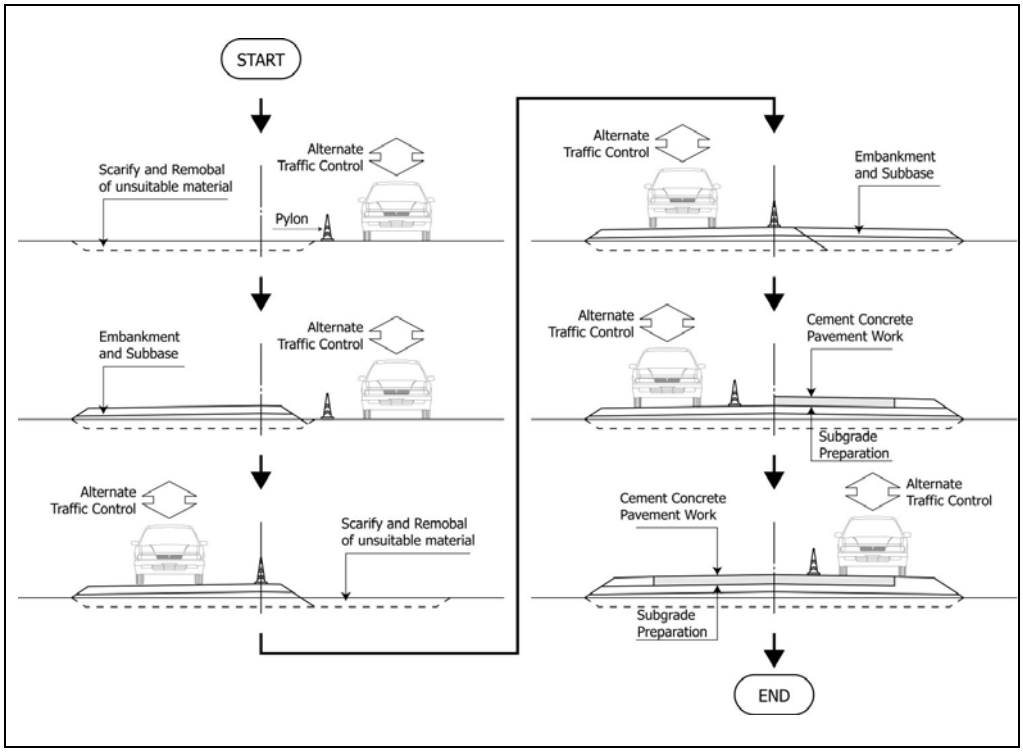


FIGURE 15.10.2-1 ROAD CONSTRUCTION PROCEDURE (1-CYCLE)

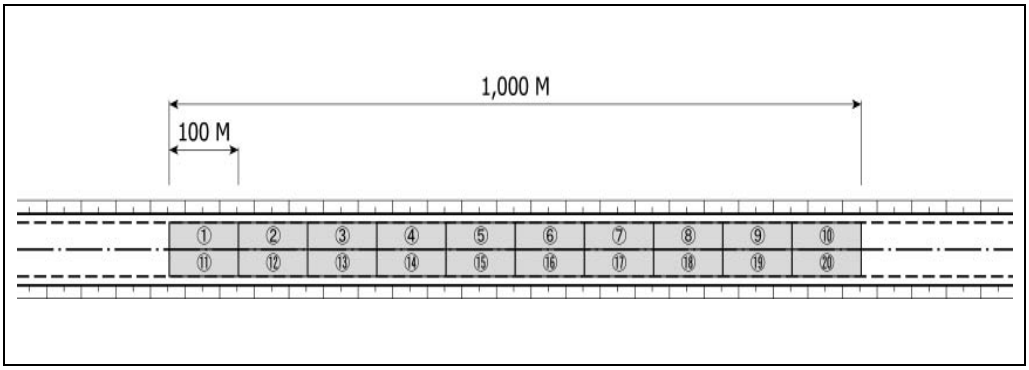


FIGURE 15.10.2-2 SAMPLE OF PAVING PROCEDURE (1-CYCLE)

TABLE 15.10.2-1 PERIOD OF ROAD CONSTRUCTION WORK

Period For 1-cycle (Length = 1,000m)		
Work Items	Quantities	No. of Days
Earthworks and Subbase	2,300 m^3	17.0 days
Scarifying and removal of unsuitable material @ left side	2,300 m^3	17.0 days
Embankment @ left side	3,800 m^3	32.0 days
Sub-base work @ right side	4,600 m^3	39.0 days
Scarify and removal of unsuitable material @ right side	1,800 m^3	14.0 days
Embankment @ right side	3,000 m^3	25.0 days
Sub-base work @ right side	3,600 m^3	30.0 days
	Total	157.0 days
	Compressed	60.0 days
Paving Work		
Sub-grade preparation, Form and rebar work per 1 panel (100 m)	--	2.0 days
Pouring Concrete per 1 panel (100 m)	--	1.0 days
For 20 panels	20 x 3.0 days	60.0 days
	Total	60.0 days

Estimated Road Construction Period	
Road Section	Months
Pinaring-Simsiman Road	18.435 km / 4 parties = 4,600 m/party (4,600 m / 1,000 m) * 60 days / 25 days/month = 11.06 months 11.06 + 60 days / 25 days/month = 13.4 months → about 13.0 months
Tamontaka-Tapian Road	14.165 km / 4 parties = 3,500 m/party (3,500 m / 1,000 m) * 60 days / 25 days/month = 8.40 months 8.40 + 60 days / 25 days/month = 10.8 months → about 11.0 months

(2) Bridge Construction

As the results of the preliminary design, the following conditions are required for bridge construction:

- Temporary road is to be installed by using the timber bridge or pipe culverts to detour the existing traffic prior to any bridge construction work;
- The existing bridge is to be removed;
- The superstructure is to be built with the All Staging Method; and
- The superstructure work is to be carried out during the dry season only.

The bridge construction period is roughly estimated, as shown in **Table 15.10.2-1**.

TABLE 15.10.2-1 BRIDGE CONSTRUCTION PERIOD

Items of Work	Estimated Period
1. Installation of Temporary Road	0.50 months
2. Removal of the Existing Bridge	0.50 months
3. Piling Work	1.00 months
4. Bridge Excavation	0.25 months
5. Form & Rebar Work for Substructures	0.50 months
6. Concreting Work for Substructures including Curing	1.00 months
7. Installation of All Staging	1.00 months
8. Form & Rebar Work for Superstructures	1.00 months
9. Concreting Work for Superstructures including Curing	1.00 months
10. Guard-railing and Miscellaneous Work	1.50 months
Total	8.25 months
Compressed	7.50 months

15.11 BARANGAY INTERVIEW SURVEY

15.11.1 Type of Surveys

Three types of survey were carried-out to get a better understanding on the socio-economic conditions of the people that are likely to benefit from the development of the two roads. These are shown in **Table 15.11-1**. Dates of barangay consultation meeting as well as detailed data of the surveys are presented in **Annex 15-3**.

TABLE 15.11-1 TYPE OF SURVEYS

Survey Type	Pinaring – Simsiman Road	Tamontaka – Tapian Road	Total
• Barangay Consultation Meeting (Focus Group Discussion)	28 barangays	7 barangays	35 barangays
• Household Interview	560 H.H.	140 H.H.	700 H.H.
• Barangay Captain Face-to-interview	28 captains	7 captains	35 captains

(1) Barangay Consultation Meeting (Focus Group Discussion)

The barangay consultation meeting is conducted to the 35 barangays within the influence are of the two roads. The participants are divided into three groups: members composing head of the family (adult male group), women group, and youth group. The idea is to collect all the needs of the barangay as perceived by its residents. Seven guide questions are then discuss with the help of facilitator.

Among the questions is the identification of the three (3) most important needs of the barangay as well as their likely contribution to the project team if the road is improved.

(2) Household Interview

A four (4) page questionnaire is prepared for the household interview. A total of 20 households for each barangay were interviewed. The objective is to collect basic information that would describe their living condition such as family income and family expenditure. Source of livelihood is also sought as well as their farming practices.

They were also asked on the negative impact brought by the poor road on their daily life as well as likely contribution they could provide to the project team if the road is improved.

(3) Barangay Captain Face-to-face Interview

A five (5) page questionnaire is prepared for the interview with the 35 barangay captains. The purpose is to collect basic information such as inventory of barangay facilities, presence of barangay cooperatives, volume of agricultural productions, size of farmland, size of irrigated rice paddy and other data relevant to agricultural activities.

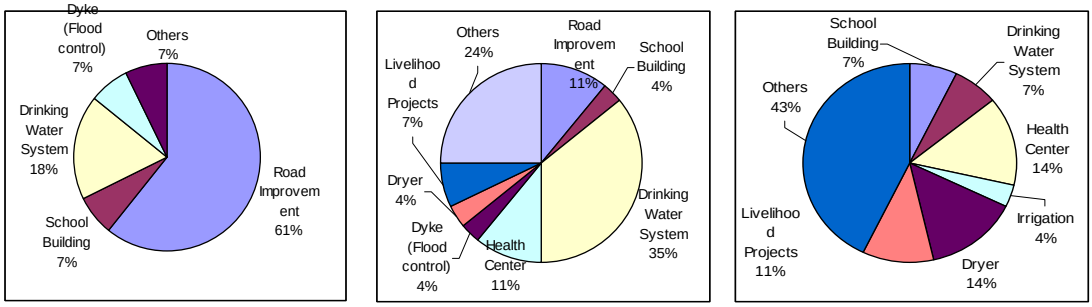
15.11.2 Barangay Consultation Meeting

(1) Three (3) Important Barangay Needs

During the barangay consultation meeting, participants are asked by facilitator to enumerate all needs of the barangay that could support their livelihood. The list is then reduced to top three by pressing the participants to identify the top three most important needs of the barangay.

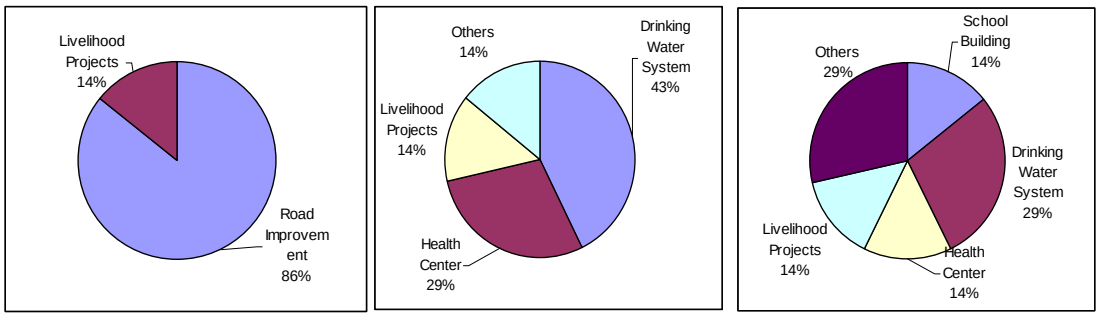
Barangays under the Pinaring-Simsiman road have the following top priorities: road improvement, drinking water system, school building, and dyke (see **Table 15.11.2-1**). Of the following priorities, 61% of the barangays chose road improvement as top priority, 18% selected drinking water system and others chose school building, dyke and others (e.g. livelihood projects).

Barangays crossed by the Tamontaka – Tapian road on the other hand chose road improvement and livelihood projects. Of the seven (7) barangays, six (6) indicated that their top priority is improvement of the road. The lone barangay which did not selected road improvement chose livelihood projects. Detail needs of all barangays under the influence of the two roads are shown in **Table 15.11.2-2**.



First Priority Second Priority Third Priority

FIGURE 15.11.2-1 TOP 3 BARANGAY NEEDS (PINARING – SIMSIMAN ROAD)



First Priority Second Priority Third Priority

FIGURE 15.11.2-2 TOP 3 BARANGAY NEEDS (TAMONTAKA - TAPIAN ROAD)

TABLE 15.11.2-1 THREE (3) MOST IMPORTANT NEEDS BY BARANGAY

Road Name	Mun.	Barangay	3 Most Important Needs of the Barangay		
			First	Second	Third
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	School building	Barangay road	Barangay trading center
		Raguisi	Road improvement	Drinking water system	Foot Bridge
		Pinaring	Road improvement	Drinking water system	Dryer
		Maidapa	Drinking water system	Barangay bridge	Health center with facilities
		Damaniog	Road improvement	School building	Livelihood (farm inputs and equipment)
		Ibotegen	Road improvement	Drinking water system	Solar Dryer
		Narra	Road improvement	Drinking water system	School building (4 units for grade 3 to 6)
		Katidtuan	Drinking water system	Elevated dryer	Barangay pump boat
		Kakar	Dyke – to control the flood	Drinking water system	Boat and fish landing
		Banatin	Road improvement	Barangay bridge in Sitio Udzudan	Irrigation
		Panatan	Road improvement	Health center with facilities	Bridge going to rice pad
		Tula-tula (sitio of Alamada)	Road improvement	Drinking water system	Electricity from Alamada to Barangay Panatan
		Limbo	Road improvement	Day care center	Health center with facilities
	Pigcawayan	South Manuangan	Concreting the road	Dyke for rice field	Drainage
		Banocagen	Road Improvement	Livelihood projects	Warehouse
		Bulocaon	Drinking water system	Road improvement	School building
		Malagakit	Farm to market road	Drainage	
		Simsiman	Concrete road	Drinking water system	Health Center with facilities
		Datu Binasing	School building for Elementary and high school	Barangay road	Drinking water system
		Lower Baguer	Barangay Road	Drinking water system	Health Center with facilities
		Buricain	Road improvement	Drinking water system	Dryer
		Balacayon	Barangay Road (Sitio Kulumpungan to Datu Binasing)	Health center	Covered court
		Matilac	Housing project	Livelihood programs	Solar dryer
		Upper Pangangkalan	Dyke – to control the flood	Irrigation	Livelihood project
		Lower Pangangkalan	Drinking water system	Boat and fish landing	Livelihood project
		Kadingilan	Drinking water system	Madrasah building	Multi-purpose building
		Datu Mantil	Madrasah building	Drinking water system	Drinking water system
		Libungan Torreta	Barangay road (Sitio Minanga)	Multi-purpose building	Health center with facilities
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	Road improvement	Drinking water system	Drainage
		Dimapatoy	Livelihood projects	Drinking water system	Post harvest facilities
		Mompong	Road improvement	Barangay health center	Additional school building
		Linek	Road improvement	Drinking water system	Boat and Fish landing
		Badak	Road improvement	Barangay health center	Madrasah
		Kusiong	Road improvement	Livelihood projects	Livelihood Projects
		Tapian	Road improvement	Public toilet for each sitio	Drinking water system

(2) Negative Impact of the Poor Road

The barangay people attended the consultation meeting were also asked on the negative impact/difficulties cause by the poor condition of road. Answers often mentioned by the barangay people located on both roads are: delay in transporting their farm produce, high transportation cost, difficulty of students in attending their schools, low income due to the high transport cost, difficulty in bring patient to hospital and lack of business opportunities.

