７－３　自然条件調査結果（エーヤワディー地域）

REPORT

ON

PREPARATORY SURVEY

FOR

RURAL INFRASTRUCTURE DEVELOPMENT

IN LOCAL AREAS

BOGALAY TOWNSHIP, AYEYARWADY REGION

THE REPUBLIC OF THE UNION OF MYANMAR

A7-3-1

YACHIO ENGINEERING CO., LTD.

FKYB – SI – 237/2017-029

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FOR
YACHIO ENGINEERING CO., LTD.
OF
RURAL INFRASTRUCTURE DEVELOPMENT PROJECT

1 INTRODUCTION

Geotechnical investigation is generally carried out to determine the substratum of ground (soil and rock) for small and large scale constructions, such as high-rise buildings, bridges, dams, factories, ports & jetties to be constructed and needs proper design of required structures. YACHIO ENGINEERING CO., LTD. is planning to develop the rural infrastructure at Bogalay Township, Ayeyarwaddy Region. Therefore, Fukken Co., Ltd. was assigned to conduct preparatory survey works to obtain the soil properties of selected locations in the project area.

1.1 Objective of Project

The conducted soil investigation during this project phase intends to define the subsurface conditions at project site as much as possible to evaluate the requirements of designing the structure. The specific objectives envisage to-

1) To understand the distribution condition of stratum in this project area
2) To recognize the physical and mechanical properties of soil
3) To evaluate the appropriate soil design parameter for construction design process
4) To point out the hazardous effects of ground respond during and after construction

1.2 Scope of Work

The scope of investigation works include three portions; field investigation work, laboratory testing and report preparation. The field investigation work includes soil boring, soil undisturbed sampling and Standard Penetration Test (SPT). There are four boring points and the total depth of investigation for four boreholes is 140.0 meter in this project area. The depth of boreholes is in accordance with soil condition of the points selected by expert's direction, according to the client requirements. Standard penetration tests were performed in all boreholes of designated locations in complies with ASTM (American Society for Testing and Materials). The collected disturbed samples and undisturbed samples from the boreholes were analyzed at Fukken's Yangon Branch Laboratory.

5) Field Works

Boring works by TOHO-D1 Drilling Machines.

- Standard Penetration Test
- Soil Disturbed Sampling
- Soil Undisturbed Sampling

6) Laboratory Test
- Physical properties test of soil
- Mechanical properties test of soil

7) Reports

All of the field investigation works and laboratory tests were carried out in accordance with ASTM, and the units are applied with SI.

1.3 Project Location

Project area is located at Bogalay Township, Ayeyarwaddy Region. The detailed location of project area is indicated as a google map in Figure -1.1.

Figure - 1.1 Google map of project area

1.4 Project Duration and Personnel

Fukken Co., Ltd. conducted preparatory survey work at the designated area of Bogalay Township. The field investigation works were started from 13th December, 2017 and completed all boreholes

on 23rd December, 2017. The laboratory tests were carried out after field work and completed on 2nd January, 2018.

The executed detailed actual working schedule is illustrated in Table-1.1. The organizational chart, including list of geotechnical engineers, drilling crews for boring machines, technicians and the entire persons involved in this operation, is shown in Figure - 1.2.

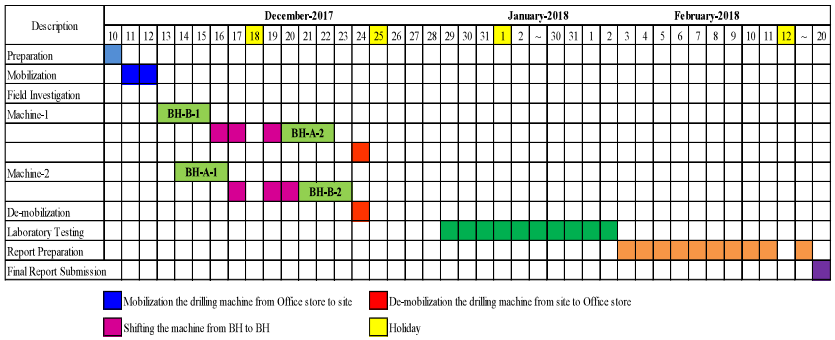
Photo - 1.1 Mobilization of Equipment

Photo - 1.2 Panoramic view of project area

Photo - 1.3 One of drilling condition

Photo - 1.4 Demobilization of Equipment

Table - 1.1 Actual Working Schedule of Geotechnical Investigation Works



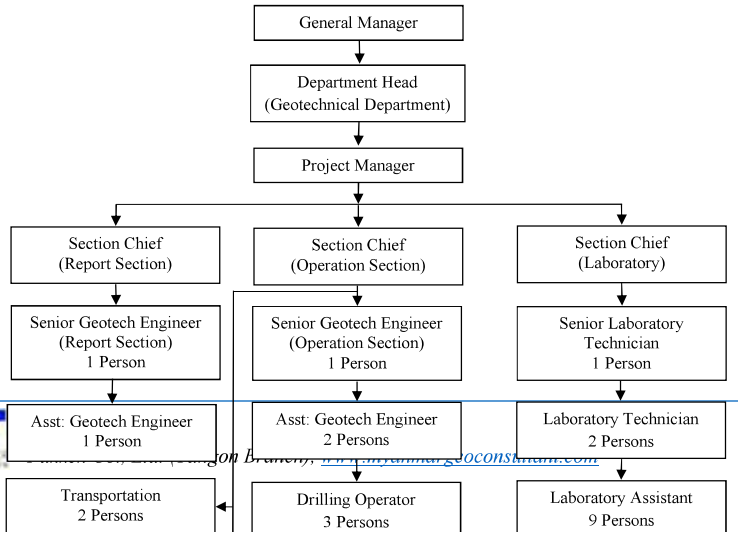


Figure - 1.2 Organization Chart of the works

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1.5 Boring Equipment Applied in the Project

The boring equipment, TOHO-D1, was applied to study the general condition of soil layers under planned area for future construction. The specification and the type of boring equipment is presented in Table-1.2.

Photo - 1.5 TOHO-D1 Drilling Machine

Table - 1.2 Specification of Boring Equipment

Parts of Equipment	Particulars
Brand of Boring machine	TOHO-"D1"
Boring Type	Rotary
Feeding Type	Hydraulic Feed Type
Drilling Capacity	150m
Spindle Stroke	400mm
Spindle Inner Dia.	43mm
Hoisting Speed	10~59m/min
Weight	476kgf
Oil Pump Delivery Capacity	19 l/min
Oil Pump Working Pressure	45~70kgf/cm^2
Attached Water Pump Type	Toho "BG-3B"
Discharge Capacity	54 l/min
Working Pressure	15 kgf/cm^2
Engine	Yanmar Engine 110
Power	11.0 HP

1.6 Laboratory Instruments

The principal instruments applied for soil laboratory tests are shown in the following table.

Table - 1.3 Applied Laboratory Instruments

Instrument Name	Manufacturer and Type
Drying Oven	YF-STHX-3A
Electrical Balance	SARTORIUS 1404B (MP8-1)
Atterberg Limits Test Apparatus	MARUI 1115013
Sieve Test Equipment	TOKYO SAITAMA (JIS Z 8801)
Unconfined Compression Test Machine	MARUI 19047
Consolidation Test Apparatus YF-WG-1B	YF-WG-1B
Triaxial Compression Test Machine	HUMBOLDT-HM-4165

Photo - 1.6 Drying Oven

Photo - 1.7 Electrical Balance

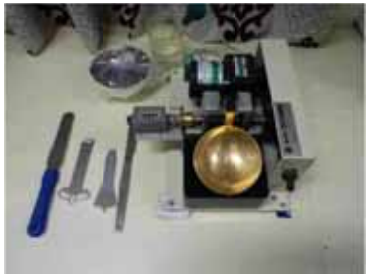

Photo - 1.8 Atterberg Limits Apparatus

Photo - 1.9 Sieve Test Equipment

Photo - 1.10 Unconfined Compression Test Machine

Photo - 1.11 Pycnometer for Specific Gravity Test

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Photo - 1.12 Consolidation Test Apparatus

Photo - 1.13 Triaxial Test Machine

2 SITE CHARACTERIZATION

In this chapter, it would be included about the topography, regional geologic setting and geology of the project area in Bogalay Township of Ayeyarwady region.

2.1 Topography

Since the entire proposed area is located in the Ayeyarwaddy Delta Region, the topographic feature of the region is regarded as relatively flat lying area. The meandering and braded channels are the distinctive features of the project area. The main river such as Bogale River; Ayeyarwaddy River; Pyinsalu River; Ywe River and Thetkethaung River; flow from north to south. All rivers and creeks are regarded as tidal affected river and creek. The characteristics of complicated channels of this area is the significant resource of navigation and transportation of this area.

2.2 Regional Geologic Setting

Refer to the geological map from Geology of Burma, published by Earth Science and Research Division in 1983, the whole project area is covered by the Younger Alluvium Deposit of Holocene age. The boring results of recent soil investigation confirmed that the project area is covered with

the clastic sediments of flood plain deposit of deltaic environment in upper portion and shallow marine deposit of lower portion. Sand, clay and silt are major unit of both flood plain and marine deposit whereas the gravel is the minor constituents. In some area, the flood plain deposit and marine deposits are observed as interlocked layers. According to the geological map, the regional geological setting of the area is described as follows.

Formation	Age	Lithology
Younger Alluvium	HOLOCENE	Clastic sediments of marine and flood plain deposits
----------	Unconformity	
Irrawaddy Formation	MIOCENE – PLIOCENE	Sand, sandstone, silt, subordinated clays and soil
----------	Unconformity	
Upper Pegu Group	MIOCENE	Tuffaceous shale, sandstone, limestone of shallow marine origin

The geological map of the Myanmar is shown in Figure – 2.1 and the regional geological map of project area is shown in Figure – 2.2.