TABLE 15.11.2-2 PERCEIVED NEGATIVE IMPACT OF POOR ROAD BY THE BARANGAY PEOPLE

Road Name	Negative Impacts of the Poor Road
PINARING - SIMSIMAN ROAD	• Damage on the vehicles serving the barangay • Damaged on farm products of farmers • Delay on the business transactions of our barangay officials • Delay of our transportation and transactions to the market • Delay on transportation of farm products of farmer • Difficult access of students to Madrasah • Difficult access of students to school • Difficult to bring patients to hospital • Difficult to buy our daily needs from the market • Very difficult to transport our farm products during rainy season • Very dusty in the summer which causes illnesses • High transportation cost/fare • Isolation of barangay • Low income for the farmers due to transportation cost • Poor living condition due to lack of business opportunities and high transportation cost • Prone to accident because very slippery during rainy season • Slow development of our barangay
TAMONTAKA - TAPIAN ROAD	• Slow development of our barangay • Prone to accident because very slippery during rainy season • Delay on transportation of agricultural products • Difficult access of students to school • Difficult to deliver farm products • Difficulties to bring patient to hospital in times of emergency • Very dusty which causes illnesses • Very high cost of transportation of people and farm products • Very inconvenient for the people to go to Cotabato City • Poor living condition because of high transport cost and lack of business opportunity

(3) Benefits from Road Improvement

On the perceived benefits on the barangay by road improvement, the barangay people believed that improvement of their road would translate into increase of their income due to low transportation of farm produce and road improvement would also open other business opportunities such as tourism (beach) and driving (since there would be large group of people assembled in the beach). Notable answer also is the barangay people's impression that road improvement would give an easy access to NGOs which provide different services such as supply of farm inputs, clothing, foods and others.

TABLE 15.11.2-3 PERCEIVED BENEFITS OF ROAD IMPROVEMENT BY THE BARANGAY PEOPLE

Road Name	Expected Benefits if the Road is Improved
PINARING - SIMSIMAN ROAD	• Provide easy accessibility and easy transportation for barangay people and farm produces • Can motivate students to study well due to easy access to school • Transportation cost will decrease • Transportation fare will also decrease • Very comfortable trip and damage to vehicles will also minimized • Development of barangay will be accelerated due to easy accessibility • More NGO's will come to our barangay due to easy accessibility • There will be easy access to market, government institutions and easy business transactions • Easy transportation during urgent situations • Improve children's awareness of Islam due to easy access to Madrasah • Income of people will increase due to cheap transport cost of farm products and more business opportunities • Barangay population will also increase because people who left the barangay will come back • Accidents will be minimize due to good road
TAMONTAKA - TAPIAN ROAD	• Development of barangay will be accelerated due to easy accessibility • Easy access to many places due to good road • Fast and easy transportation of farm products • Very easy to go to market in Cotabato City • Improve students' safety while going to school • Increase business opportunities due to easy access • Increase income of farmers due to low transport cost • More livelihood opportunities will be developed such as driving, small stores, etc. • It will motivate students to attend classes • Tourism will be developed and people will come to our beaches

(4) On Whether they Would Agree to Improve the Road

All people attended in the barangay consultation meeting held in the 35 barangays recognized the importance of good road. Their most common reasons for agreeing to have the road improved are: (i) this will make easy our delivery of farm products to market, (ii) this will increase our income and (iii) this will help develop our barangay.

TABLE 15.11.2-4 BARANGAY PEOPLE'S RESPONSE IF THEY WOULD AGREE TO ROAD IMPROVEMENT

Road Name	Mun.	Barangay	Agree/Not Agree	Reason(s)
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	Agree	For comfortable transportation and fast transaction
		Raguisi	Agree	For easy transactions like delivery of farm produce, buying household needs from the market
		Pinaring	Agree	For comfortable transportation of people and farm produce
		Maidapa	Agree	To easily accomplish activities necessary for living and for easy transportation
		Damaniog	Agree	For easy delivery of farm produce
		Ibotegen	Agree	For comfortable transportation
		Narra	Agree	For easy delivery of produce and for easy access of tourists
		Katidtuan	Agree	To improve living condition and easy transportation
		Kakar	Agree	For easy delivery of farm produce
		Banatin	Agree	For easy delivery of farm produce
		Panatan	Agree	For easy delivery of farm produce
		Tula-tula (sitio of Alamada)	Agree	For a comfortable community
		Limbo	Agree	For easy access to city proper
	Pigcawayan	South Manuangan	Agree	For easy transportation of farm produce and people
		Banocagen	Agree	For comfortable life and help increase our income
		Bulocaon	Agree	For easy transportation of farm produce and people
		Malagakit	Agree	For easy and fast delivery of farm produce
		Simsiman	Agree	For the development of our barangay
		Datu Binasing	Agree	For the enhancement of the road, improvement of our barangay, and easy delivery of farm produce
		Lower Baguer	Agree	So we can easily reach Cotabato City anytime we want
		Buricain	Agree	For the development of our barangay, as well as for the attainment of peace and order to the community
		Balacayon	Agree	For the betterment of the community
		Matilac	Agree	For the development of barangay
		Upper Pangangkalan	Agree	For the development of barangay
		Lower Pangangkalan	Agree	For the development of the barangay and it can open up business opportunities
		Kadingilan	Agree	For the development of the barangay
		Datu Mantil	Agree	For the development of the barangay
		Libungan Torreta	Agree	For the development of the barangay
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	Agree	For improvement of living condition
		Dimapatoy	Agree	For improvement of living condition
		Mompong	Agree	For easy access to Cotabato City to deliver farm produce and buy household needs
		Linek	Agree	For easy transportation of farm produce
		Badak	Agree	For more convenient transportation
		Kusiong	Agree	For easy transportation of catches fish and easy access of tourists (beach)
		Tapian	Agree	For the development of our barangay

(5) Employment Expectation of Barangay People

If the two roads under the feasibility study will be improved, it is necessary to take into account the expectation of the barangay people. During the meeting, they were asked if they expect to be hired as part of the team if the road is improved. All of them are expecting to be somehow part of the team as laborer or any other type of work that would suit them. Their main reason is to earn extra income aside from their permanent job. They also believed that having members of the barangay in the team would facilitate smooth implementation of the project since they could serve as the coordinator if problems arise.

TABLE 15.11.2-5 EMPLOYMENT EXPECTATIONS OF BARANGAY PEOPLE

Road Name	Mun.		Employment Expectation (from locals)
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	They want to be hired for any position for smooth implementation of the project
		Raguisi	They want to be hired for additional income
		Pinaring	They want to be hired as the project would generate employment from barangay people
		Maidapa	They want to join in the project if possible for employment
		Damaniog	They want to be hired for additional income
		Ibotegen	They want to be hired for any position for smooth implementation of the project
		Narra	They want to be hired for any position for smooth implementation of the project
		Katidtuan	They want to be hired for community employment and to earn extra income
		Kakar	They want to be hired for any position for smooth implementation of the project
		Banatin	They want to be hired for additional income
		Panatan	Yes, so that we can help also for the implementation of the said project.
		Tula-tula	They want to be hired for additional income
		Limbo	They want to join in the project if possible for employment
	Pigcawayan	South Manuangan	They want to join in the project if possible for employment
		Banocagen	They want to be hired for additional income
		Bulocaon	They want to be hired for additional income
		Malagakit	They want to be hired for additional income
		Simsiman	They want to join in the project if possible for employment
		Datu Binasing	Yes, we want to be hired to help the team and also for their security
		Lower Baguer	Yes, we want to join the project for whatever way we can help
		Buracain	They want to be hired for additional income
		Balacayon	They want to join in the project if possible for employment
		Matilac	They want to be hired for additional income
		Upper Pangangkalan	They want to be hired for additional income
		Lower Pangangkalan	They want to join in the project if possible for employment
		Kadingilan	They want to join in the project if possible for employment
		Datu Mantil	They want to join in the project if possible for employment
		Libungan Torreta	They want to be hired for additional income
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	They want to join in the project if possible for employment
		Dimapatoy	They want to join in the project if possible for employment and earn income
		Mompong	They want to be hired for additional income
		Linek	They want to be hired for additional income
		Badak	They want to join in the project if possible for employment and develop their skills
		Kusiong	They want to join in the project if possible for employment and earn income
		Tapian	They want to join in the project if possible for employment

(6) Support from the Barangay People during the Implementation of the Project

A question of "in the future, if the road will be improved what support you could offer to the project team' is posed to the barangay people during the meeting. Most of them are willing to offer security – meaning they will secure the equipment for construction as well as taking care of the staff working in the project.

TABLE 15.11.2-6 TYPE OF SUPPORT FROM THE BARANGAY PEOPLE

Road Name	Mun.		Support from community
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	Security of materials and equipment
		Raguisi	Security of materials and equipment and assurance for the safety of workers
		Pinaring	Security of equipment and materials
		Maidapa	Assurance for the safety of workers
		Damaniog	Security of materials and equipment
		Ibotegen	Security of materials and equipment
		Narra	Security of materials and equipment and assurance for the safety of workers
		Katidtuan	Security of materials and equipment and assurance for the safety of workers
		Kakar	Security of materials and equipment and assurance for the safety of workers
		Banatin	Security of equipment and materials
		Panatan	Cooperation to the team working on the road
		Tula-tula	Security of materials and equipment
		Limbo	Security of materials and equipment
	Pigcawayan	South Manuangan	Security of materials and equipment and assurance for the safety of workers
		Banocagen	Security of materials and equipment
		Bulocaon	Cooperation to the team working on the road
		Malagakit	Security of materials and equipment and cooperation to the project team
		Simsiman	Security of equipment and materials
		Datu Binasing	Security of materials and equipment and assurance for the safety of workers
		Lower Baguer	Security of materials and equipment and assurance for the safety of workers
		Buracain	Security of materials and equipment and assurance for the safety of workers
		Balacayon	Security of materials and equipment and assurance for the safety of workers
		Matilac	Assurance for the safety of workers
		Upper Pangangkalan	Security of materials and equipment and assurance for the safety of workers
		Lower Pangangkalan	Security of materials and equipment and assurance for the safety of workers
		Kadingilan	Security of materials and equipment and assurance for the safety of workers
		Datu Mantil	Security of materials and equipment and assurance for the safety of workers
		Libungan Torreta	Security of materials and equipment and assurance for the safety of workers
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	Security of materials and equipment and assurance for the safety of workers
		Dimapatoy	Security of materials and equipment
		Mompong	Security of materials and equipment
		Linek	Security of materials and equipment
		Badak	Security of materials and equipment
		Kusiong	Security of materials and equipment
		Tapian	Security of materials and equipment and assurance for the safety of workers

(7) Name of Roads they Want to be Improved

The barangay people were also asked to identify important roads they want to be improved which they believed could help improve their livelihood. **Table 15.11.2-7** shows the list of roads barangay people wanted for improvement.

TABLE 15.11.2-7 BARANGAY ROAD PEOPLE WANTED TO IMPROVE

Road Name	Mun.		Which Brgy. Road(s) to Improve
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	Crossing Pinaring to Manuangan (all-weather road)
		Raguisi	Crossing Pinaring to Brgy. Raguisi.
		Pinaring	Crossing Pinaring toNational Highway
		Maidapa	Maidapa to Crossing Pinaring
		Damaniog	Crossing Pinaring to Brgy. Damaniog and Barangay Damaniog to Brgy. Ladia
		Ibotegen	Crossing Pinaring to Brgy. Manuangan
		Narra	Crossing Pinaring to Brgy. Narra
		Katidtuan	Provincial road to Brgy Katidtuan
		Kakar	Brgy. road of Kakar going to Narra to Banatin
		Banatin	From Panatan to Sitio Udzudan (Brgy. Banatin)
		Panatan	Brgy. Panatan to Crossing Pinaring and Brgy. Panatan to Alamada
		Tula-tula	Brgy. Alamada to Brgy. Panatan
		Limbo	Datu Paisal Talusan Street – Limbo Proper Sitio Torres Street – Limbo Proper Datu Talusan Street – Limbo Proper
	Pigcawayan	South Manuangan	From South Manuangan to the boundary of Banucagon
		Banocagen	From South Manuangan to Banocagen
		Bulocaon	From Bulucaon to Banucagon
		Malagakit	From South Manuangan to Malagakit
		Simsiman	Provincial road to Sitio Bangon
		Datu Binasing	Datu Binasing to Pinaring and Datu Binasing to Manuangan
		Lower Baguer	Lower Baguer to Datu Binasing and Lower Baguer to Pangankalan
		Buracain	Provincial road to Brgy. Buricain
		Balacayon	Balacayon to Datu Binasing
		Matilac	Matilac to Sitio Silungan
		Upper Pangangkalan	Upper Pangankalan to Lower Baguer road
		Lower Pangangkalan	Lower Pangangkalan to Lower Baguer (dyke is necessary)
		Kadingilan	Sitio Sampalok to Kadingilan
		Datu Mantil	Provincial road to Datu Mantil
		Libungan Torreta	Provincial road to Sitio Minanga
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	Proper Semba – Tamontaka Riverbank Sitio Siawan – Tamontaka Riverbank
		Dimapatoy	Sitio Nabilan – Provincial road Sitio Fishing landing – provincial road
		Mompong	Provincial road – Sitio Balalaan Provincial road – Sitio Tambir Provincial road – Sitio Ling
		Linek	Brgy. Linek proper – Sitio Lasdan Brgy. Linek proper – Sitio Gagadiao
		Badak	Provincial road – Sitio Siringanen – Sitio Kinuta Provincial road – Sitio Serung
		Kusiong	Sitio Madalay – Sitio Basalan – Upi Sitio Pinutulan – Provincial road
		Tapian	Provincial road – Sitio Paraman

15.11.3 Household Interview Survey

1) Population

The total population of barangays under the influence of the Pinaring – Simsiman road is about 61,000. This figure represents 34% of the population living in the municipalities of Sultan Kudarat and Pigcawayan. On the other hand, barangays covered by the Tamontaka – Tapian road is about 18,000 which represent 18% of the total population of Datu Odin Sinsuat Municipality.