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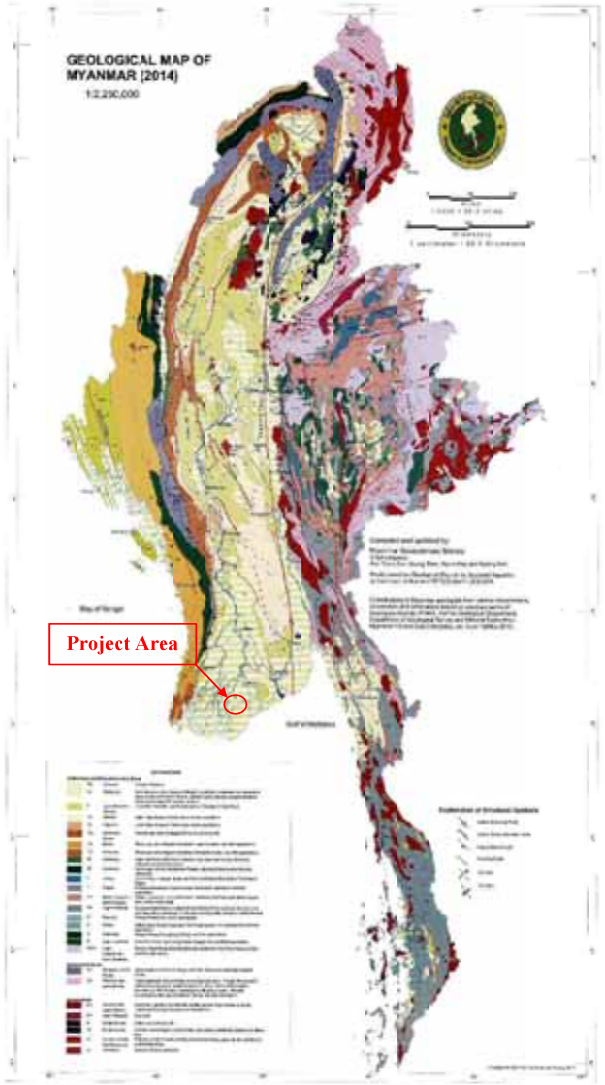

Figure - 2.1 Geological Map of Myanmar

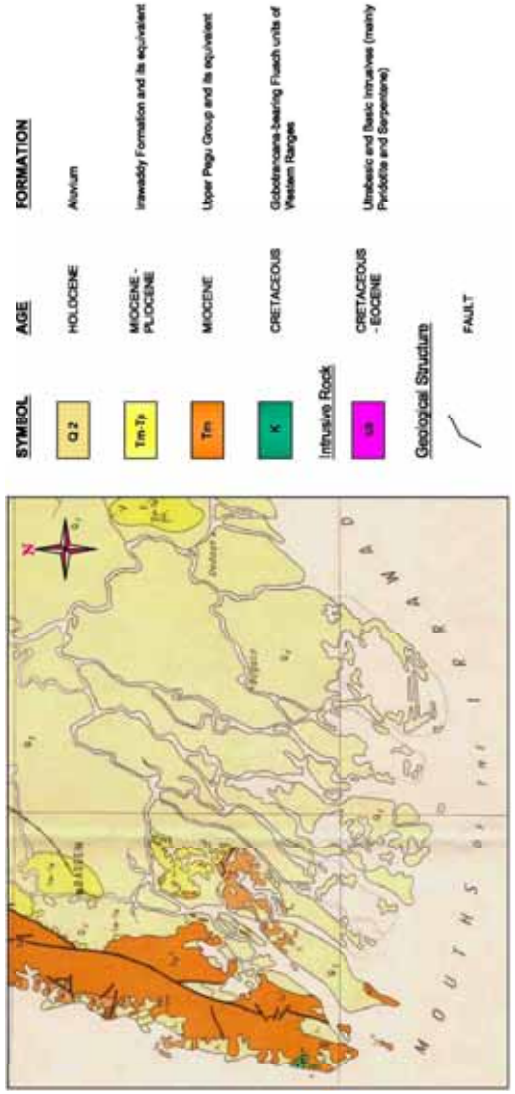

Figure - 2.2 Regional Geological Map of Project Area, Ayeyarwady Region

3 FIELD INVESTIGATION

3.1 Investigation works

The objective of present investigation work is to identify the general stratification of the ground and the nature of the soil. Total four boring points were planned to investigate by the client's requirements. The field investigation work included the soil boring associated with Standard Penetration Test (SPT), disturbed soil sampling, undisturbed soil sampling and water sampling. Total boring length is 140.0m and the total quantity of investigation work is listed in Table-3.1.

Table - 3.1 Total Quantity of Boring Works

No.	BH. No.	Soil Drilling (m)			Standard Penetration Test (Nos)	Undisturbed Sampling (Nos)	Water Sample (Nos)
		Ø 112 mm	Ø 64 mm	Total			
1	BH-A-1	3.0	32.0	35.0	28	7	1
2	BH-A-2	2.0	33.0	35.0	32	3	1
3	BH-B-1	1.0	34.0	35.0	31	4	1
4	BH-B-2	1.0	34.0	35.0	34	1	1
Total		**7.0**	**133.0**	**140.0**	**125**	**15**	**4**

3.2 Location of Boring Points

The locations of investigated points were designated by client. The coordinate and elevation of all borehole points are shown in Table-3.2. The coordinate of all investigated points were measured by Hand GPS, and the elevations of all investigated points were measured by Auto level from Bench Mark. Borehole number: BH-B-1 and BH-A-2 are surveyed from bench mark number-2 (BM-2). Other two boreholes (BH-A-1 and BH-B-2) are surveyed from bench mark-3 (BM-3). Photo-3.1 is shown the leveling process and one of the bench marks used in this project.

Photo - 3.1 Leveling Process and bench mark

Table - 3.2 Coordinates and Boring Ponts

No.	BH No.	Easting (E)	Northing (N)	Elevation EL: (m)	Village Name	Bridge (or) Water Gate
1	BH-A-1	767881.091	1804443.013	+1.930	Tha Kan Wa	Bridge
2	BH-A-2	766253.910	1804730.117	+1.270	Tha Kan Wa	Water Gate
3	BH-B-1	768277.015	1801362.966	+2.180	Sabai Kone	Bridge
4	BH-B-2	755665.687	1827470.677	+2.670	Sit Sali Htone	Bridge

Photographs showing location of boring points

Photo - 3.2 View of BH-A-1

Photo - 3.3 View of BH-A-2

Photo - 3.4 View of BH-B-1

Photo - 3.5 View of BH-B-2

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3.3 Boring Works

In boring, rotary direct circulation method is appropriately applied using metal crown bits attached to casings Ø112mm and metal crown bits of Ø64mm in diameter setting with single core tube are properly applied depending on soil condition to drilling process. The drilling machines are operated by setting on the stage with maintaining horizontal level of drilling machine and vertical position of drilling direction while drilling on field investigation works. Boring and SPT testing in all the points are operated from drilling stage maintaining the stability of boring machine. In the way of direct circulation of drilling fluid, water and bentonite slurry was inevitably utilized to control the circulation of the sludge. The schematic diagram of boring equipment is shown in Figure - 3.1.

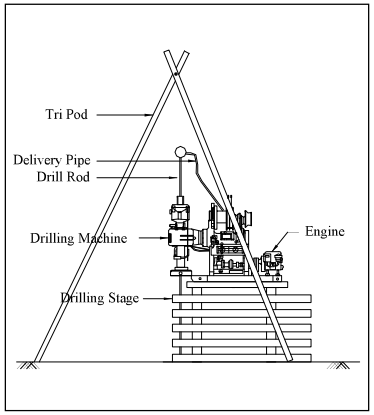

Figure - 3.1 Schematic View of Drilling Machine setting

3.4 Standard Penetration Test (SPT)

The standard penetration test was done in accordance with the ASTM Standard (American Society for Testing and Materials; D 1586-99). The test was performed using a spilt barrel sampler (50mm diameter) connected to the end of boring rods. The sampler was driven into the soil by means of a 63.5kg (140lb) hammer falling freely through the height of 76cm onto the anvil attached to the rod. The sampler is driven 450mm into the soil. SPT N-value is recorded for each 150mm penetration of the sampling tube. In this case, seating drive of 150mm is first reached and the blow count for the seating drive is not applied because the bottom of the hole may be apart from natural condition at a certain extent. The resistance, N-value, is taken as number of blow for the penetration of test drive of next 300mm. When 50 blows are reached before the full penetration 300mm, no other blows are applied but final penetration is recorded. At the conclusion of the test, the retained soil sample is extracted and stored in plastic bag for further analysis. In which, Figure-3.2 indicates the procedure and apparatus of standard penetration test. The distribution of N-value for each stratum is summarized in Figure-3.3.