TABLE 15.11.3-1 POPULATION SHARE OF BARANGAYS UNDER THE FS ROADS

	Total Population		Percentage	
	2000	2007	2000	2007
PINARING - SIMSIMAN				
Sultan Kudarat & Pigcawayan	145,869	180,719	100%	100%
Barangays on FS Road	41,954	61,628	29%	34%
TAMONTAKA - TAPIAN				
Datu Odin Sinsuat	71,569	103,765	100%	100%
Barangays on FS Road	13,958	18,200	20%	18%

Source: NSCB, 2009

Table 15.11.3-2 shows the population, annual growth rate and number of household of the barangays under the roads for feasibility. As mention, the Pinaring – Simsiman road belongs to the municipalities of Sultan Kudarat and Pigcawayan. Population increase in the barangays of Sultan Kudarat under the FS road is rather high which is around 6.6% (average) compared to the municipal average of 3.6%. The same is true to the barangays of Pigkawayan under FS where municipal average is just 2.2% but the average annual growth rate of the barangays under the FS is around 3.9%.

Population annual growth rate of barangays under the Tamontaka – Tapian road is also high where except to barangays Dinaig Proper and Mompong, all exceeded 3%.

TABLE 15.11.3-2 BARANGAY POPULATION, ANNUAL GROWTH RATE AND NUMBER OF HOUSEHOLD

Road Name	Municipality/Barangay Name	Population		Annual Growth Rate	No. of Household (2000 data)
		2000	2007		
Pinaring - Simsiman	**SULTAN KUDARAT**				
	Limbo	4,173	7,223	8.2	762
	Ungap	1,392	2,017	5.4	231
	Raguisi	1,586	2,430	6.3	261
	Pinaring	1,937	2,779	5.3	299
	Maidapa	1,445	2,137	5.7	265
	Damaniog	1,531	2,019	4.0	247
	Ibotegen	3,179	6,060	9.7	465
	Nara	1,693	2,332	4.7	290
	Katidtuan	4,060	5,544	4.6	603
	Kakar	1,196	2,026	7.8	216
	Banatin	1,294	1,952	6.0	184
	Panatan	1,795	2,731	6.2	263
	Alamada	1,165	2,059	8.5	234
	PIGKAWAYAN				
	South Manuangan	1,675	1,581	(0.8)	332
	Banucagon	1,079	1,131	0.7	212
	Bulucaon	2,505	3,048	2.8	461
	Malagakit	473	606	3.6	100
	Simsiman	1,002	1,847	9.1	213
	Datu Binasing	961	984	0.3	175
	Lower Baguer	516	712	4.7	95
	Buricain	1,244	1,987	6.9	210
	Balacayon	1,017	1,354	4.2	192
	Matilac	1,405	1,433	0.3	264
	Upper Pangangkalan	577	880	6.2	124
	Lower Pangangkalan	485	1,024	11.3	105
	Kadingilan	1,243	1,596	3.6	223
	Datu Mantil	536	706	4.0	102
	Libungan Torreta	790	1,430	8.8	150
Tamontaka - Tapian	**DATU ODIN SINSUAT**				
	Semba	3,508	5,262	6.0	659
	Dinaig Proper	3,153	3,378	1.0	584
	Mompong	1,221	1,369	1.6	241
	Linek	1,219	1,509	3.1	231
	Badak	1,610	2,121	4.0	365
	Kusiong	1,376	1,815	4.0	259
	Tapian	1,871	2,746	5.6	357

Source: NSCB, 2009

2) Occupation

The occupation of barangay people living the influence area of the two FS roads is shown in **Figure 15.11.3-1**. Farming (43%) and working as barangay official (16%) have a share of more than half in the Pinaring – Simsiman road indicating that the area is suited for agricultural activities. Barangays closer to Liguasan Marsh have their livelihood relied mostly on fishing.

For the barangay people living along the Tamontaka - Tapian road, most people captured by the survey are housewives (24%), farmers (21%), fishermen (19%) and barangay officials (19%). Fishermen have a substantial share since these barangays are along a shoreline.

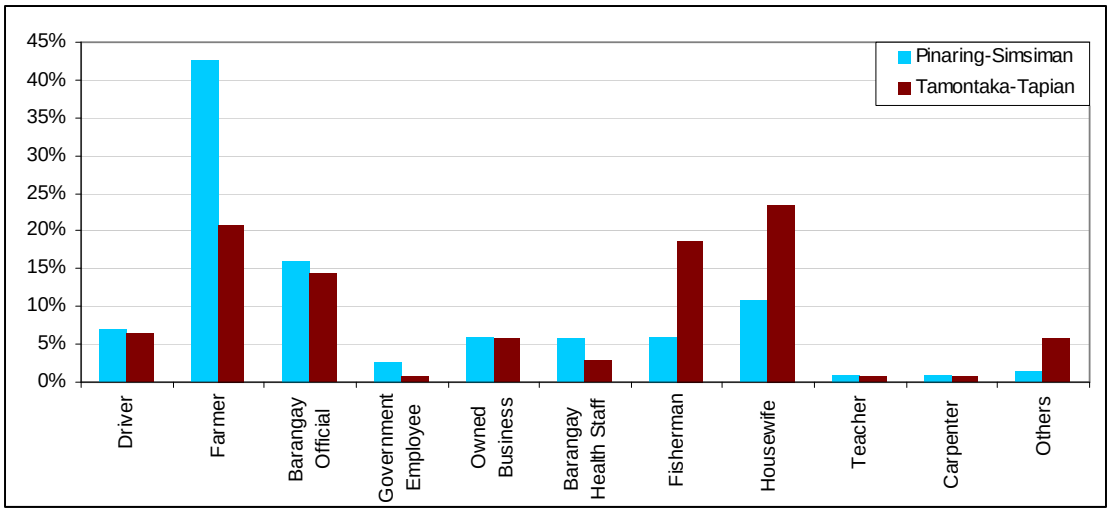


FIGURE 15.11.3-1 OCCUPATION OF BARANGAY PEOPLE UNDER THE FS ROADS

3) Household Size

Most of the families living along the Pinaring – Simsiman road have 4 to 6 members. This is followed by families having members of 1 to 3 and followed closely by those having 7 to 9 members. For the families living along the Tamontaka – Tapian road, around 55% have 4 to 6 members. Families with 7 to 9 members have a share of 20% and families with 1 to 3 members have 14% share.

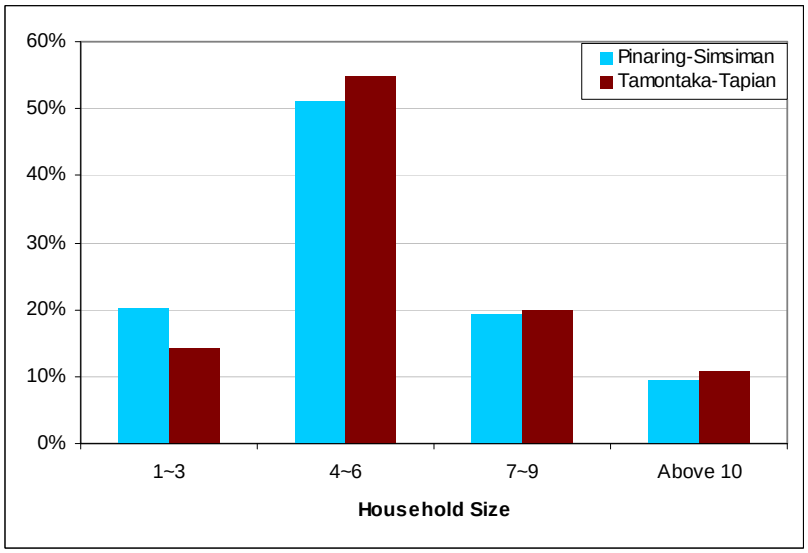


FIGURE 15.11.3-2 HOUSEHOLD SIZE OF BARANGAY PEOPLE UNDER THE FS ROADS

4) Monthly Income

According to the figure from the National Statistics Coordinating Board (NSCB), the average annual family income in the ARMM region in 2006 is 88,632 pesos which is equivalent to 7,386 pesos per month. This means that family income of most families living the FS roads is way below that average in the ARMM region as shown in the **Figure 15.11.3-3**.

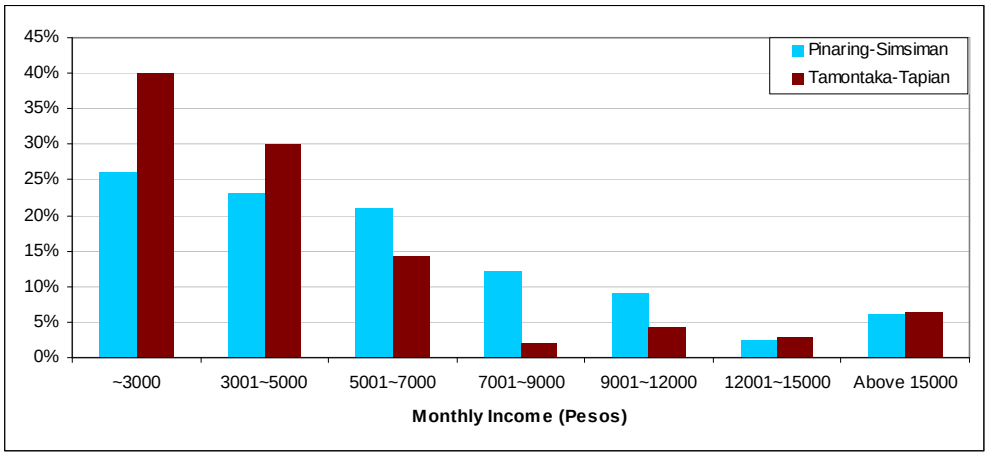


FIGURE 15.11.3-3 MONTHLY FAMILY BARANGAY PEOPLE UNDER THE FS ROADS

5) Source of Income

As shown in the figure below, most of the families are earning their income from farming, fishing, driving and salary from their government positions such as barangay official. It should be noted that most of those interviewed who give driving as their profession are actually driving either passenger motorbike or tricycle as shown in **Figure 15.11.3-5**.

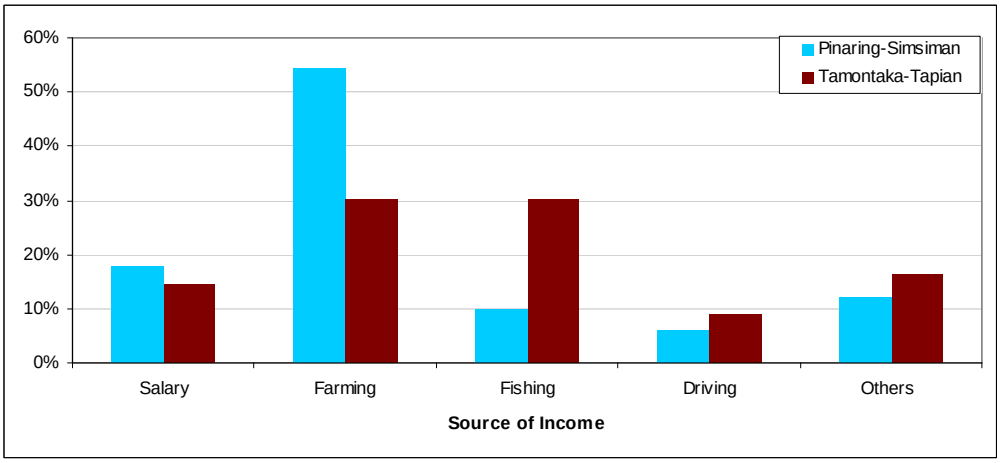


FIGURE 15.11.3-4 SOURCE OF INCOME

Figure 15.11.3-5 *(left)* Passenger Motorbike which could carry up to 5 passenger including the driver; *(right)* Tricycle is serving mostly until the barangay with good road

6) Family Expenditure and Breakdown

Figure 15.11.3-6 shows that a large number of families have monthly expenditure from the range of 3,000 pesos to 7,000 pesos. These expenditures are mostly spent for foods (56% for Pinaring – Simsiman and 61% for Tamontaka – Tapain) and followed by those spent for education, medicine, electricity and water, and farm inputs. It should be noted that 'others' normally refers to daily needs aside from food such as shampoo, soap, and materials for fishing.