Photo - 3.6 View of Standard Penetration Test and SPT Sample

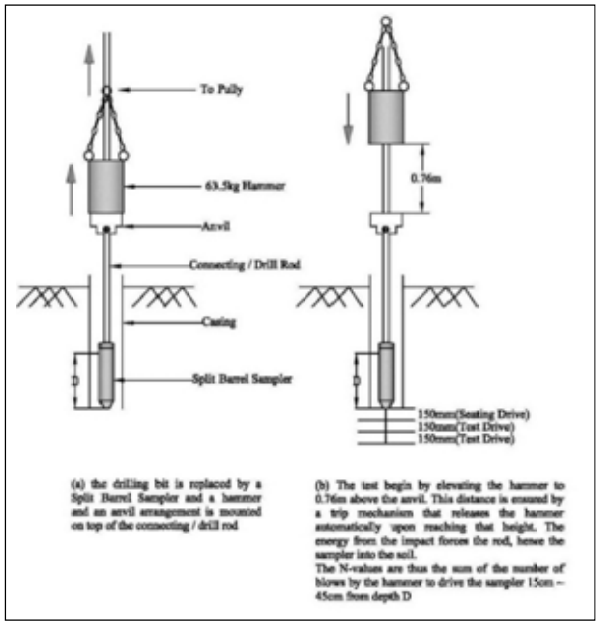

Figure - 3.2 Procedure and Apparatus of Standard Penetration Test

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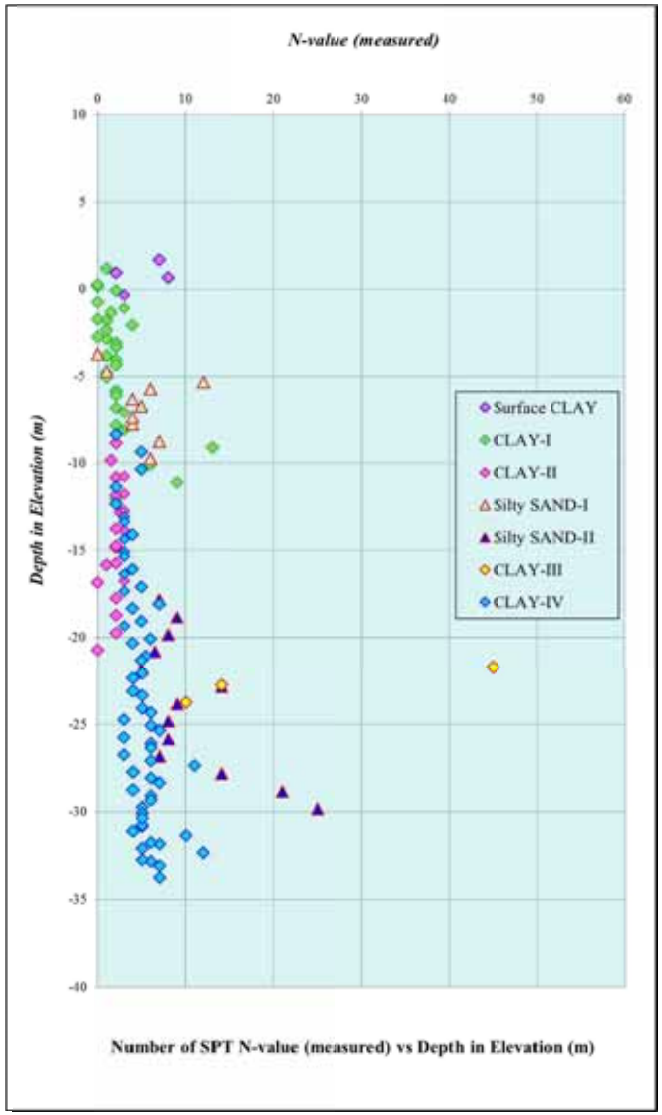

Figure - 3.3 Number of N-Value (measured) vs Depth in Elevation (m)

3.5 Undisturbed Sampling

Undisturbed soil samplers, which are required for physical and especially for mechanical properties tests such as unconfined compression test, and one dimensional consolidation test were obtained by techniques which aim at preserving in-situ structure and water content of soil without any disturbance.

During the course of SPT testing, when SPT value was as low as N-value of 1 to 4 due to existence of fine soil. Piston Thin Wall samplers (Figure-3.4) are used to take as undisturbed sample in the layer of N-value below 5 and Denison samplers (Figure-3.5) are used in the layer of N-value between 5 and 12 in accordance with ASTM Standard for site investigation; by applying piston samplers by water pressure type, properly designed not to disturb in-situ condition of soil.

If the Denison samplers are applied, the borehole is flushed with water to remove the remnants left at the bottom of the borehole. The sampler tube ahead of the outer rotating barrel is manually adjusted before commencement of sampling operation, rather than spring-controlled during sample penetration. The basic components of the sampler are an outer rotating tube with carbide metal crown bit and an inner stationary sampling tube with a cutting shoe. When sampler put down to the bottom of the borehole, firstly sampler tube was pressed to penetrate about 4 cm in the fresh soil. At the same time, outer soil portion was cut and flushed by metal crown bit with rotation. In that way drilling with sampling is progressed until 0.80m full recovery. When sampler tube was brought on to the surface, some soil was removed from each end and molten paraffin was applied to form as seal. As a result of this, losing natural water content can be surely prevented.

In this project, total (1) numbers of undisturbed sample was carried out in clayey soil layers by using Denison undisturbed samplers. Detailed list of undisturbed samples are described in Table-3.3.

Table - 3.3 List of undisturbed samples

Sr. No.	Borehole No.	Date	Sample No.	Depth (m)	Soil Type	Recovery	Type of Sampler
1	BH-A-1	14.12.17	T-1	3.00 ~ 3.80	CLAY	100%	Piston Sampler
2		14.12.17	T-2	6.00 ~ 6.50	CLAY	62%	Piston Sampler
3		14.12.17	T-3	9.00 ~ 9.60	CLAY	75%	Piston Sampler
4		14.12.17	T-4	19.00 ~ 19.50	CLAY	62%	Piston Sampler
5	BH-A-2	20.12.17	T-1	2.00 ~ 2.80	CLAY	100%	Piston Sampler
6		20.12.17	T-2	5.00 ~ 5.80	Silty SAND	100%	Piston Sampler
7		20.12.17	T-3	13.00 ~ 13.80	CLAY	100%	Piston Sampler
8	BH-B-1	13.12.17	T-1	3.00 ~ 3.80	CLAY	100%	Piston Sampler
9		13.12.17	T-2	6.00 ~ 6.80	CLAY	100%	Piston Sampler
10		13.12.17	T-3	9.00 ~ 9.80	CLAY	100%	Piston Sampler
11		13.12.17	T-4	12.00 ~ 12.80	CLAY	100%	Piston Sampler
12		13.12.17	T-5	15.00 ~ 15.80	CLAY	100%	Piston Sampler
13		13.12.17	T-6	18.00 ~ 18.75	CLAY	94%	Piston Sampler
14		13.12.17	T-7	23.00 ~ 23.45	Clayey SAND	56%	Piston Sampler
15	BH-B-2	21.12.17	D-1	4.00 ~ 4.70	CLAY	87%	Denison Sampler

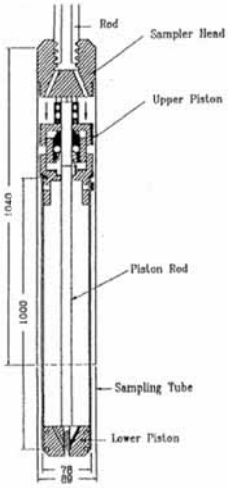

Figure - 3.4 Thin wall tube attached to Fixed-Piston (undisturbed soil) sampler

Photo - 3.7 Taking Undisturbed Sampling

Photo - 3.8 After taking Undisturbed Sample

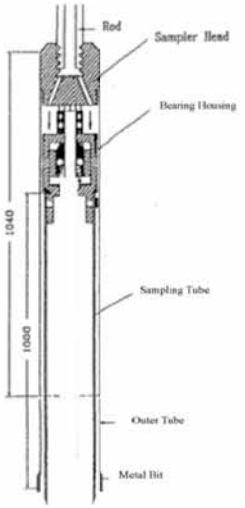

Figure - 3.5 Thin wall tube attached to Denison (undisturbed soil) sampler

Photo - 3.9 Taking Undisturbed Sampling

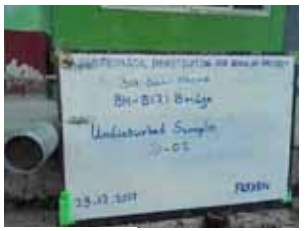

Photo - 3.10 After taking Undisturbed Sample

3.6 Observation of Groundwater Level

During the boring works, groundwater level recording was carefully carried out by using automatic alarm water level indicator twice a day in the borehole before and completion of drilling works. The groundwater table is recorded from ground elevation between GL-0.10m in minimum and 1.30m in maximum (see Boring Logs in Appendix-A). Groundwater level that confirmed at the boring points through project area during 15th December, 2017 to 23rd December, 2017 are shown in Table-3.4.

Table - 3.4 Groundwater level of investigation points through project area

No.	BH-No.	BH EL - (m)	Groundwater Level		Measured Date
			GL - (m)	EL - (m)	
1	BH-A-1	+1.93	+1.30	+0.60	15.12.2017
2	BH-A-2	+1.27	+0.10	+1.17	22.12.2017
3	BH-B-1	+2.18	+1.30	+0.88	16.12.2017
4	BH-B-2	+2.67	+1.30	+1.37	23.12.2017

8) It is considered that groundwater level in the boreholes may not be precise due to remnant of drilling slurry at the time of measuring.

3.7 Characteristics of Soil Strata Relying on Field Test

According to the investigation results, soil profiles were drawn based on not only visual check of soil samples at site and SPT results of the boreholes but also laboratory test results to determine the cross section throughout project area. Figure -3.6, 3.7, 3.8 and 3.9 show the soil profile through the project area. Moreover, the detailed drawing is attached in Appendix-B.