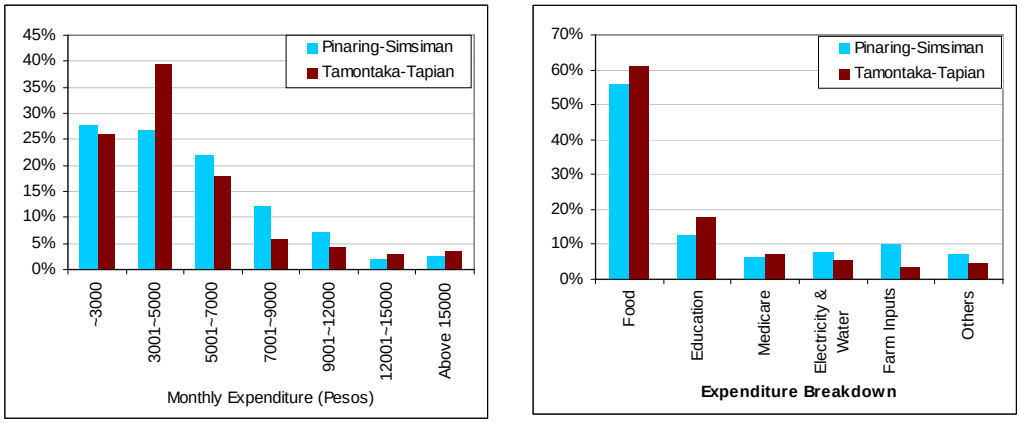


FIGURE 15.11.3-6 MONTHLY EXPENDITURE AND BREAKDOWN OF EXPENDITURE

7) Farmland Ownership and Average Size of Cultivated Farm

Tenant farmers comprise around 27% of farmers along the Pinaring – Simsiman road and around 30% for Tamontaka – Tapian road as shown in **Figure 15.11.3-7**. This means that most of the farmers in the two areas are owner of their farmland. For the size of cultivated farmland, tenant farmers have smaller farmland (1.4 hectare for Pinaring – Simsiman road and 2.0 hectare for Tamontaka – Tapian road). Size of cultivated farm land based on the type of crop is shown in **Figure 15.11.3-8**. A closer look reveals that farmland for palay is larger in those irrigated areas.

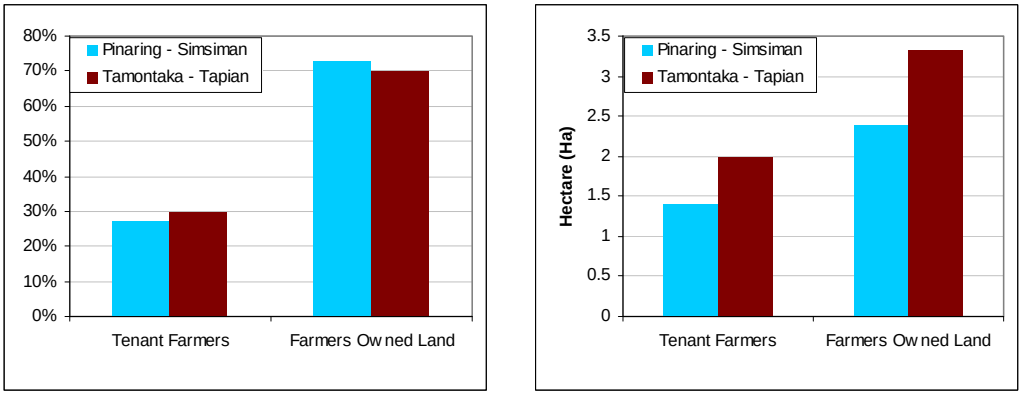


FIGURE 15.11.3-7 OWNERSHIP OF FARMLAND AND AVERAGE SIZE OF FARMLAND

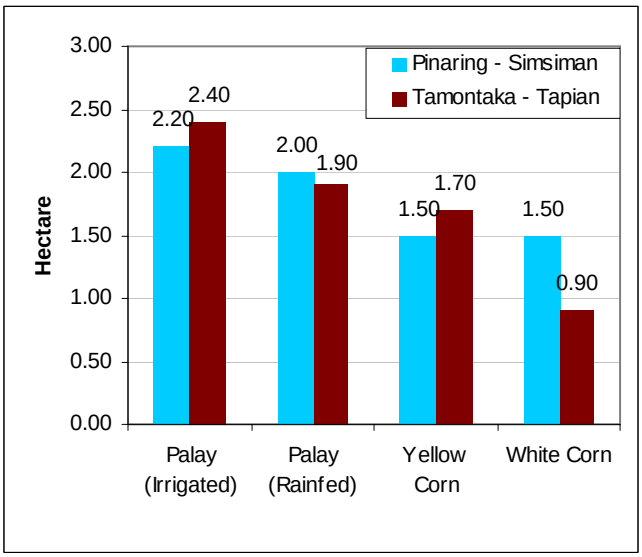


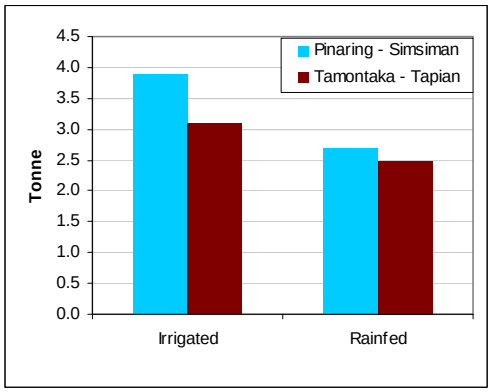
FIGURE 15.11.3-8 AVERAGE SIZE OF CULTIVATED FARMLAND

8) Agricultural Production

(i) Palay and Corn Yield

Obviously, irrigated rice paddy has a higher yield compared to those without supply of irrigation as shown by the figure below. The obvious reason is the ability of farmers to control the supply of water depending on the needs of the planted palay. In the same figure, it is observed that yield per hectare is higher in the rice paddies located along the Pinaring – Simsiman road that those in Tamontak – Tapian. This is perhaps due to the fertility of soil of the former since it is closer to Liguasan Marsh.

The national average of palay yield per hectare is 3.8 indicating that Pinaraing-Simsiman has a higher yield (3.9). Rice paddy in Tamontaka – Tapian however has a lower yield which is just the same to the average of ARMM as reflected in **Figure 15.11.3-9**. Typical rice paddy is shown in **Figure 15.11.3-10** and corn field is presented in **Figure 15.11.3-11**.



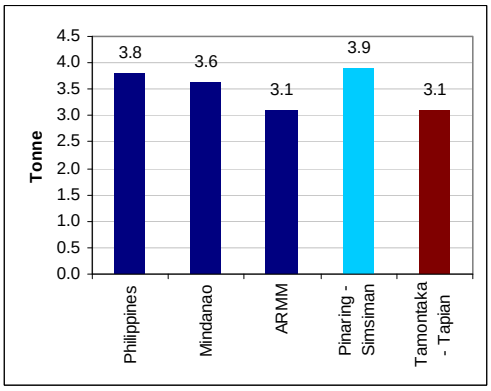


FIGURE 15.11.3-9 PALAY YIELD (TONNE/HECTARE)

Yield per hectare for both yellow corn and white corn is shown in **Figure 15.11.3-12**. Corn fields along the Pinaring – Simsiman road have a higher yield to those located in Tamontaka – Tapian road. Comparison of yield per hectare to national average is shown in **Figure 15.11.3-13**.

FIGURE 15.11.3-10 RICE PADDY ON BOTH SIDE OF THE ROAD (PINARING - SIMSIMAN)

FIGURE 15.11.3-11 CORN FIELDS (PINARING – SIMSIMAN ROAD)

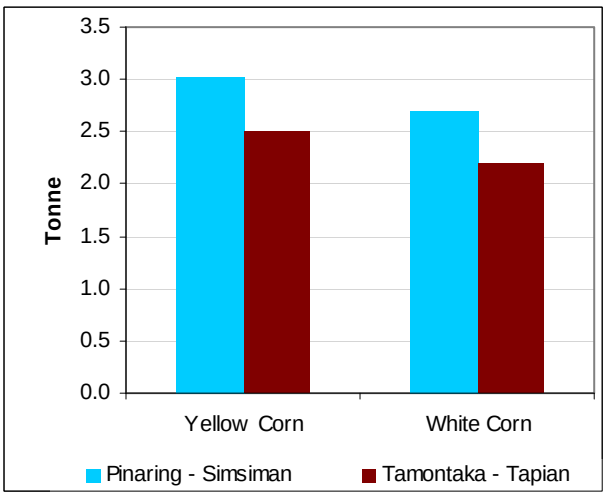
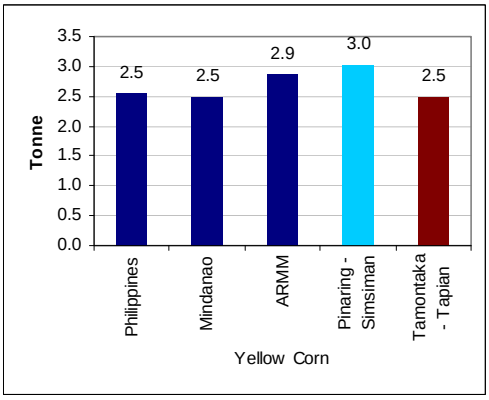


FIGURE 15.11.3-12 YELLOW CORN AND WHITE CORN YIELD (TONNE/HECTARE)



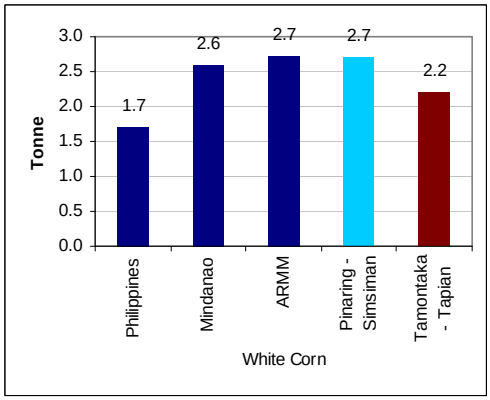


FIGURE 15.11.3-13 CORN YIELD IN TONNE/HECTARE (NATIONAL AVERAGE, MINDANAO AVERAGE, AND ARMM AVERAGE)

(ii) Coconut and Mango

According to Philippine Coconut Authority, coconut plantations are producing 800 kg/ha on average which is just 40% of the total production potential of the plantations. The plantation along the Pinaring – Simsiman road is producing about 865 kg/ha and about 773 kg/ha for Tamontaka – Tapian road.

For mango production, depending on the type of planted mangoes, a hectare of mango is normally produces between 400 kg to 1000 kg. Mango plantation along the Pinaring –Simsiman road is producing about 578 kg/ha while plantation along the Tamontaka – Tapian road is about 556 kg/ha.

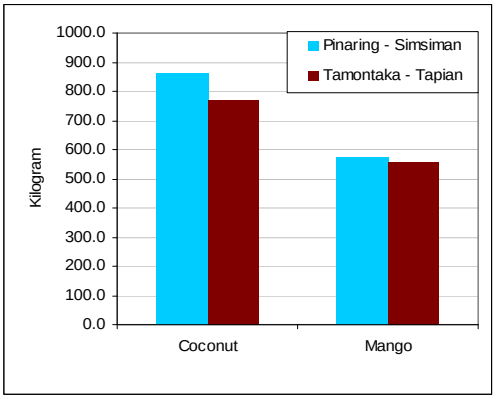


FIGURE 15.11.3-14 COCONUT AND MANGO PRODUCTION PER HECTARE

COCONUT TREES ALONG THE TAMONTAKA – TAPIAN ROAD

9) Frequency of Harvest

Frequency of harvest for each type of crop is shown in the two figures below. It can be observed that despite the supply of irrigated water (Pinaring – Simsiman road), some farmers are still harvesting once a year. Interview shows that this partly due to weak supply of water which could not cover the entire rice paddies.

On the other hand, some farmers are able to harvest three times a year even without the water supply of irrigation. This is due to water impounding technique where substantial amount of water is kept to serve the rice paddies through out the year.

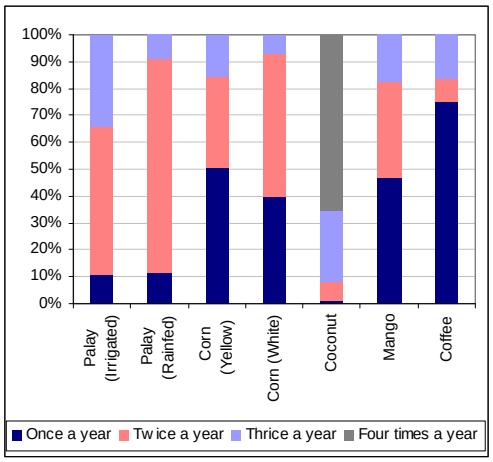


FIGURE 15.11.3-15 FREQUENCY OF HARVEST (PINARING – SIMSIMAN ROAD)

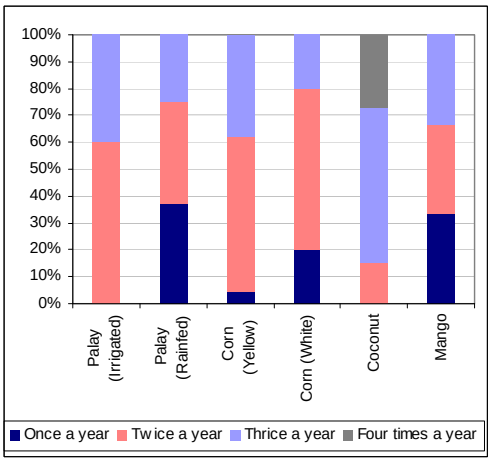


FIGURE 15.11.3-16 FREQUENCY OF HARVEST (TAMONTAKA – TAPIAN ROAD)

10) Transportation Cost of Agricultural Produce

The share of transportation cost on agricultural produce and fisheries of barangays along the Pinaring – Simsiman road is as follows: 7% for palay, 9% for corn, 5% for coconut, 3% for fish and 4% for coffee. Shifting to Tamontaka – Tapian road, the following figures are arrived: 5% for palay, 8% for corn, 5% for coconut, 3% for fish and 4% for coffee.

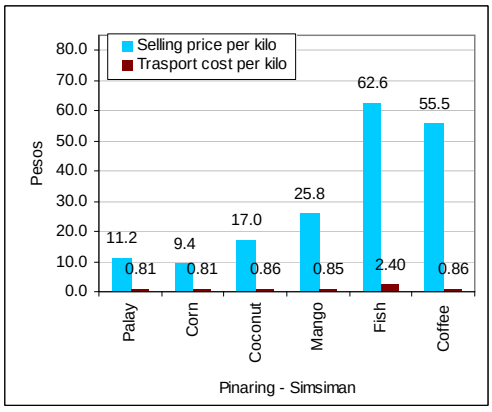


FIGURE 15.11.3-17 TRANSPORTATION COST (PINARING – SIMSIMAN ROAD)

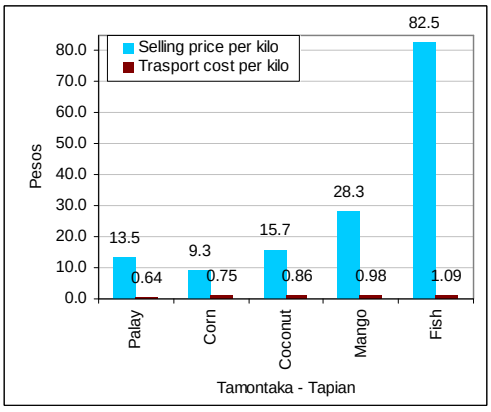


FIGURE 15.11.3-18 TRANSPORTATION COST (TAMONTAKA – TAPIAN ROAD)

FIGURE 15.11.3-19 VEHICLE TRANSPORTING AGRI-PRODUCTS SUCH AS BANANA, COPRA AND FIRE WOODS (TAMONTAKA – TAPIAN ROAD)

FIGURE 15.11.3-20 MOTORBIKE USES TO TRANSPORT COCONUT COPRA (PINARING – SIMSIMAN ROAD)

15.11.4 Barangay Captain Face-To-Face Interview

1) Cooperatives in the Barangay

Cooperatives can be a source of farm inputs, post harvest facilities and even credit and financing from the Cooperative Development Authority. Most of the barangays located in the two roads have existing cooperatives. For the cooperative that is not active anymore, reasons include lost of interest by the members, dysfunctional organizations, etc.

TABLE 15.11.4-1 ACTIVE AND INACTIVE COOPERATIVES

Road Name	Mun.	Barangay name	Cooperative	
			Active	Not
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	-	-
		Raguisi	-	-
		Pinaring	-	-
		Maidapa	2	-
		Damaniog	-	-
		Ibotigen	-	2
		Narra	2	-
		Katidtuan	2	1
		Kakar	-	-
		Banatin	-	-
		Panatan	2	-
		Alamada	1	-
		Limbo	2	-
	Pigcawayan	South Manuangan	-	-
		Banucageon	1	-
		Bulucaon	1	-
		Malagakit	-	-
		Simsiman	2	-
		Datu Binasing	-	1
		Lower Baguer	-	-
		Buricain	-	1
		Balacayon	-	2
		Matilac	3	1
		Upper Pangankalan	-	-
		Lower Pangankalan	-	-
		Kadingilan	-	-
		Datu Mantil	-	1
		Libungan Toreta	1	-
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	2	-
		Dinaig Proper	1	-
		Brgy.Mompong	2	-
		Linek	-	-
		Badak	1	-
		Kusiong	-	-
		Tapian	4	-

2) Barangay Facilities

An inventory of barangay facilities is also carried through interview to the barangay captain of each baragay where barangay facilities like boat landing and multi-purpose building as shown in **Figures 15.11.4-1** and **15.11.4-2** are accounted. The following figures were obtained through interview:

- ***Pinaring – Simsiman Road***

  22 of 28 barangays have school building for elementary students; 10 of 28 barangays have school building for high school students; 16 of 28 barangays have health center; 18 of 28 barangays have barangay hall (multi-purpose building); 9 of 28 barangays have drinking water system; 9 of 28 barangays have warehouse; 24 of 28 barangays have dryer; 21 of 28 barangays have daycare center.

- ***Tamontaka - Tapian Road***

  6 of 7 barangays have school building for elementary students; 3 of 7 barangays have school building for high school students; 6 of 7 barangays have health center; 5 of 7 barangays have barangay hall (multi-purpose building); 3 of 7 barangays have drinking water system; 2 of 7 barangays have warehouse; 4 of 7 barangays have dryer; 5 of 7 barangays have daycare center.

TABLE 15.11.4-2 AVAILABLE FACILITIES TO EACH BARANGAY

Road Name	Mun.	Barangay Name	Elem. School	High School	Health Center	Barangay Hall/Multi-purpose Hall	Water Supply (not deep well)	Warehouse	Dryer	Daycare Center	Church	Daycare Center	Madrasah	Others
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap				■				■		■	■	
		Raguisi	■			■			■	■	■	■	■	
		Pinaring	■	■										
		Maidapa	■		■				■	■		■	■	
		Damaniog			■	■	■	■	■	■		■	■	
		Ibotigen	■		■	■		■	■	■		■		Irrigation
		Narra		■	■	■				■		■	■	
		Katidtuan	■						■					
		Kakar			■	■		■	■				■	
		Banatin	■		■	■	■	■	■					
		Panatan	■	■	■	■	■	■	■					
		Alamada	■		■	■		■	■	■		■	■	
		Limbo	■				■		■					
	Pigcawayan	South Manuangan	■	■					■	■	■	■		
		Banucageon	■	■	■	■	■	■	■	■	■	■	■	
		Bulucaon	■	■	■		■		■	■	■	■		
		Malagakit	■					■	■	■	■	■		
		Simsiman	■	■		■			■	■		■		
		Datu Binasing	■	■		■	■		■	■		■	■	
		Lower Baguer			■				■				■	
		Buricain	■							■		■	■	
		Balacayon	■		■	■	■		■	■		■	■	
		Matilac	■	■	■	■		■	■	■		■	■	
		Upper Pangankalan	■		■	■			■	■		■	■	
		Lower Pangankalan	■		■				■	■		■	■	
		Kadingilan	■		■	■			■	■		■	■	
		Datu Mantil				■			■	■		■		
		Libungan Toreta	■	■		■	■		■	■		■		Boat Landing
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	■	■	■	■	■	■	■	■	■	■	■	
		Dinaig Proper	■		■				■	■		■		Boat Landing
		Brgy.Mompong	■	■	■	■	■	■	■					
		Linek	■		■	■								
		Badak			■	■			■	■		■	■	
		Kusiong	■	■			■			■		■		Beach Resort
		Tapian	■		■	■				■	■	■		Boat Landing

Note:

■ Available

FIGURE 15.11.4-1 BOAT LANDING DONATED BY THE USAID IN BARANGAY TAPIAN

FIGURE 15.11-4-2 MULTI-PURPOSE BUILDING DONATED BY THE ARMM SOCIAL FUND IN BARANGAY BADAK

3) Size of Rice Paddy and Total Irrigated Area

Based on the interview to the barangay captains, the total rice paddy of barangays along the Pinaring – Simsiman Road is about 5,583 hectares. Of these, 92% of the area is irrigable however only 1,062 ha of 5,174 irrigable have irrigation system. This means that around 80% of the rice paddy lacks supply of irrigation water.

For the barangays located along the Tamontaka – Tapian Road, the total rice paddy is around 466 hectares. Thirty eight (38) hectares of the 354 irrigable areas are already supplied by irrigation water.

TABLE 15.11.4-3 SIZE OF RICE PADDY

Road Name	Mun.	Barangay name	Total Rice Paddy (Ha)	Irrigated (Ha)	Potential for Irrigation but not yet Irrigated (Ha)
PINARING - SIMSIMAN ROAD	Sultan Kudarat	Ungap	10	0	15
		Raguisi	840	0	800
		Pinaring	300	11	40
		Maidapa	150	0	150
		Damaniog	70	0	70
		Ibotigen	350	350	0
		Narra	170	0	170
		Katidtuan	257	0	257
		Kakar	100	50	50
		Banatin	60	0	60
		Panatan	155	55	100
		Alamada	20	0	20
		Limbo	96	96	0
	Pigcawayan	South Manuangan	50	20	30
		Banucagen	200	150	160
		Bulucaon	300	265	35
		Malagakit	60	0	35
		Simsiman	85	65	30
		Datu Binasing	300	0	300
		Lower Baguer	80	0	80
		Buricain	50	0	30
		Balacayon	50	0	50
		Matilac	500	0	300
		Upper Pangankalan	320	0	320
		Lower Pangankalan	360	0	360
		Kadingilan	450	0	450
		Datu Mantil	120	0	120
		Libungan Toreta	80	0	80
		Sub-Total	5,583	1,062	4,112
TAMONTAKA - TAPIAN ROAD	Datu Odin Sinsuat	Semba	30	0	80
		Dinaig Proper	160	0	160
		Brgy.Mompong	20	0	50
		Linek	53	33	20
		Badak	0	0	0
		Kusiong	200	5	3
		Tapian	3	0	3
		Sub - Total	466	38	316

FIGURE 15.11.4-3 IRRIGATED RICE PADDY ALONG THE PINARING – SIMSIMAN ROAD

FIGURE 15.11.4.4 RICE PADDY ALONG THE TAMONTAKA – TAPIAN ROAD

15.12 ENVIRONMENTAL IMPACT ASSESSMENT

15.12.1 Needs Assessment

During the Barangay consultation meetings, needs of most important projects were asked. As presented in **Table 15.11.2-1**, need of road improvement is quite high. Among 35 barangays, 22 barangays answered that "road improvement" is the top priority for them, and 5 barangays as second priority. Thus, road improvement is quite important for the residents in the project influence areas.

15.12.2 Disadvantages of Poor Road Condition

As presented in **Table 15.11.2-2**, barangay people pointed out disadvantages of poor road as follows;

- Delay in transporting their farm products
- High transportation cost
- Difficulty of students in attending their schools
- Low income due to high transport
- Difficulty in bringing patients to a hospital
- Poor business opportunity

15.12.3 Perceived Benefits from Road Improvement

As presented in **Table 15.11.2-3**, perceived benefits from road improvement answered by barangay people are as follows;

PERCEIVED BENEFITS OF ROAD IMPROVEMENT

- Development of barangay will be accelerated due to better accessibility
- Easy access to many places due to good road
- Fast and easy transportation of farm products
- Very easy to go to market in Cotabato City
- Improvement in students' safety when going to school
- Increase business opportunities due to easy access
- Increase income of farmers due to low transport cost
- More livelihood opportunities will be developed such as car rentals, small stores, etc.
- It will motivate students to attend classes
- Tourism will be developed and people will come to our beaches

15.12.4 Social Acceptability

When asked if road improvement is acceptable, as presented in **Table 15.11.2-4**, a very high **100% agreement** of barangay people was obtained. It is important to note that the people, particularly the male population also requested that they be given a **chance to participate** during project implementation as hired labourers or any other type of job that would suit them. They also committed to help **provide security** to the equipments to be used as well as to personnel who will be assigned during the construction period.

15.12.5 Impact Assessment and Mitigation Measures

1) Pinaring-Simsiman Road

Predicted impacts and mitigation measures during pre-construction and construction phases are summarized in **Table 15.12.5-1**, and operation phase in **Table 15.12.5-2**.

TABLE 15.12.5-1 PREDICTED IMPACTS AND MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION PHASES

Predicted and Assessed Impacts	Rating	Proposed Mitigating Measures
ROW Acquisition	NO	• Detailed design shall follow the design policy not to require ROW acquisition.
Involuntary Resettlement	No	• Detailed design shall follow the design policy not to require involuntary resettlement.
Increase in noise level	B	• Schedule equipment move-in to blend with regular non-peak hour-daytime vehicular traffic; no night time movements • Provide barriers in work areas where use equipment with high noise power level is expected
Slope modification	B	• Minimize land modification; follow established design consideration
Decreased public/ community access to or through the area	B	• Minimize obstruction to areas • Provide alternative access in the event total road closure is necessary
Disruption of service utilities and infrastructures	B	• Coordinate with appropriate utility firms prior to project implementation • Ensure prompt and proper relocation of utility lines
Demolition of structures	B	• Minor only; mainly fences and extensions. Proper notification of, and compensation to owners of affected structures
Construction wastes	B	• Construction wastes such as unsuitable soils, demolished box culvert materials, etc., shall be dumped at the location specified by the Engineer
Noise due to pile driving	B	• Pile driving shall be undertaken only during daytime.
Dust caused by construction work	B	• Prior to the start of the work activities, proper measures such as watering shall be undertaken to minimize dusting
Increased housing requirement for transient workers, and project management staff	B	• Provide temporary bunkhouse on site or rent houses in neighboring communities if housing requirements cannot be accommodated in the locality where the project is located
Traverse areas with historical significance	No	• Coordinate with Local Cultural and Historical Affairs Commission to ensure proper handling of archaeological finds, if any
Increased hazards due to construction activities	B	• Provide safety equipment and appropriate warning signs along the route • Provide alternative use of the construction yard/staging area once the project demobilizes • Clear construction debris, form works and equipment and remove all obstructions • Minimize construction clutter, manage construction debris properly and provide barriers to reduce eye sores • Screen laborers (particularly if they come from other localities other than the project area) to prevent possible spread of HIV / AIDS. This can be done by requiring applicants to submit blood tests (for HIV detection) prior to hiring.
Cutting trees	B	• Cutting trees shall be minimized, and transplanted. If cutting trees is inevitable, new trees in double number shall be planted.