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SOIL PROFILE FOR BH-A-1

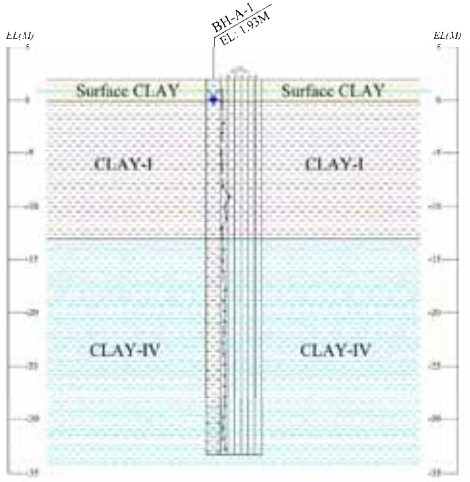

Figure - 3.6 Soil profile for BH-A-1

SOIL PROFILE FOR BH-A-2

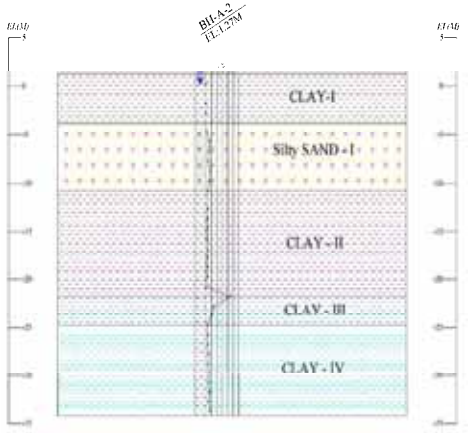

Figure - 3.7 Soil profile for BH-A-2

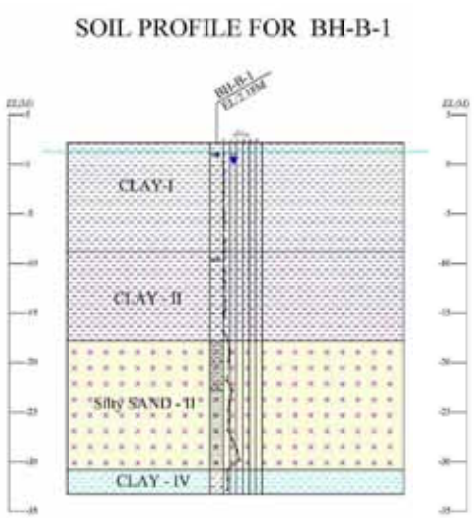

Figure - 3.8 Soil profile for BH-B-1

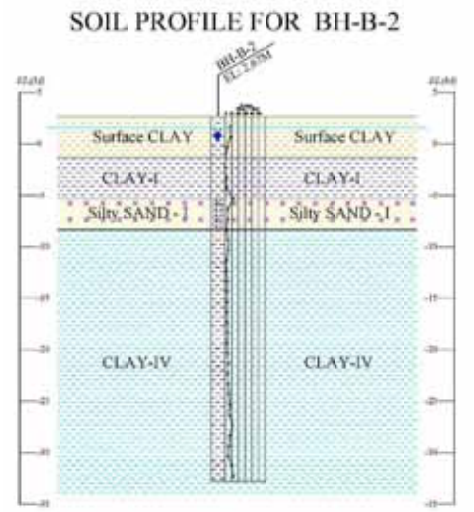

Figure - 3.9 Soil profile for BH-B-2

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There are four numbers of boreholes, the depth of boreholes is 35.0m from ground level with the performance of Standard Penetration Test. In this operation, total seven numbers of different layers have been recognized. The soil layers are classified in accordance with their physical properties and/or their relative density. The seven different layers observed in project area are described from top to bottom as follows.

1. Surface CLAY
2. CLAY-I
3. CLAY-II
4. Silty SAND-I
5. Silty SAND-II
6. CLAY-III
7. CLAY-IV

3.7.1 Surface CLAY

According to the investigation results, the upper most layer is Surface CLAY layer. This soil layer is observed only at BH-A-1 and BH-B-2. The thickness of this layer is a minimum 1.0m and a maximum 4.0m. The color of this layer is brownish gray. The plasticity of this layer is medium to high plasticity and the water content is moist. SPT N-value range of this layer is 2/30 to 7/30 blows, and it can be described as soft to firm in consistency.

3.7.2 CLAY-I

This layer is well observed in all investigated holes and the name of this layer is CLAY-I. The thickness of it is a minimum 4.0m and a maximum 13.0m. The color of it is mottled gray and the water content is moist. The plasticity of this layer is medium to high plasticity. SPT N-value range is varying from 0/30 to 13/30 blows, and it can be described as very soft to stiff.

3.7.3 CLAY-II

According to the investigation results, the third sub-soil most layer is CLAY-II layer. This layer is observed only at BH-B-1 and BH-A-2. The thickness of this layer is a minimum 9.0m and a maximum 11.0m. The color of this layer is gray. The plasticity of this layer is also medium to high plasticity and the water content is moist. Moreover, trace of silt is including in this layer. SPT N-value range of this layer is 0/30 to 3/30 blows, and it can be described as very soft to soft in consistency.

3.7.4 Silty SAND I

This layer is observed only at BH-B-2 and BH-A-2. The thickness of it is a minimum 3.0m and a maximum 6.0m. The color of it is gray and the water content is moist. The grained size of sand is fine grained. SPT N-value range is varying from 1/30 to 12/30 blows, and it can be described as very loose to medium dense in relative density.

3.7.5 Silty SAND-II

According to the investigation result, the fifth sub-soil layer is Silty SAND-II layer. This layer is observed only at BH-B-1. The thickness of this layer is about 8.0m. The color of this layer is yellowish brown to gray and the water content is moist. The grained size of sand is fine to medium grained. SPT N-value range is 5/30 to 25/30 blows. The relative density of it is loose to medium dense.

4 LABORATORY TEST

There have been four numbers of investigation boreholes and total (125) numbers of disturbed samples and (15) numbers of undisturbed samples with Denison sampler and Piston sampler were collected in project site. Some selected numbers of disturbed samples and all undisturbed samples were sent to office laboratory and purposed to test physical and mechanical properties of soil in consulting with expert's discretion. The entire tests were carried out in accordance with ASTM Standard.

The physical properties tests include the following items.

- Natural Moisture Content Test (ASTM D 2216-05)
- Specific Gravity Test (ASTM D 854-06)
- Particle Size Analysis Test (ASTM D 422-63)
  - Grain Size Distribution Test
  - Hydrometer Test

9) Atterberg Limits Test (ASTM D 4318-05)
  - Liquid Limit Test
  - Plastic Limit Test

The mechanical properties tests include the following items.

10) Unconfined Compression Test (ASTM D 2166-06)
11) Unconsolidation Undrained Triaxial Compression Test (ASTM D 2850)
12) Consolidation Undrained Triaxial Compression Test (ASTM D 4767)
13) One Dimensional Consolidation Test (ASTM D 2435-04)

Total quantity of laboratory tests are described in Table-4.1 and summary of laboratory test results for each borehole are illustrated in Table-4.2.

Table - 4.1 Total Quantity of Laboratory Tests

BH-No.	Physical Properties Test							Engineering Properties Test			
	Natural Moisture Content Test	Specific Gravity Test	Particle Size Analysis Test		Atterberg Limits Test		Unit Weight	Unconfined Compression Test	Unconsolidated Undrained Triaxial Compression Test	Consolidated Undrained Triaxial Compression Test	One Dimensional Consolidation Test
			Sieve Analysis Test	Hydrometer Analysis Test	Liquid Limit Test	Plastic Limit Test					
BH-A-1	10	10	10	10	10	10	4	4	-	1	3
BH-A-2	10	10	10	10	8	8	3	3	-	1	2
BH-B-1	10	10	10	10	7	7	7	7	-	1	3
BH-B-2	10	10	10	10	8	8	1	1	-	1	1
Total	**40**	**40**	**40**	**40**	**33**	**33**	**15**	**15**	**0**	**4**	**9**