Rating: A: Serious Impact is expected
B: Some impact is expected
C: Extent of impact is unknown
No: No impact is expected

TABLE 15.12.5-2 PREDICTED IMPACTS AND MITIGATION MEASURES DURING OPERATION PHASE

Predicted and Assessed Impacts	Rating	Proposed Mitigating Measures
Increase of traffic accident	B	• Traffic regulatory signs, warning signs shall be properly maintained to be always visible. If necessary humps, to reduce vehicle speed, shall be installed.
Localized flooding	B	• Side ditches and pipe / box culverts shall be always cleaned so as to properly function.
Travel cost increase	B	• Paved carriageway shall be properly maintained so as to provide smooth travel.
Obstruction at bridge opening	B	• Obstruction at the bridge opening shall be always removed to assure smooth water flow at bridge sites.
Disorderly urbanization	B	• Concerned LGUs shall strictly enforce the zoning ordinance along the road

Rating: A: Serious Impact is expected
B: Some impact is expected
C: Extent of impact is unknown
No: No impact is expected

2) Tamontaka-Tapian Road

Predicted impacts and mitigation measures during pre-construction and construction phases are summarized in **Table 15.12.5-3** and operation phase in **Table 15.12.5-4**,

TABLE 15.12.5-3 PREDICTED IMPACTS AND MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION PHASES

Predicted and Assessed Impacts	Rating	Proposed Mitigating Measures
ROW Acquisition	No	• Detailed design shall follow the design policy not to require ROW acquisition.
Involuntary Resettlement	No	• Detailed design shall follow the design policy not to require involuntary resettlement.
Increase in noise level	B	• Schedule equipment move-in to blend with regular non-peak hour-daytime vehicular traffic; no night time movements • Provide barriers in work areas where use equipment with high noise power level is expected
Slope modification	B	• Minimize land modification; follow established design consideration
Decreased public/ community access to or through the area	B	• Minimize obstruction to areas • Provide alternative access in the event total road closure is necessary
Disruption of service utilities and infrastructure	B	• Coordinate with appropriate utility firms prior to project implementation • Ensure prompt and proper relocation of utility lines
Demolition of structures	B	• Minor only; mainly fences and extensions. Proper notification of, and compensation to owners of affected structures
Construction wastes	B	• Construction wastes such as unsuitable soils, demolished box culvert materials, etc., shall be dumped at the location specified by the Engineer
Noise due to pile driving	B	• Pile driving shall be undertaken only during day time.
Dust caused by construction work	B	• Prior to the start of the work activities, proper measures such as watering shall be undertaken to minimize dusting
Increased housing requirement for transient workers, and project management staff	B	• Provide temporary bunkhouse on site or rent houses in neighboring communities if housing requirements cannot be accommodated in the locality where the project is located
Traverse areas with historical significance	No	• Coordinate with Local Cultural and Historical Affairs Commission to ensure proper handling of archaeological finds, if any
Increased hazards due to construction activities	B	• Provide safety equipment and appropriate warning signs along the route • Provide alternative use of the construction yard/staging area once the project demobilizes • Clear construction debris, form works and equipment and remove all obstructions • Minimize construction clutter, manage construction debris properly and provide barriers to reduce eye sores • Screen laborers (particularly if they come from other localities other than the project area) to prevent possible spread of HIV / AIDS. This can be done by requiring applicants to submit blood tests (for HIV detection) prior to hiring.
Cutting trees	B	• Cutting trees shall be minimized, and transplanted. If cutting trees is inevitable, new trees in double number shall be planted.

Rating: A: Serious Impact is expected
B: Some impact is expected
C: Extent of impact is unknown
No: No impact is expected

TABLE 15.12.5-4 PREDICTED IMPACTS AND MITIGATION MEASURES DURING OPERATION PHASE

Predicted and Assessed Impacts	Rating	Proposed Mitigating Measures
Increase of traffic accident	B	• Traffic regulatory signs, warning signs shall be properly maintained to be always visible. If necessary humps, to reduce vehicle speed, shall be installed.
Localized flooding	B	• Side ditches and pipe / box culverts shall be always cleaned so as to properly function.
Travel cost increase	B	• Paved carriageway shall be properly maintained so as to provide smooth travel.
Obstruction at bridge opening	B	• Obstruction at the bridge opening shall be always removed to assure smooth water flow at bridge sites.
Disorderly urbanization	B	• Concerned LGUs shall strictly enforce the zoning ordinance along the road, particularly beach resorts development shall be properly controlled.

Rating: A: Serious Impact is expected
B: Some impact is expected
C: Extent of impact is unknown
No: No impact is expected

15.12.6 Environmental Management and Monitoring Plan

1) Environmental Management and Monitoring Plan

Environmental management and monitoring plan (EMMP) is presented in **Table 15.12.6-1**.

2) Institutional Plan for EMMP Implementation

The institutional plan that will be implemented during project implementation of the project is presented in **Figure 15.12.6-1.** As shown in the said figure, the DPWH-ARMM shall be the Implementing Agency of the Project. The DPWH-ARMM Secretary shall have overall responsibility for all technical aspects of the project;

During the construction phase, the Contractor shall assign an Environment Safety and Health (ESH) Officer. In coordination with the DPWH-ARMM Environmental Specialist, he shall be responsible for implementing the Environmental Management and Monitoring Plan (EMMP) presented in **Table 15.12.6-1** on the side of the Contractors.

Aside from the above mentioned tasks, the main duties of the ESH Officer shall be to:

(i) ensure that the other staff understand and properly carry out their responsibilities;

(ii) ensure that environmental monitoring activities are carried out in a timely and accurate manner;

(iii) implement an effective preventive and corrective control system, particularly in terms of environmental emergency preparedness and response procedures;

(iv) collate performance data and prepare reports that includes an assessment of performance vis-à-vis the EMMP objectives and targets, for submittal to DPWH-ARMM Environmental Specialist. To ensure effectiveness of the IEC, he shall also act as a liaison between DPWH-ARMM, DENR-ARMM, and the primary stakeholders, particularly the LGU of Datu Odin Sinsuat, other government agencies, and more importantly, the affected barangays. This task is particularly important in terms of receiving comments, views, complaints (if any), and other concerns from the stakeholders mentioned.

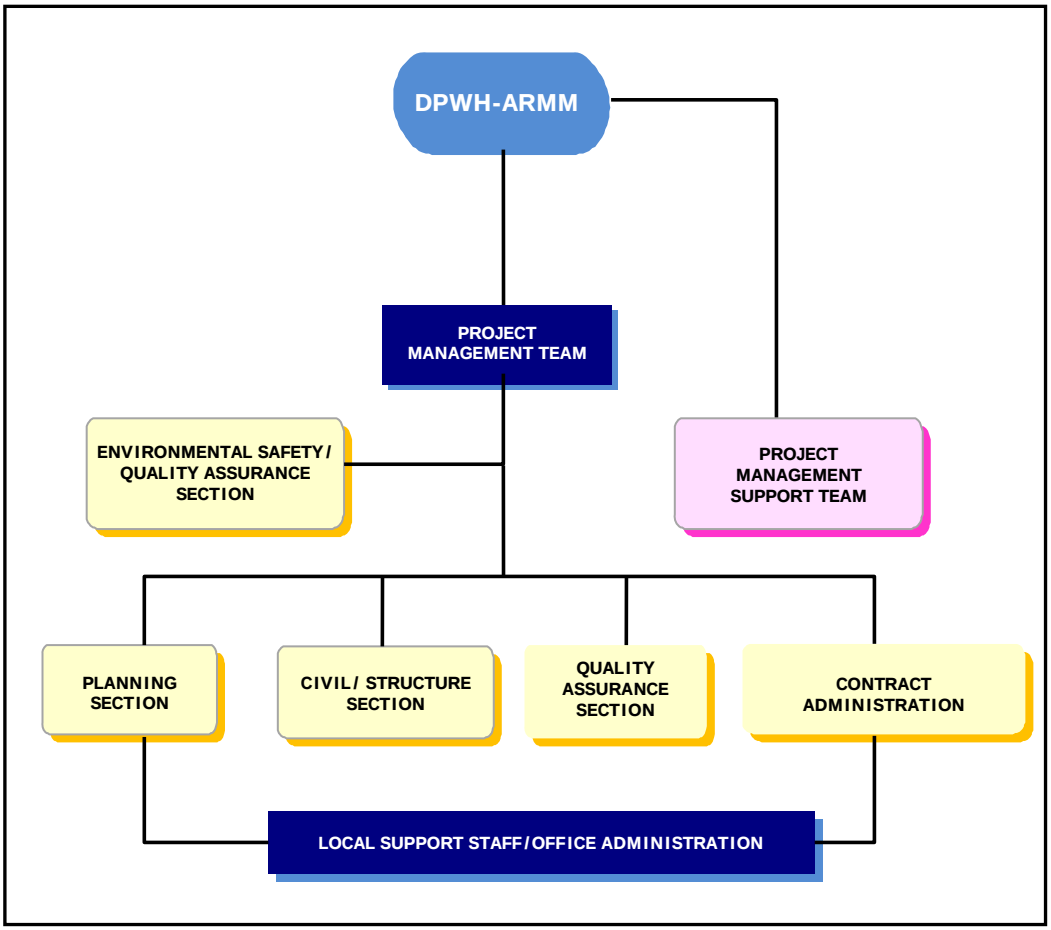


FIGURE 15.12.6-1 INSTITUTIONAL PLAN FOR THE IMPLEMENTATION OF PINARING-SIMSIMAN ROAD AND TAMONTAKA-TAPIAN ROAD

TABLE 15.12.6-1 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

CONSTRUCTION PHASE

Parameters to be Monitored	Stations to be Monitored	Frequency of Monitoring	Methods of Analysis/Execution	DENR Standard	Implementor
BIOLOGICAL					
Tree Cutting, if any	Sites where trees will be cut	Daily	Site inspection	Permit to Cut to be secured by Contractor from DENR-ARMM prior to any cutting of trees	Environment, Safety, and Health (ESH) Personnel of Contractor, to be supervised by counterpart Environmental Specialist of DPWH-ARMM
PHYSICAL					
Air Quality (TSP, SO_2 and NO_2)	At all densely populated areas fronting construction site	Daily	Site inspection	Visual only	Pollution Control Officer (PCO) of Contractor to be supervised by Environment, Safety, and Health (ESH) Personnel, also of Contractor
		Quarterly	Air quality sampling and analysis: TPS (gravimetric method), SO_2 (Pararosaniline method), NO_2 (Griess-Saltzman method)	TSP – 300 uGN/NCM SO_2 – 340 uGN/NCM NO_2 – 260 uGN/NCM	Pollution Control Office (PCO) of Contractor to be supervised by Environment, Safety, and Health (ESH) Personnel, also of Contractor (Note: if Contractor does not have the necessary equipment, this maybe contracted out)
Noise Levels	Particularly at areas where high noise generating equipment will be used	Daily for high noise level generating activities; Weekly for other activities during construction Investigation on a complaint basis shall be immediately undertaken	Noise Meter	Noise = **85 dB(A)** (For Areas fronting 2-lane roads)	Pollution Control Officer (PCO) of Contractor to be supervised by Environment, Safety, and Health (ESH) Personnel, also of Contractor
Solid waste management and disposal	Areas where hauling of unusable excavated materials and construction spoils are necessary Areas where temporary stockpiles are located	Daily Daily	Site inspection Site inspection	Based on IEE	Pollution Control Officer (PCO) of Contractor to be supervised by Environment, Safety, and Health (ESH) Personnel, also of Contractor

SOCIAL					
Supply of Basic Utilities	Areas which will experience power/water supply interruptions due to disturbance utility lines (water, electricity, telecommunication) during construction	Depends on schedule of interruption. Investigation on a complaint basis shall be immediately undertaken	Site observation and receipt of complaints from affected population	Based on IEE	Environment, Safety, and Health (ESH) Personnel of Contractor, to be supervised by counterpart Environmental Specialist of DPWH-ARMM in coordination with local offices of service provider
Traffic Management	Road sections and crossings affected by construction activities	Daily	Site observation shall be recorded	Based on IEE and Traffic Management Plan duly approved by DPWH-ARMM	Environment, Safety, and Health (ESH) Personnel of Contractor, to be supervised by counterpart Environmental Specialist of DPWH-ARMM
Safety of Pedestrians	Construction areas along populated areas and other areas with commercial establishments, schools, and other institutional structures	Daily Investigation on a complaint basis shall be immediately undertaken	Site observation shall be recorded	Based on IEE	Traffic Aides to be assigned by the Contractor Environment, Safety, and Health (ESH) Personnel of Contractor, to be supervised by counterpart Environmental Specialist of DPWH-ARMM
Compliance of Contractor to occupational health and safety rules and regulation	All construction areas	Weekly	Site inspection of work areas including sanitation facilities shall be recorded	Based on IEE	Environment, Safety, and Health (ESH) Personnel of Contractor, to be checked by counterpart Environmental Specialist of DPWH-ARMM

OPERATION PHASE

Parameters to be Monitored	Stations to be Monitored	Frequency of Monitoring	Methods of Analysis/Execution	DENR Standard	Implementor
SOCIAL					
Safety of Travel and Efficiency of System	Entire road section, including bridges	Monthly	Check continuous, smooth, and safe travel along the road network, minimizing accidents	Based on DPWH Standard	DPWH –ARMM Bureau of Maintenance
Efficiency of traffic management measures and parking restrictions	Entire road section, including bridges	Monthly	Site patrolling; Strict implementation in traffic rules and regulations; and Stiff penalties for violators	Based on existing local Traffic Rules and Regulations	Traffic Patrol Group of concerned LGUs
Safety features for pedestrian traffic	Entire road section, particularly along populated areas, schools, hospitals	Monthly	Site patrolling; Strict implementation in usage of proper pedestrian crossings; Strict implementation in traffic rules and regulations; and Stiff penalties for violators	Based Traffic Management Plan and existing local Traffic Rules and Regulations	Traffic Patrol Group of concerned LGUs
Cleanliness and aesthetic appeal	Entire road section, particularly along urban areas	Monthly	Site monitoring; Maintenance of landscaped areas; and Stiff penalties for violators	Based on local ordinances	DPWH –ARMM Bureau of Maintenance Concerned LGUs

15.13 ECONOMIC EVALUATION FOR PRE-F/S PROJECTS

15.13.1 Future Traffic Volume Forecast

The future traffic volumes of subject roads are calculated as the sum of the traffic along the roadside of the subject road and the diverted traffic which will be diverted from other roads by improving the subject road. Sources of future traffic of each subject road are indicated in the table below.

TABLE 15.13.1-1 SOURCES OF FUTURE TRAFFIC

Objective Roads	Future Traffic Volume	
	Traffic along Roadside	Converted Traffic from Other Roads
Pinaring – Simsiman Road	○	○ : Diversion from Cotabato – Davao Road
Tamontaka – Tapian Road	○	×

(1) Precondition of Estimation

i) Present Traffic Volume

The present traffic condition of the subject roads and neighboring roads are captured from the field survey and shown in the table below.

(Unit: vehicles/day)

Objective Road	Car	Jeepney	Bus	Truck	Total
Pinaring – Simsiman Road	20	30	0	15	65
Tamontaka – Tapian Road	20	40	0	40	100
Cotabato – Davao Road	910	432	86	339	1,767

ii) Increase Rate of Traffic Volume

The number of cars, jeepneys, and buses will increase as a result of increase in population, and number of trucks will increase as a result of increase in GRDP of roadside.

iii) Converted Traffic Volume

It is envisaged that many long-distance trips between Cotabato and Davao are passing through the Cotabato - Davao Road which is parallel to the Pinaring - Simsiman Road. When the Pinaring - Simsiman Road is improved and travel speed improved, it is possible that some traffic will be diverted from the Cotabato - Davao road to the Pinaring – Simsiman Road (refer to the figure).

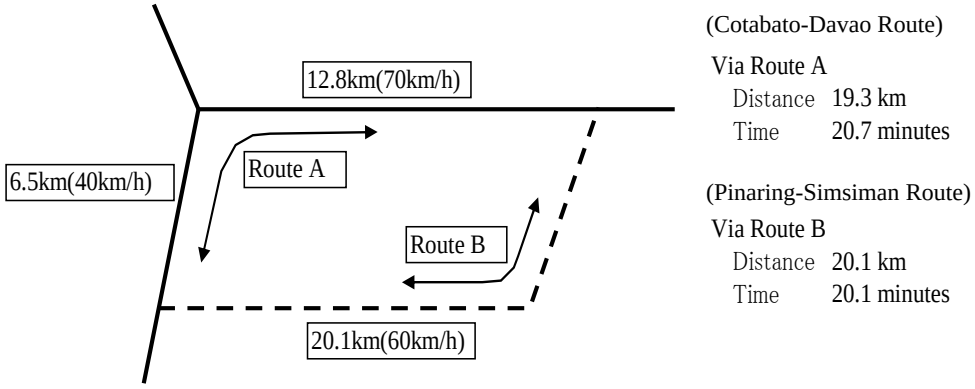


FIGURE 15.13.1 COTABATO-DAVAO ROUTE AND PINARING-SIMSIMAN ROAD

It was assumed that around 10% of traffic of the Cotabato - Davao Road will be diverted to the Pinaring – Simsiman Road in 2013 after the road is improved, and 20% in 2015 and beyond.

(2) Result of Forecast

The results of traffic volume forecast are shown in Table 15.13.1-1. Traffic volume on the Pinaring – Simsiman Road is expected to reach 289 veh./day in 2013 after its improvement is complete. Traffic volume will further increase through diverted traffic from the Cotabato – Davao Road. As a result, 521 veh./day in 2015, 604 veh./day in 2020, 711 veh./day in 2025 are expected to use the road. On the other hand, the traffic volume on the Tamontaka - Tapian road is expected to reach 121 veh./day in 2013 after its improvement, to 131 veh./day in 2015, 158 veh./day in 2020, and 192 veh./day in 2025 as a result of increase of roadside population and economic development.

TABLE 15.13.1-1 RESULTS OF TRAFFIC VOLUME FORECAST ON THE OBJECTIVE ROADS FOR PRE-F/S

[Pinaring – Simsiman Road]

1) Increase of Present Traffic Volume

	Car	Jeepny	Bus	Truck	Total
2013	25	38	0	22	85
2015	27	41	0	25	93
2020	32	49	0	37	118
2025	38	59	0	56	153

2) Diverted Traffic Volume from Cotabato – Davao Road

	Car	Jeepny	Bus	Truck	Total	Conversion Rate
2010	0	0	0	0	0	0%
2013	103	49	10	42	204	10%
2015	215	102	20	91	428	20%
2020	237	113	22	114	486	20%
2025	263	125	25	145	558	20%

3) Total Traffic Volume

	Car	Jeepny	Bus	Truck	Total
2013	128	87	10	64	289
2015	242	143	20	116	521
2020	269	162	22	151	604
2025	301	184	25	201	711

[Tamontaka – Tapian Road] (Only Increase of Present Traffic Volume)

	Car	Jeepny	Bus	Truck	Total
2013	23	47	0	51	121
2015	25	50	0	56	131
2020	28	57	0	73	158
2025	32	64	0	96	192

15.13.2 Economic Benefits Calculation

(1) Traffic Benefit

Traffic Benefits are calculated through savings from Vehicle Operating Cost (VOC) and Travel Time Cost (TTC). For VOC, the difference between before and after improvement corresponds to its economic benefit. TTC on the other hand is generated as a result of travel speed improvement as consequence of new construction. For the Pinaring - Simsiman Road, the travel time abbreviation benefit from the diverted traffic from the Cotabato – Davao Road was also taken into account. The calculation results are shown in **Table 15.13.2-1**.

TABLE 15.13.2-1 TRAFFIC BENEFITS (SAVINGS OF VOC AND TTC)

(Unit: 1,000PhP/year)

	Year	VOC	TTC	TOTAL
Pinaring – Simsiman Road				
Traffic among Roadside Area	2013	9,627.6	8,039.5	17,667.1
	2015	10,770.5	8,677.5	19,378.0
	2020	14,519.0	10,337.0	24,856.0
	2025	20,256.4	12,380.1	32,636.5
Converted Traffic	2013	43.5	470.5	514.0
	2015	89.2	981.2	1,070.4
	2020	98.6	1,083.4	1,182.0
	2025	110.1	1,200.9	1,311.0
Total	2013	9,671.1	8,510.0	18,181.1
	2015	10,789.7	9,658.7	20,448.4
	2020	14,617.6	11,420.4	26,038.0
	2025	20,366.5	13,581.0	33,947.5
Tamontaka – Tapian Road				
	2013	14,994.2	7,831.7	22,825.9
	2015	16,363.4	8,390.0	24,753.4
	2020	20,591.2	9,509.8	30,101.0
	2025	26,179.3	10,739.3	36,918.6

(2) Saving of Operating and Maintenance Costs

The difference between paved and unpaved road in terms of operating and maintenance costs is about 130,100 pesos/km/year. The saving of operating and maintenance costs in both roads after improvement are shown in the table below.

TABLE 15.13.2-2 SAVING OF OPERATING AND MAINTENANCE COSTS

	Saving of O&M Costs (1,000PhP/year)
Pinaring – Simsiman Road	2,393.8
Tamontaka – Tapian Road	2,094.6

(3) Improvement in Agricultural Productivity

In the roadside area of the objective road for pre-F/S, agriculture is a main industry, and the income from agriculture serves as the main household income with 54% of household along the Pinaring-Simsiman Road and 30% along the Tamontaka-Tapian Road. In these areas, the impact to the agriculture is assumed by improving objective roads. That is, by improving those roads, the transportation cost of agricultural products is reduced and product damage in transit also decreases. Moreover, the impassable period in the rainy season is eliminated, and the number of times of shipment to market increases. As a result, the motivation for production of farmer increases and it is possible that productivity improves.

1) Setting of Affected Area

Affected area of the objected roads is shown in **Figure 15.13.2-1**.

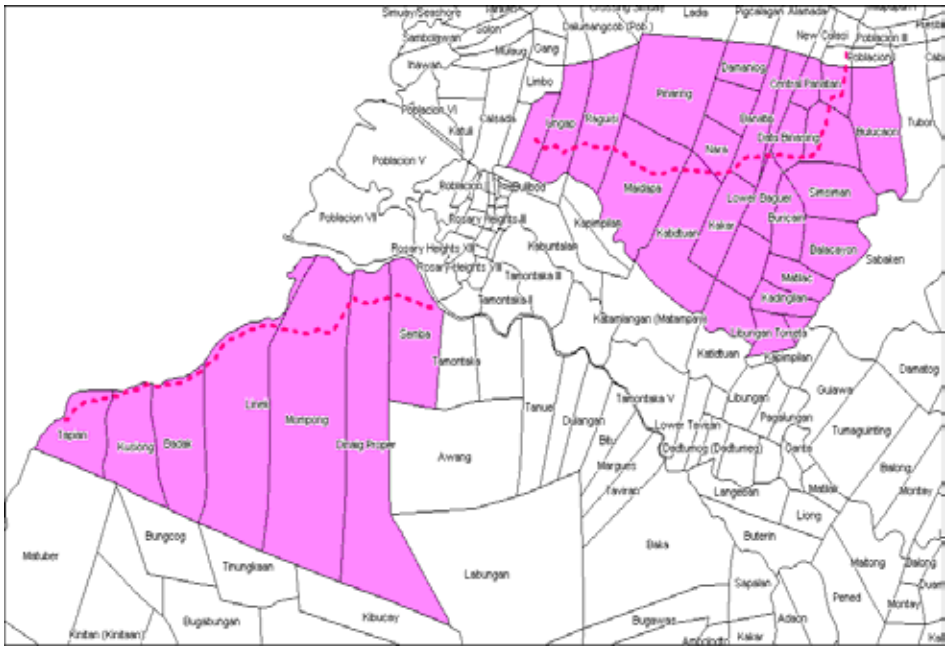


FIGURE 15.13.2-1 DIRECT INFLUENCE AREA OF THE OBJECTIVE ROADS FOR F/S

2) Agricultural Productivity of Direct Influence Area

The main agricultural products in the affected/influenced area are rice and corn. The planted area of these agricultural products is calculated by multiplying the barangay's area by the farmland rate (from analyses of aerial photography), and the planted area of rice and corn are calculated in consideration of the annual average planted area rate in ARMM. Moreover, the net income of farmhouse is calculated by multiplying these planted areas by frequency of harvest, the yield per unit area and farm gate price.

Planted Area by Agricultural Product = Barangay's Area x Farmland Rate x Planted Area Rate
Agricultural Productivity = Planted Area by Agricultural Product x Frequency of Harvest x Yield per Unit Area x Farm Gate Price

a) Planted Area Rate

Planted area rate of rice and corn, which are the main agricultural products in the affected area, was calculated using the rate of ARMM in 2008 as shown below.

- % of Irrigated Palay 12.9%
- % of Rainfed Palay 27.5%
- % of White Corn 44.4%
- % of Yellow Corn 15.2%

b) Frequency of Harvest

Frequency of harvest was set as follows through the hearing survey results in the objective area.

(times/year)

	Pinaring – Simsiman Road	Tamontaka – Tapian Road
Palay (Irrigated)	2.2	2.4
Palay (Rainfed)	2.0	1.9
Corn (Yellow)	1.6	2.3
Corn (White)	1.7	2.0

Source: Study Team

c) Yield per Unit Area

The yield per unit area was calculated with actual data of ARMM in 2008 as shown below.

- Palay (Irrigated) 4.0 metric ton/hectare
- Palay (Rainfed) 2.4 metric ton/hectare
- Corn (Yellow) 3.4 metric ton/hectare
- Corn (White) 2.5 metric ton/hectare

d) Farm Gate Price

Farm gate price is set using the average farm gate prices of ARMM in 2008.

(per kilogram)

	Farmgate Price of 2008
Palay (Paddy) Fancy, dry	**14.97**
Corngrain (Maize)Yellow, matured	**9.67**
Corngrain (Maize)White, matured	**10.44**

e) Agricultural Productivity in Related Area

The result of agricultural productivity in related area is shown as follows based on the above preconditions.

TABLE 15.13.2-3 AGRICULTURAL INCOME OF THE RELATED AREA

(1000Pesos/year)

	Pinaring – Simsiman Road	Tamontaka – Tapian Road
Palay (Irrigated)	88,690	83,466
Palay (Rainfed)	171,903	140,945
Yellow Corn	113,886	118,538
White Corn	37,824	49,203
Total	**412,303**	**392,151**

f) Benefit by Improvement Objective Road

By improving objective roads, the motivation for production of farmer increases and productivity improves. Specifically, the following effectiveness is expected.

- The productivity of the roadside area on Tamontaka - Tapian Road is relatively low in Mindanao or ARMM area, and improvement in productivity by improvement of the road can be expected. For example, supposing productivity improves even to the Mindanao average, 16% (Palay) and 18% (White Corn) of productivity increase will be expected, respectively.

- According to the estimate of VOC, VOC of a rigid truck with 2-axle decreases by about 65% by paving a road (travel speed rises from 20km/h to 50km/h, and VOC decreases in 56.0 Pesos/km to 19.45 Pesos/km). The rate of the transportation cost occupied to a shipment price is considered 7 to 9% (interview survey result to farmhouses), a transportation cost will decrease 5 to 6% by objective road improvement. This decrement is connected with the augmentation in farmhouses' income.

- If a road is improved, the product damage in transit will decrease, and it will lead to lifting of commodity value or the increase in the income by the decrease in a defective.

According to these expected effects, the agricultural productivity of farmhouses can be expected to increase about 40 to 60%. Increase-of-income effectiveness is calculated based on agricultural productivity of the related area calculated in section e). In the case of the increase in 40%, it becomes 164,900,000 pesos per annum along Pinaring-Simsiman Road area and 156,900,000 pesos per annum along Tamontaka-Road area as shown below.

TABLE 15.13.2-4 INCREASE IN AGRICULTURAL INCOME OF THE RELATED AREA

(Mil. PhP/year)

	Pinaring – Simsiman Road	Tamomtaka – Tapian Road
Improvement in Agricultural Productivity	164.9	156.9

15.13.3 Cost-Benefit Analysis

The results of cash flow analysis with costs and benefits per annum are shown in **Table 15.13.3-1**. Based on these results, each road project is economically feasible enough to be executed.