Table - 4.2 Summary of Laboratory Test Results

BH No.	Sample No.	Depth		Soil Types	Water Content	Specific Gravity	Grain Size Distribution				Atterberg Limits			Bulk Density		One Dimensional Consolidation Test			Unconsolidated Undrained Triaxial Compression Test		Consolidated Undrained Triaxial Compression Test				Unconfined Compression Test						
		GL - (m)	EL; (m)		W (%)	Gs	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	ρ_t g/cm^3		e_o	Py kN/m^2	Cc	C_{UU} kN/m^2	φ_{UU} Degree	C' kN/m^2	φ' Degree	C kN/m^2	φ Degree	qu kN/m^2		ε_f (%)		E_{50} kN/m^2		Sensitivity Ratio
BH-B-1	T-1	3.00	-0.82	CL	46.56	2.662	-	1.53	77.48	21.00	36.10	21.92	14.18	1.714	1.730	1.260	75.9	0.370							19.0	22.0	9.36	8.80	432.9	476.9	
	T-2	6.00	-3.82	CL	41.32	2.692	-	2.25	76.85	20.90	38.55	24.92	13.63	1.781	1.762										41.1	42.2	5.39	5.90	2334.2	1936.1	
	T-3	9.00	-6.82	CL	38.58	2.710	-	7.15	74.95	17.90	32.75	22.07	10.68	1.760	1.760	1.170	171.8	0.357			0.0	23.00	13.3	10.00	31.6	33.4	2.85	3.40	1628.9	1852.9	
	T-4	12.00	-9.82	CL	45.96	2.713	-	6.78	67.03	26.20	37.95	23.58	14.37	1.715	1.713										38.2	35.4	2.83	3.40	2356.4	1769.3	
	T-5	15.00	-12.82	CL	41.23	2.692	-	13.03	66.48	20.50	32.60	20.31	12.29	1.779	1.773	1.260	116.4	0.440							42.0	35.7	2.85	4.30	1734.2	1476.1	
	T-6	18.00	-15.82	CL	45.24	2.711	-	13.50	30.20	56.30	47.50	20.03	27.47	1.756	1.763										87.3	91.6	3.99	3.40	3141.7	3848.9	
	T-7	23.00	-20.82	SC	26.19	2.663	-	57.02	19.28	23.70	33.30	16.73	16.57	1.917	1.939										30.4	29.4	1.97	1.70	3456.9	3773.0	
	P-20	27.00	-24.82	SM (or) SC	27.56	2.681	-	79.03	13.97	7.00	-	-	-																		
	P-24	31.00	-28.82	SM (or) SC	19.98	2.663	-	85.38	12.32	2.30	-	-	-																		
	P-27	34.00	-31.82	F	38.74	2.742	-	0.88	45.13	54.00	-	-	-																		
BH-A-2	T-1	2.00	-0.73	CH	67.20	2.660	-	0.47	44.53	55.00	59.10	27.37	31.73	1.582	1.573	1.940	53.5	0.777							18.0	18.1	14.92	14.80	538.9	652.4	
	T-2	5.00	-3.73	SC-SM	38.24	2.700	-	53.07	37.23	9.70	28.00	21.04	6.96	1.841	1.817										21.0	19.6	4.83	4.90	1049.9	818.2	
	P-5	7.00	-5.73	SC	29.84	2.714	-	77.30	20.40	2.30	25.40	17.84	7.56																		
	P-7	9.00	-7.73	SM (or) SC	34.21	2.698	-	83.57	12.43	4.00	-	-	-																		
	T-3	13.00	-11.73	SM	45.65	2.694	-	4.80	73.20	22.00	39.59	25.80	13.79	1.793	1.803	1.290	90.8	0.361			0.0	23.60	16.0	12.00	29.3	30.8	3.43	4.30	1523.5	1362.8	
	P-16	19.00	-17.73	CL	41.93	2.646	-	8.90	63.80	27.30	36.55	20.61	15.94																		
	P-20	23.00	-21.73	F	28.42	2.710	-	10.53	31.78	57.70	-	-	-																		
	P-22	25.00	-23.73	CH	47.81	2.705	-	18.48	40.33	41.20	50.00	24.07	25.93																		
	P-25	28.00	-26.73	CH	47.85	2.709	-	1.47	35.33	63.20	59.92	25.71	34.21																		
	P-30	33.00	-31.73	CH	37.04	2.742	-	1.05	33.95	65.00	51.35	23.36	27.99																		
BH-A-1	P-1	1.00	0.93	CH	46.00	2.660	-	4.15	36.65	59.20	76.13	28.08	48.05																		
	T-1	3.00	-1.07	CH	65.11	2.700	-	1.47	39.13	59.40	64.20	28.33	35.87	1.509	1.486	2.050	60.2	0.798							19.8	16.3	14.93	14.90	444.9	374.4	
	T-2	6.00	-4.07	CL	47.86	2.714	-	1.15	67.85	31.00	41.00	9.76	31.24	1.711	1.708	1.330	171.2	0.422							27.6	29.8	4.85	6.00	1170.3	973.6	
	T-3	9.00	-7.07	CH	56.00	2.698	-	2.58	49.63	47.80	57.85	24.23	33.62	1.650	1.644						0.0	23.60	22.4	8.70	25.8	25.9	6.79	7.30	1076.3	1771.8	
	P-10	13.00	-11.07	CL	45.10	2.694	-	8.14	67.46	24.40	33.15	23.24	9.91																		
	T-4	19.00	-17.07	CH	48.78	2.646	-	1.68	48.63	49.70	55.60	25.14	30.46	1.713	1.727	1.410	117.7	0.540							49.0	56.3	4.81	4.20	1513.6	1783.1	
	P-18	22.00	-20.07	CH	47.70	2.710	-	1.18	34.83	64.00	63.85	26.70	37.15																		
	P-22	26.00	-24.07	CH	46.44	2.705	-	1.18	35.83	63.00	60.15	24.21	35.94																		
	P-26	30.00	-28.07	CH	48.65	2.709	-	0.38	32.63	67.00	60.95	26.31	34.64																		
	P-29	33.00	-31.07	CH	45.20	2.742	-	0.40	37.00	62.60	58.35	28.36	29.99																		
BH-B-2	P-2	2.00	0.67	F	27.46	2.721	-	0.72	22.88	76.40	-	-	-																		
	D-1	4.00	-1.33	CL	38.33	2.720	-	34.92	41.68	23.40	35.95	19.79	16.16	1.870	1.790	1.070	133.2	0.311							21.6	18.4	12.86	14.30	641.6	278.3	
	P-6	7.00	-4.33	CL	38.78	2.712	-	11.10	54.60	34.30	42.55	20.13	22.42																		
	P-8	9.00	-6.33	SM (or) SC	31.17	2.692	-	85.78	10.82	3.40	-	-	-																		
	P-14	15.00	-12.33	CH	45.82	2.703	-	0.40	50.60	49.00	59.10	26.55	32.55																		
	P-18	19.00	-16.33	CH	46.40	2.719	-	0.38	53.43	46.20	50.15	24.02	26.13																		
	P-23	24.00	-21.33	CH	45.76	2.691	-	0.50	43.80	55.70	61.20	25.58	35.62																		
	P-26	27.00	-24.33	CH	37.99	2.710	-	3.63	47.08	49.30	51.60	23.61	27.99																		
	P-29	30.00	-27.33	CL	37.90	2.754	-	11.38	44.63	44.00	39.30	20.09	19.21																		
	P-32	33.00	-30.33	CL	41.27	2.733	-	1.60	46.80	51.60	49.50	24.72	24.78																		

4.1 Index Property of Soil

Physical and mechanical properties tests were done for investigation. The detailed laboratory test results are illustrated in Appendix-C in this report.

4.1.1 Natural Moisture Content Test

Natural moisture content tests of (40) numbers have been carried out on soil samples for required seven different soil layers at office laboratory in accordance with ASTM Standard (ASTM D 2216-05). Table-4.3 illustrates the summary of natural moisture content in each soil layers. The photograph of testing natural moisture content is shown in Photo-4.1 and the variation of moisture content with depth in elevation can be seen in Figure-4.1. The detailed laboratory test results are illustrated in Appendix-C.

Photo - 4.1 Natural Moisture Content Test

Table - 4.3 Summary of Natural Moisture Content of Test Results

No.	Soil Types	Natural Moisture Content (%)
1	Surface CLAY	27.46 ~ 46.00
2	CLAY-I	38.33 ~ 67.20
3	CLAY-II	41.23 ~ 45.96
4	Silty SAND-I	29.84 ~ 38.24
5	Silty SAND-II	19.98 ~ 27.56
6	CLAY-III	28.42 ~ 47.81
7	CLAY-IV	37.04 ~ 48.78

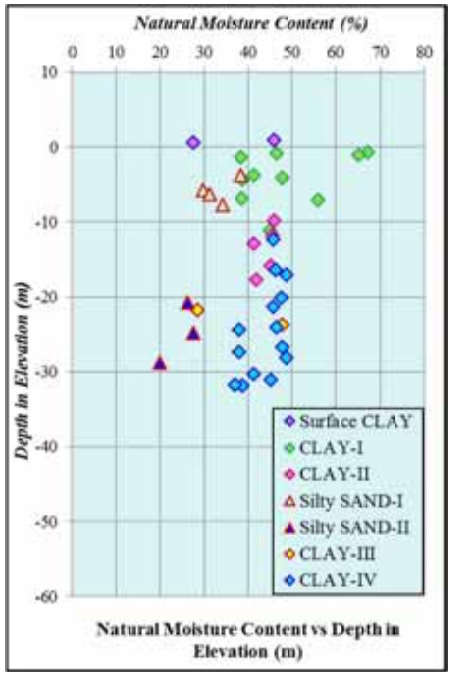

Figure - 4.1 Natural Moisture Content vs Depth in elevation (m)

4.1.2 Specific Gravity Test

The specific gravity tests in this project were carried out in accordance with ASTM Standard (ASTM D 854-06) at office laboratory. There have been (40) numbers of specific gravity tests. Table-4.4 illustrates the summary of specific gravity for each soil layer. The photograph of specific gravity testing is shown in Photo-4.2 and the relationship between specific gravity and depth in elevation of each soil layer is shown in Figure-4.2. The detailed test results were described in Appendix-C.

Photo - 4.2 Specific Gravity Test

Table - 4.4 Summary of Specific Gravity Test Results

No.	Soil Types	Specific Gravity
1	Surface CLAY	2.660 ~ 2.721
2	CLAY-I	2.660 ~ 2.720
3	CLAY-II	2.646 ~ 2.713
4	Silty SAND-I	2.692 ~ 2.714
5	Silty SAND-II	2.663 ~ 2.681
6	CLAY-III	2.705 ~ 2.710
7	CLAY-IV	2.646 ~ 2.754

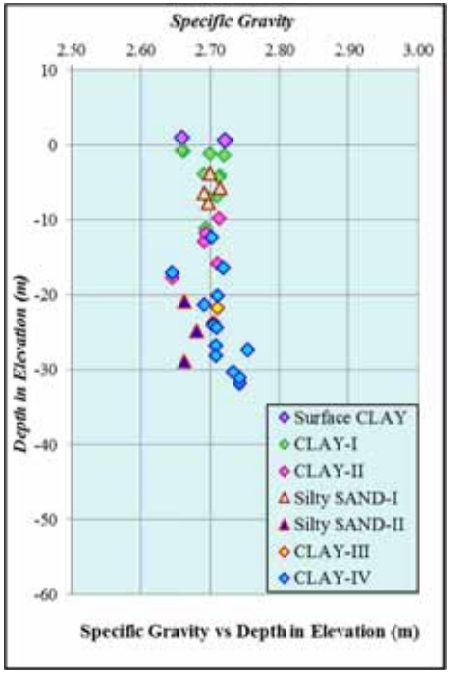

Figure - 4.2 Specific Gravity vs Depth in Elevation (m)

4.1.3 Atterberg Limits Test

The Atterberg Limits tests were made on (33) numbers for liquid limit tests and same numbers for plastic limit tests of specimens from disturbed and undisturbed samples by ASTM Standard (ASTM D 4318-05) at office laboratory. The summary of Atterberg Limits Test results are shown in Table-4.5. Figure-4.3 to 4.5 illustrate the Plastic Limit, Liquid Limit and Plasticity Index of each soil layer versus depth in elevation(m) and Figure-4.6 shows condition of soil in project area by ranges in plasticity chart. The photograph of testing is shown in Photo-4.3. The detailed test results were shown in Appendix-C.