TABLE 15.13.3-1 ECONOMIC ANALYSIS RESULTS FOR PRE-F/S ROADS

	EIRR	NPV (Mil. PhP) (R=15%)	B/C (R=15%)
Pinaring – Simsiman Road	18.4	113.6	1.27
Tamontaka – Tapian Road	19.8	139.3	1.37

TABLE 15.13.3-2 CASH FLOW ANALYSIS FOR PRE-F/S ROADS

Pinaring - Simsiman Road (Mil. PHP)

	Cost			Benefit					Net Cash Flow
	Construction	Maintenance	Total	VOC	TTC	Reduction of Maintenance Cost	Increase in Agricultural Production	Total	
2010	23.5	0.0	23.5	0.0	0.0	0.0	0.0	0.0	-23.5
2011	196.1	0.0	196.1	0.0	0.0	0.0	0.0	0.0	-196.1
2012	279.0	0.0	279.0	0.0	0.0	0.0	0.0	0.0	-279.0
2013	93.0	2.6	95.6	8.1	7.1	2.0	20.6	37.8	-57.8
2014	0.0	3.2	3.2	10.2	9.1	2.4	41.2	62.9	59.7
2015	0.0	3.2	3.2	10.8	9.7	2.4	61.8	84.7	81.5
2016	0.0	3.2	3.2	11.6	10.0	2.4	82.5	106.4	103.2
2017	0.0	3.2	3.2	12.3	10.4	2.4	103.1	128.2	125.0
2018	0.0	3.2	3.2	13.1	10.7	2.4	123.7	149.9	146.7
2019	0.0	3.2	3.2	13.9	11.1	2.4	144.3	171.6	168.4
2020	0.0	3.2	3.2	14.6	11.4	2.4	164.9	193.4	190.2
2021	0.0	3.2	3.2	15.8	11.9	2.4	164.9	194.9	191.7
2022	0.0	3.2	3.2	16.9	12.3	2.4	164.9	196.5	193.3
2023	0.0	3.2	3.2	18.1	12.7	2.4	164.9	198.1	194.9
2024	0.0	3.2	3.2	19.2	13.1	2.4	164.9	199.7	196.5
2025	0.0	3.2	3.2	20.4	13.6	2.4	164.9	201.3	198.1
2026	0.0	3.2	3.2	21.0	14.0	2.4	164.9	202.4	199.2
2027	0.0	3.2	3.2	21.7	14.5	2.4	164.9	203.5	200.3
2028	0.0	3.2	3.2	22.5	15.0	2.4	164.9	204.7	201.5
2029	0.0	3.2	3.2	23.2	15.5	2.4	164.9	206.0	202.8
2030	0.0	3.2	3.2	24.0	16.0	2.4	164.9	207.3	204.1
2031	0.0	3.2	3.2	24.7	16.5	2.4	164.9	208.6	205.4
2032	0.0	3.2	3.2	25.6	17.0	2.4	164.9	209.9	206.7
Total	591.6	63.4	655.0	347.5	251.5	47.6	2,721.2	3,367.8	2,712.8

EIRR	**18.4%**
NPV(R=15%)	**113.6**
B/C(R=15%)	**1.27**

Tamontaka - Tapian Road (Mil. PHP)

	Cost			Benefit					Net Cash Flow
	Construction	Maintenance	Total	VOC	TTC	Reduction of Maintenance Cost	Increase in Agricultural Production	Total	
2010	23.5	0.0	23.5	0.0	0.0	0.0	0.0	0.0	-23.5
2011	186.4	0.0	186.4	0.0	0.0	0.0	0.0	0.0	-186.4
2012	264.4	0.0	264.4	0.0	0.0	0.0	0.0	0.0	-264.4
2013	44.1	2.8	46.9	15.0	7.8	2.1	19.6	44.5	-2.3
2014	0.0	2.8	2.8	15.7	8.1	2.1	39.2	65.1	62.3
2015	0.0	2.8	2.8	16.4	8.4	2.1	58.8	85.7	82.9
2016	0.0	2.8	2.8	17.2	8.6	2.1	78.4	106.4	103.6
2017	0.0	2.8	2.8	18.1	8.8	2.1	98.0	127.0	124.2
2018	0.0	2.8	2.8	18.9	9.1	2.1	117.6	147.7	144.9
2019	0.0	2.8	2.8	19.7	9.3	2.1	137.3	168.4	165.6
2020	0.0	2.8	2.8	20.6	9.5	2.1	156.9	189.1	186.3
2021	0.0	2.8	2.8	21.7	9.8	2.1	156.9	190.4	187.6
2022	0.0	2.8	2.8	22.8	10.0	2.1	156.9	191.8	189.0
2023	0.0	2.8	2.8	23.9	10.2	2.1	156.9	193.2	190.4
2024	0.0	2.8	2.8	25.1	10.5	2.1	156.9	194.5	191.7
2025	0.0	2.8	2.8	26.2	10.7	2.1	156.9	195.9	193.1
2026	0.0	2.8	2.8	27.0	11.1	2.1	156.9	197.1	194.3
2027	0.0	2.8	2.8	27.9	11.5	2.1	156.9	198.4	195.6
2028	0.0	2.8	2.8	28.9	11.8	2.1	156.9	199.7	196.9
2029	0.0	2.8	2.8	29.8	12.2	2.1	156.9	201.0	198.2
2030	0.0	2.8	2.8	30.8	12.6	2.1	156.9	202.4	199.6
2031	0.0	2.8	2.8	31.8	13.0	2.1	156.9	203.8	201.0
2032	0.0	2.8	2.8	32.9	13.5	2.1	156.9	205.3	202.5
Total	518.3	56.0	574.3	405.7	180.1	37.8	2,274.5	2,898.1	2,329.4

EIRR	**19.8%**
NPV(R=15%)	**139.3**
B/C(R=15%)	**1.37**

15.14 CONCLUSION

It was concluded that two road projects are technically, environmentally and economically feasible. It is recommended that two road projects should be implemented at the earliest possible time.

CHAPTER 16

TECHNOLOGY TRANSFER

16.1 MAJOR AREAS OF TECHNOLOGY TRANSFER

In the course of the Study, various seminars/workshops were undertaken focusing on the following:

- How to undertake Road/Bridge Inventory and Condition Survey
- Results of Road/Bridge Inventory and Condition Survey and how to utilize them
- How to undertake traffic surveys
- Present issues and how to improve institutional weakness
- Present issues and how to improve road maintenance
- EIA Systems
- How to prepare Road Network Development Master Plan

JICA-assisted "ARMM Human Capacity Development Project" has been conducted in parallel with this Study. The human capacity development project covers general procedures and methodology for each stage of the road project development cycle while this Study focused on the more concrete topics which were considered important and useful for road development planning, institutional improvement and maintenance improvement.

16.2 SEMINARS/WORKSHOP UNDERTAKEN

Seminars/workshops undertaken in the course of the Study are shown in **Table 16.2-1**.

TABLE 16.2-1 SEMINARS/WORKSHOPS UNDERTAKEN

Date	Topics	Presenter	No. of Participants
15 October 2008	Presentation of Inception Report	Mr. M. Kiuchi Mr. T. Encarnacion	120
12 & 13 November 2008	How to Accomplish Road/Bridge Inventory and Condition Survey Formats including dry-runs	Mr. T. Tsuchida	17
11 March 2009	How to undertake traffic surveys and analysis	Dr. N. Sinarimbo	26
11 March 2009	EIA system of the Philippines and JICA	Ms. A. Herrera	26
13 March 2009	Institutional Weakness and Constraints	Mr. T. Encarnacion	25
06 May 2009	Traffic Demand Forecast Methodology and Outcome	Mr. M. Ishiya	21
25 May 2009	Proposed Institutional Improvement and Reinforcement	Mr. T. Encarnacion	36
26 May 2009	Results of Road/Bridge Inventory and Condition Survey	Mr. A. Okazaki	30
26 May 2009	How to undertake IEE	Ms. A. Herrera	30
28 May 2009	Road Maintenance Problems and How to Evaluate Priority of Maintenance Work	Mr. K. Tsuzuki	14
16 June 2009	How to Prepare Road Network Master Plan	Mr. M. Kiuchi	20
17 June 2009	Project Prioritization Criteria and Method	Mr. M. Kiuchi	20
28 & 29 October 2009	Joint Inspection on Pre-F/S Roads (How to undertake road/bridge inspection)	Mr. M. Kiuchi Ms. A. Herrera	6

16.3 OBSERVATIONS THROUGH SEMINAR/WORKSHOP

Following were observations obtained through seminars/workshops;

- All participants were quite serious in learning something from the JICA Study Team.
- They actively joined to express their opinions/suggestions in consideration of DPWH-ARMM conditions.
- Most participants came from DPWH-ARMM Headquarter and a few participants came from District Engineering Offices since seminars/workshops were held at DPWH-ARMM Headquarter.
- It is believed that they have learned basic knowledge, such as how to undertake field surveys, how to identify projects, how to prioritize projects, what are the weaknesses of their institutional arrangements, what

are the problems of road/bridge maintenance, etc. What is important from now on is that they will practice what they have learned from this Study. They should actively seek opportunities to practice what they have learned.

- What they have learned under this Study is rather limited to the planning aspects. Next step will be the actual implementation of the projects. This Study could not cover technology transfer for the project implementation. It is hoped that in the course of project implementation proposed by the Master Plan, they would seek opportunities to be involved in the project implementation with some guidance of international experts.

CHAPTER 17

RECOMMENDATIONS

17.1 PEACE BUILDING

Peace building is the most important issue in the Study Area. Without attainment of peace in the region, people will continue to suffer from unstable life, harsh economic conditions, poverty and further deterioration of infrastructure. The National Government, the ARMM Government and the MILF should make all efforts to reach peace agreement at the earliest possible time.

On the part of a road sector, road network development should be planned that universal area development can be achieved to erase hostility among people.

17.2 REALIZATION OF THE MASTER PLAN

The Master Plan was prepared. The next step is to plan how to realize the Master Plan. Proposed projects, institutional reinforcement, road maintenance improvement measures, etc., should be included in the forthcoming ARMM Medium-term Regional Development Plan to show ARMM Government's strong will to implement the Master Plan and steadily implement them.

The following should also be undertaken;

- ARMM Government relies on its fund from the National Government. Now it has technical basis such as road projects, institutional improvement measures, road maintenance improvement, etc., to request funds for those to the National Government. All kinds of efforts should be exercised to obtain more funds from the National Government.

- In order to get more funds from the National Government, the DPWH-ARMM should show good performance. Planned and budgeted projects should be completed as scheduled.

17.3 COORDINATION WITH DPWH-NATIONAL

Much closer coordination with DPWH-National should be made and technical assistance from DPWH-National should be sought, particularly on the following;

Road/Bridge Database and HDM-IV Analysis

DPWH-ARMM's road/bridge database should be integrated with DPWH-National, and HDM-IV analysis which will be the basis of allocation of MVUC fund should be undertaken for roads within ARMM. Although DPWH-National is, at present, rather reluctant to do so because of difficulty to

examine data reliability owing to peace and order situation of the region, DPWH-ARMM should continue to discuss it with DPWH National.

Foreign-Assisted Projects Within ARMM

Foreign-assisted projects within ARMM are implemented by DPWH-National. Implementation arrangement should be discussed with DPWH-National so that engineers of DPWH-ARMM can be involved in the implementation of foreign-assisted projects within ARMM. These projects will provide good opportunities for DPWH-ARMM staff to be trained.

Implementation of Road Projects Which Extends Beyond ARMM Boundary

Many road projects proposed under the Master Plan extend beyond ARMM boundary and ends in Region X or Region XII. Implementation of such projects should not be planned by DPWH-ARMM alone but with close coordination with DPWH-National.

17.4 FARM-TO-MARKET ROAD IMPROVEMENT

ARMM is the poorest region in the country and has the highest rate of poverty. The dominant industry in the Region is agro-fishery thus road sector should support agro-fishery development so as to increase farmers and fishermen's income. Whenever a national or a provincial road improvement is planned, farm-to-market road improvement should also be included in the project.

17.5 INSTITUTIONAL REINFORCEMENT

Institutional weaknesses have been discussed in the course of the Study and a roadmap for institutional reinforcement was proposed by the Master Plan. Priority areas for institutional capacity development identified by DPWH-ARMM officials were as follows:

- Road database
- Traffic database
- Bridge management system
- Multi-year programming and scheduling
- Pavement management system
- Maintenance planning and programming
- Road network planning system
- Computerized road design system
- Budgeting within organizational performance indicator framework
- Project preparation: Feasibility Study

Since DPWH-National has already developed above system, DPWH-ARMM should coordinate with DPWH-National for technical assistance.

17.6 ROAD MAINTENANCE IMPROVEMENT

The Study recommended the following;

- Gradual shifting from Maintenance By Administration (MBA) to Maintenance By Contract (MBC) due to difficulty of renewal of equipment
- Much emphasis to be given to routine maintenance activities at least for next 10 years due to limited maintenance budget.
- Gradual shifting of man-power from Area Equipment Service Offices (AESO) to District Engineering Offices (DEO) in line with shifting to MBC.
- Road maintenance level and priority of maintenance activities to maximize usage of limited maintenance budget

Above recommendations should be realized by DPWH-ARMM.

17.7 IMPLEMENTATION OF PRE-F/S ROAD PROJECTS

Pre-feasibility study of two (2) road projects was undertaken under this Study. DPWH-ARMM should exert all efforts to realize these projects. All possible funding sources should be tapped for the realization of the projects. DPWH-ARMM should also make them as good opportunities for the on-the-job training to learn about project implementation.

Concerned LGUs' endorsements for the project should be secured and a certificate of non-coverage (CNC) should be obtained from DENR. To obtain CNC, DPWH-ARMM needs to submit a Project Description of which format is presented in Annex 17-1.

17.8 FEASIBILITY STUDY OF PROJECTS PROPOSED FOR THE SHORT-TERM PERIOD

Feasibility studies of projects proposed for the short-term period (2011-2015) should be undertaken at the earliest possible time, since it is the first step to realize the Master Plan.

17.9 ENVIRONMENTAL IMPACT ASSESSMENT

Projects for eliminating missing links and new road construction are expected serious environmental impacts. EIA for those type of projects should be carried out and possible mitigation measures should be planned and implemented. Typical Terms of Reference (TOR) for EIA study is shown in Annex 17-2.

17.10 UPDATING OF ROAD/BRIDGE DATABASE

Road/bridge database covering road/bridge inventory and condition survey results should be up-dated annually.


JICA