Photo - 4.3 Atterberg Limits Test (Liquid Limit & Plastic Limit)

Table - 4.5 Summary of Atterberg Limits Test Results

No.	Soil Types	Liquid Limit (LL) (%)	Plastic Limit (PL) (%)	Plasticity Index (PI)
1	Surface CLAY	76.13	28.08	48.05
2	CLAY-I	32.75 ~ 64.20	9.76 ~ 28.33	9.91 ~ 35.87
3	CLAY-II	32.60 ~ 47.50	20.03 ~ 25.80	12.29 ~ 27.47
4	Silty SAND-I	25.40 ~ 28.00	17.84 ~ 21.04	6.96 ~ 7.56
5	Silty SAND-II	33.30	16.73	16.57
6	CLAY-III	50.00	24.07	25.93
7	CLAY-IV	39.30 ~ 63.85	20.09 ~ 28.36	19.21 ~ 37.15

A7-3-20

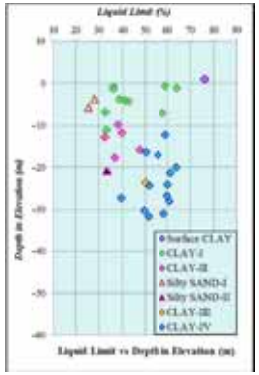

Figure - 4.3 Liquid Limit vs Depth in elevation (m)

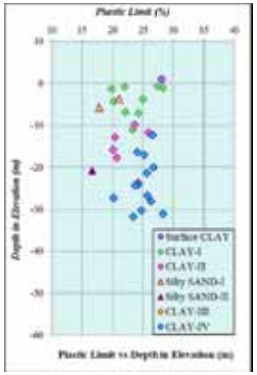

Figure - 4.4 Plastic Limit vs Depth in elevation (m)

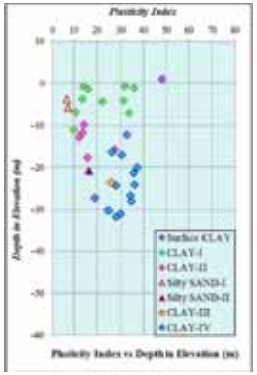

Figure - 4.5 Plasticity Index vs Depth in elevation (m)

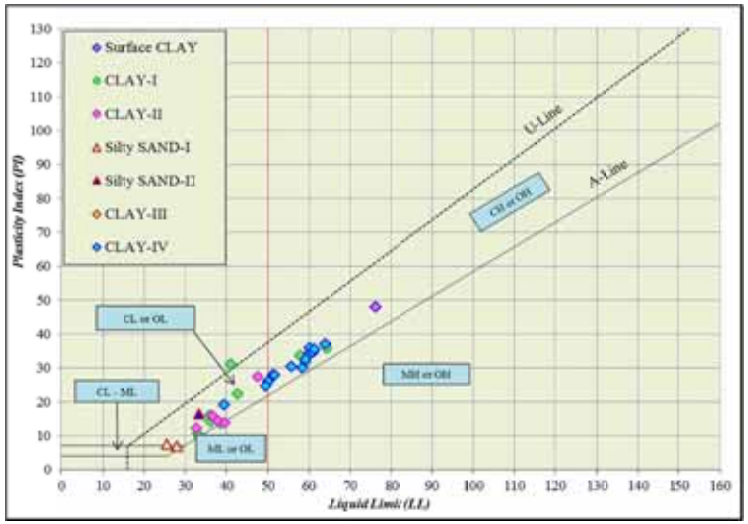

Figure - 4.6 Condition of Atterberg Limits Test Results

4.1.4 Grain Size Analysis Test

Soil classifications or grain size distribution test were done by ASTM Standard (ASTM D 422-63). In this project, (40) numbers of sieve analysis tests including same numbers of hydrometer tests were carried out in laboratory of Fukken Co., Ltd. Grain size analysis test and hydrometer test are shown in Photo-4.4 and 4.5. Figure-4.7 is illustrated the grain size distribution of each soil layer versus depth in elevation. The details of Grain Size Analysis Test results were shown in Appendix-C.

Photo - 4.4 Grain Size Distribution Test

Photo - 4.5 Hydrometer Test

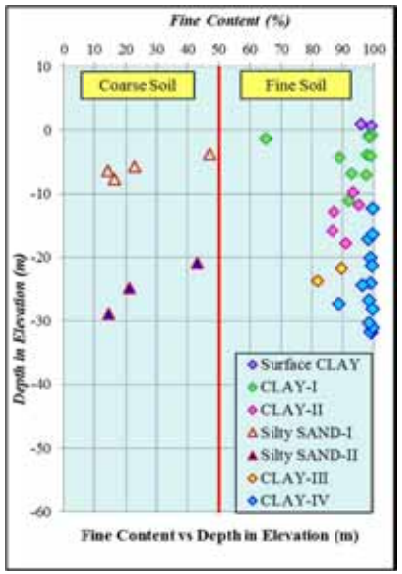

Figure - 4.7 Fine Content vs Depth in Elevation (m)

4.2 Mechanical Properties of Soil

In order to obtain the mechanical properties of soils, (15) numbers of undisturbed soil samples from four boreholes were sent to laboratory for unconfined compression test and (9) numbers of soil samples from four boreholes were sent to laboratory for one dimensional consolidation test.

4.2.1 Unconfined Compression Test

Total (15) numbers of undisturbed samples were carried out for unconfined compression test at office laboratory in accordance with ASTM Standard (ASTM D 2166-06). Summary of unconfined compression test results are described in Table-4.6. The relationship between the unconfined compressive strength vs their depth in elevation is presented in Figure-4.8 and that of failure strain versus depth in elevation is illustrated in Figure-4.9. Moreover, Figure-4.10 shows the deformation modulus of soil versus depth in elevation, and Figure-4.11 shows the relationship between the bulk density and depth in elevation. The detailed test results are shown in Appendix-C.

Photo - 4.6 Unconfined Compressive Strength Test

Table - 4.6 Summary of Unconfined Compression Test Results

No.	Soil Type	Unconfined Compressive Strength (kN/m^2)	Failure Strain (%)
1	CLAY-I	16.3 ~ 42.2	2.9 ~ 14.9
2	CLAY-II	29.3 ~ 91.6	2.8 ~ 4.3
3	Silty SAND-I	19.6 ~ 21.0	4.8 ~ 4.9
4	Silty SAND-II	29.4 ~ 30.4	1.7 ~ 2.0
5	CLAY-IV	49.0 ~ 56.3	4.2 ~ 4.8

Moreover, Deformation Modulus (E50) of soil from unconfined compression test are calculated from following formula in accordance with the standard of Japan Geotechnical Society. The summary of Modulus of Deformation and wet density are shown in Table-4.7.

$$E_{50} = \frac{(\frac{qu}{2})}{\varepsilon_{50}} \times 100$$

Table - 4.7 Summary of Deformation Modulus and Bulk Density

No.	Soil Type	Modulus of Deformation E_{50} (kN/m^2)	Bulk Density (g/cm^3)
1	CLAY-I	278.3 ~ 2334.2	1.486 ~ 1.870
2	CLAY-II	1362.8 ~ 3848.9	1.713 ~ 1.803
3	Silty SAND-I	818.2 ~ 1049.9	1.817 ~ 1.841
4	Silty SAND-II	3456.9 ~ 3773.0	1.917 ~ 1.939
5	CLAY-IV	1513.6 ~ 1783.1	1.713 ~ 1.727

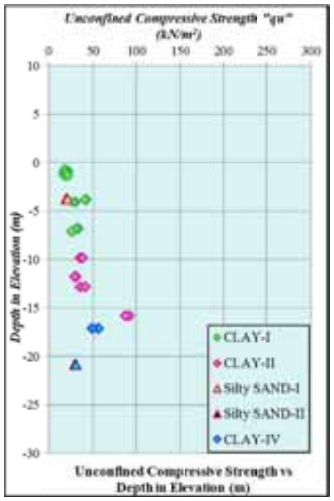

Figure - 4.8 Unconfined Compressive Strength vs Depth in elevation (m)

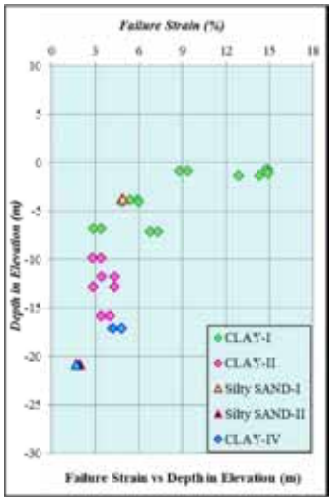

Figure - 4.9 Failure Strain vs Depth in elevation (m)

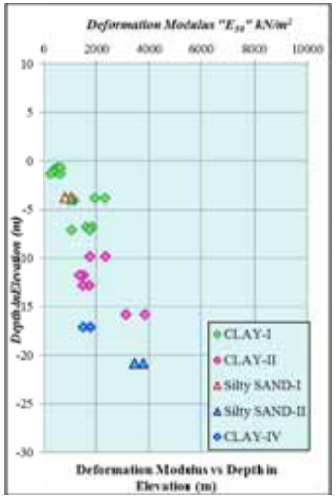

Figure - 4.10 Deformation Modulus vs Depth in elevation (m)

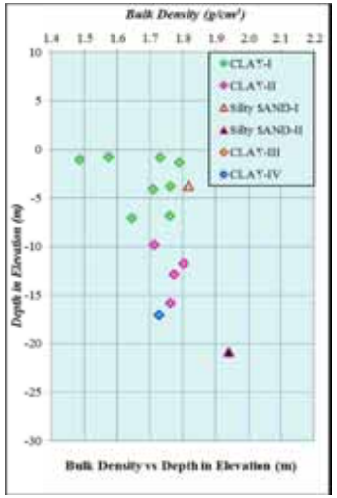

Figure - 4.11 Bulk Density vs Depth in elevation (m)

4.2.2 Consolidated Undrained Triaxial Compression Test

There are total (3) numbers of undisturbed samples were carried out for consolidated undrained triaxial compression test at office laboratory in accordance with ASTM D 4767. Summary of consolidated undrained triaxial comperssion test results are described in Table-4.8. Figure-4.12 and 4.13 show failure envelopes and Mohr's circles for CLAY-I and CLAY-II. Figure-4.14 and Figure-4.15 indicate the relationship between cohesion (C) and friction angle (ϕ) versus their depth in elevation (m) of investigation area. Moreover, Figure-4.16 and Figure-4.17 show the relationship between the effective cohesion (c') and effective friction angle (ϕ') versus their depth in elevation (m) at the investigation area. The detailed test results were shown in Appendix-C.

Photo - 4.7 Consolidated Undrained Triaxial Compression Test

Table - 4.8 Summary of Consolidated Undrained Triaxial Compression Test Results

No.	Soil Type	Total Stress		Effective Stress		Borehole No.
		Cohesion (C) (kN/m²)	Friction Angle (ϕ) (Degree)	Cohesion (C´) (kN/m²)	Friction Angle (ϕ´) (Degree)	
1	CLAY-I	13.3	10.0	0.0	23.0	BH-A-1, T-3
		22.4	8.7	0.0	23.6	BH-B-1, T-3
2	CLAY-II	16.0	12.0	0.0	23.6	BH-A-2, T-3

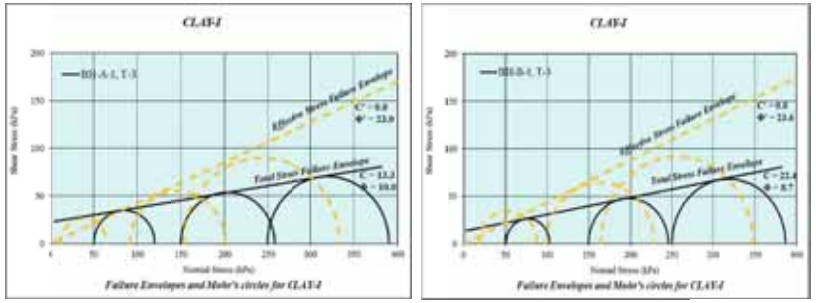

Figure - 4.12 Failure Envelopes and Mohr's circles for CLAY-I

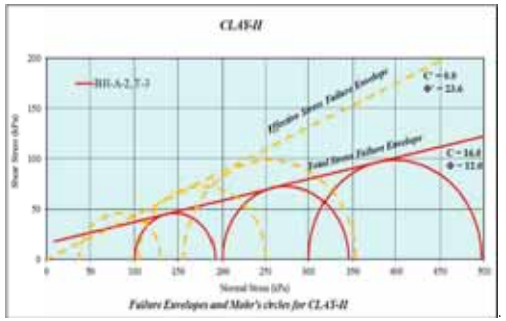

Figure - 4.13 Failure Envelopes and Mohr's circles for CLAY-II

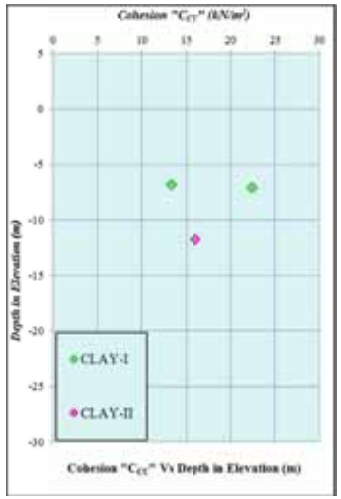

Figure - 4.14 Cohesion " C_{CU} " vs Depth in Elevation (m)

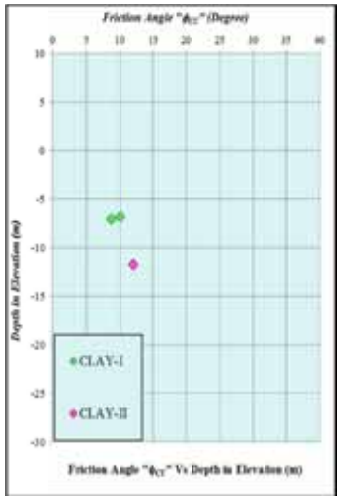

Figure - 4.15 Friction Angle " ϕ_{CU} " vs Depth in Elevation (m)

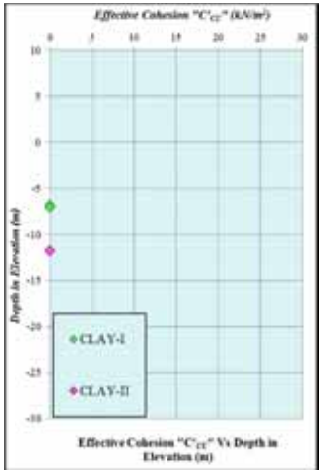

Figure - 4.16 Effective Cohesion " c'_{CU} " vs Depth in Elevation (m)

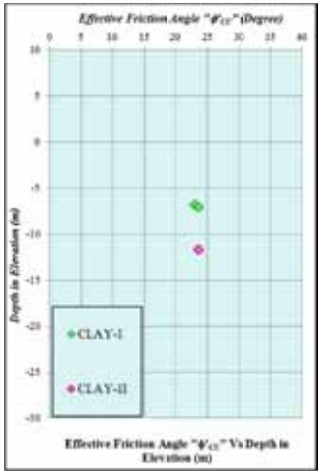

Figure - 4.17 Effective Friction Angle " ϕ'_{CU} " vs Depth in Elevation (m)

4.2.3 One Dimensional Consolidation Test

The one dimensional consolidation tests were carried out in undisturbed samples taken from the project area. There are total (9) numbers of one dimensional consolidation test were carried out in accordance with ASTM Standard (ASTM D 2435-04). Table-4.9 summarized some results of one dimensional consolidation test such as initial void ratio (e0), consolidation yield stress (Pc) and compression index (Cc). Figure-4.18 to Figure-4.20 indicate the relationship between (e_0), (Pc) and (Cc) versus depth in elevation. Moreover, Figure-4.21 to Figure-4.22 show the e-log-P curve results from one dimensional consolidation tests of soil from the investigation area, and Figure-4.23 to Figure-4.24 show the relationship between coefficient of consolidation (Cv) versus mean consolidation pressure of that soil.

Table - 4.9 Summary of One Dimensional Consolidation Test Results

No.	Soil Type	Initial Void Ratio (e_0)	Consolidation Yield Stress Pc (kN/m^2)	Compression Index (Cc)
1	CLAY-I	1.070 ~ 2.050	53.5 ~ 171.8	0.311 ~ 0.798
2	CLAY-II	1.260 ~ 1.290	90.8 ~ 116.4	0.361 ~ 0.440
3	CLAY-IV	1.410	117.7	0.540

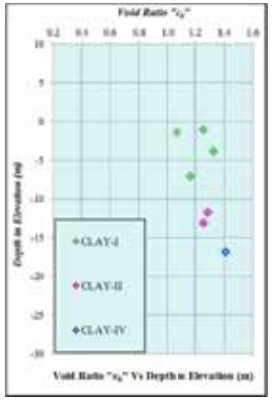

Figure - 4.18 Void Ratio vs Depth in elevation (m)

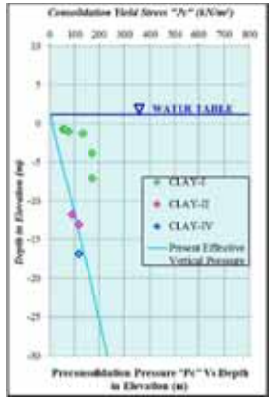

Figure - 4.19 Consolidation Yield Stress vs Depth in elevation (m)

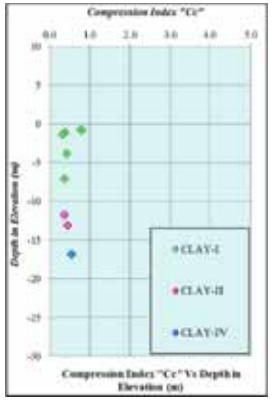

Figure - 4.20 Compression Index "Cc" vs Depth in elevation (m)

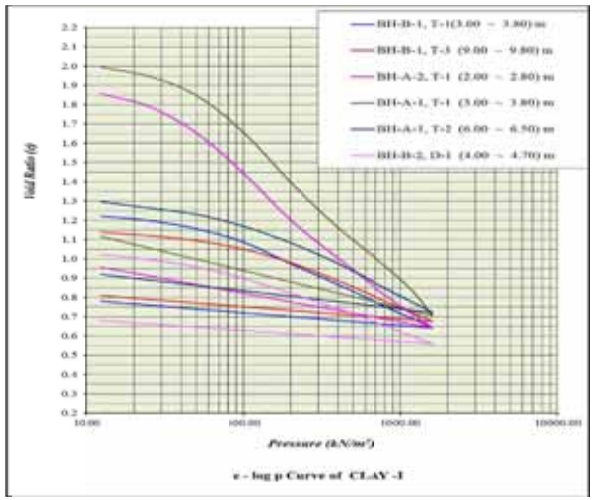

Figure - 4.21 e-log P Curve of CLAY-I

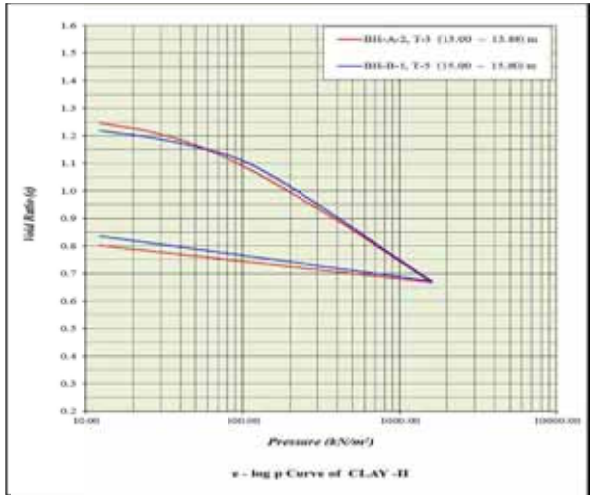

Figure - 4.22 e-log P Curve of CLAY-II

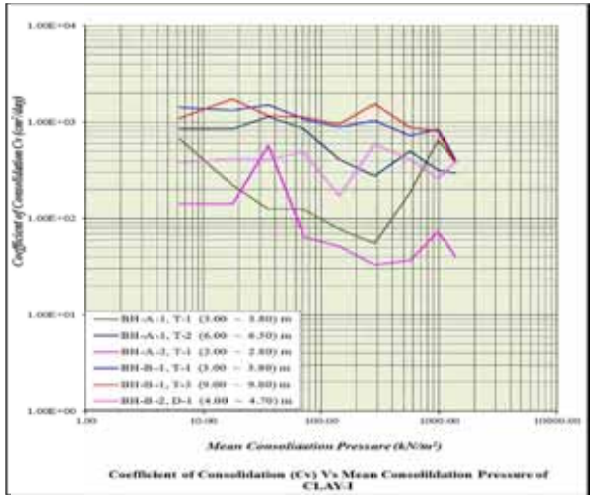

Figure - 4.23 Coefficient of consolidation (Cv) vs mean consolidation pressure of CLAY-I

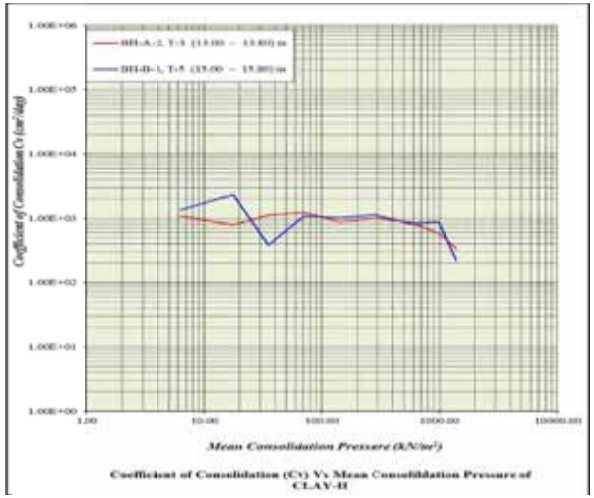

Figure - 4.24 Coefficient of consolidation (Cv) vs mean consolidation pressure of CLAY-II

4.2.4 Design CBR Test

(1) Design CBR Test for Original Soil

Design CBR Test was carried out in accordance with JIS Standard (JIS A 1211). Total (22) number of samples were performed in Bogalay area. The location maps and coordinates of sampling points are shown in Figure-4.25 to Figure-4.27 and Table-4.10. Moreover, the photographs of each sampling point are indicated in Photo-4.8 to Photo-4.29.

Soil samples were collected beside planned road points. Because, the existing road material was used beside a soil. Moreover, it was considered that road condition became the bad road due to the sampling.

Figure - 4.25 Sampling Point of CBR Test (Road-1)

Figure - 4.26 Sampling Point of CBR Test (Road-2, Road-3, Road-5and Road-6))

Figure - 4.27 Sampling Point of CBR Test (Road-7)

Table - 4.10 Coordinate of Sampling Point

Sr.	Road No.	Point No.	Easting	Northing
1	Road-A	Point 1	755765.000	1827699.000
2		Point 2	755988.000	1828506.000
3		Point 3	756391.000	1829326.000
4		Point 4	756858.000	1830178.000
5		Point 5	757618.000	1830787.000
6		Point 6	758087.000	1831339.000
7		Point 7	758199.000	1831856.000
8		Point 8	759297.000	1831549.000
9		Point 9	760008.000	1830679.000
10		Point 10	760861.000	1829889.000
11		Point 11	761618.000	1829197.000
12	Road-B	Point 1	768278.000	1801352.000
13		Point 2	767889.000	1800315.000
14		Point 3	767698.000	1799235.000
15		Point 4	767047.000	1798281.000
16		Point 5	765965.000	1798039.000
17	Road-C	Point 1	768049.000	1801807.000
18		Point 2	767994.000	1802533.000
19		Point 3	768003.000	1803223.000
20		Point 4	767943.000	1803928.000
21		Point 5	767874.980	1804476.920
22		Point 6	767710.210	1805212.890

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Photo - 4.8 Sampling Point (Road 1, Point 1)

Photo - 4.9 Sampling Point (Road A, Point 2)

Photo - 4.10 Sampling Point (Road A, Point 3)

Photo - 4.11 Sampling Point (Road A, Point 4)

Photo - 4.12 Sampling Point (Road A, Point 5)

Photo - 4.13 Sampling Point (Road A, Point 6)

Photo - 4.14 Sampling Point (Road A, Point 7)

Photo - 4.15 Sampling Point (Road A, Point 8)

Photo - 4.16 Sampling Point (Road A, Point 9)

Photo - 4.17 Sampling Point (Road A, Point 10)

Photo - 4.18 Sampling Point (Road A, Point 11)

Photo - 4.19 Sampling Point (Road B, Point 1)

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Photo - 4.20 Sampling Point (Road B, Point 2)

Photo - 4.21 Sampling Point (Road B, Point 3)

Photo - 4.22 Sampling Point (Road B, Point 4)

Photo - 4.23 Sampling Point (Road B, Point 5)

Photo - 4.24 Sampling Point (Road C, Point 1)

Photo - 4.25 Sampling Point (Road C, Point 2)

Photo - 4.26 Sampling Point (Road C, Point 3)

Photo - 4.27 Sampling Point (Road C, Point 4)

Photo - 4.28 Sampling Point (Road C, Point 5)

Photo - 4.29 Sampling Point (Road C, Point 6)

The photographs of each stage of Design CBR Test are shown in Photo-4.30 to Photo-4.32.

The summary table of results of Design CBR Test is indicated in Table-4.11. The details of Design CBR Test results were shown in Appendix-C.

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Photo - 4.30 Compaction Stage

Photo - 4.31 Soaking Stage

Photo - 4.32 Penetration Stage

Table - 4.11 Summary of Design CBR Test Result

Road No.	Sampling Point	Sample No.	Result of Design CBR Test (%)		
			Specimen 1	Specimen 2	Mean CBR
Road A	Point 1	1-2	4.0	3.5	3.8
	Point 2	1-2	4.7	5.2	5.0
	Point 3	1-2	4.2	4.3	4.3
	Point 4	1-2	7.0	6.3	6.7
	Point 5	1-2	6.7	6.7	6.7
	Point 6	1-2	3.5	3.3	3.4
	Point 7	1-2	2.5	2.4	2.5
	Point 8	1-2	2.1	2.0	2.1
	Point 9	1-2	1.7	1.6	1.7
	Point 10	1-2	4.7	4.5	4.6
	Point 11	1-2	0.9	0.9	0.9
Road B	Point 1	1-2	1.6	1.6	1.6
	Point 2	1-2	3.6	3.8	3.7
	Point 3	1-2	0.5	0.3	0.4
	Point 4	1-2	2.9	3.0	3.0
	Point 5	1-2	0.6	0.6	0.6
Road C	Point 1	1-2	3.6	3.7	3.7
	Point 2	1-2	3.2	3.0	3.1
	Point 3	1-2	1.7	1.6	1.7
	Point 4	1-2	5.0	4.3	4.7
	Point 5	1-2	1.0	1.0	1.0
	Point 6	1-2	3.5	3.9	3.7

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(2) Design CBR Test for Mixed Soil with Original Soil and Lime

Soft soil is distributed along the project area. Design CBR test was conducted for this soil. However, CBR values of some samples are less than 2%. Hence, these samples cannot be used as subgrade material. Therefore, these samples (less than 2% of CBR value) were mixed with lime powder (for three kinds of lime dosage), and design CBR test was carried out. The condition of lime dosage is shown as follows;

Table - 4.12 Condition of Lime Dosage

Case	Dosage Amount (kg/m^3)	Dosage Rate (%)
Case-1	30	2
Case-2	60	4
Case-3	90	6

The results of Desgin CBR for mixed soil with original soil and lime are shown in Table-4.13. Moreover, relationship between lime dosage and CBR value is indicated in Figure-4.28.

Table - 4.13 Summary of Design CBR Test Result for Mixed Soil

Road No.	Result of Design CBR Test (%)								
	Lime Dosage $30kg/m^3$			Lime Dosage $60kg/m^3$			Lime Dosage $90kg/m^3$		
	Spe. 1	Spe. 2	Mean	Spe. 1	Spe. 2	Mean	Spe. 1	Spe. 2	Mean
Road A	7.9	6.8	7.4	13.1	13.1	13.1	16.5	17.7	17.1
Road B	2.2	2.0	2.1	4.6	5.7	5.2	11.3	12.2	11.8
Road C	12.1	19.0	15.6	30.0	37.3	33.7	48.5	39.5	44.0

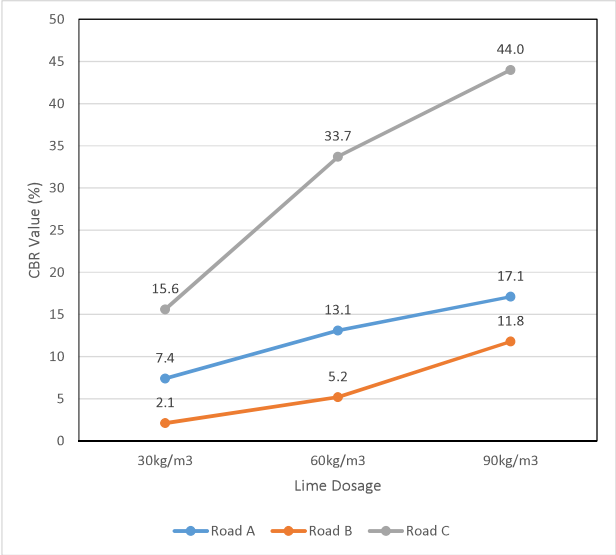

Figure - 4.28 Relationship between Lime Dosage and CBR Value

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5 GEOTECHNICAL ASSESEMENT

5.1 Setting of geotechnical design parameters

The geotechnical parameters are set up by the results of field testing and laboratory testing. Some of the design parameters cannot be evaluated directly neither from field tests nor laboratory tests due to the unfavorable nature of deposits or investigation methods. However, some parameters can be evaluated from the reference formulas by using SPT N-values, and sometimes referred from standard of Nippon Expressway Company Limited (hereinafter called "NEXCO").

(1) Unit weight of soil (γ_t)

Unit weight of soil (γ_t) can be obtained from laboratory test as Bulk density in case of taking undisturbed sample. For the case of non-taking undisturbed sample, unit weight of soil (γ_t) is referred to Table-5.1. Moreover, unit weight of soil (γ_t) can be evaluated from the following formula.-

$\gamma_t = (G_s\gamma_w (1+w) / (1+e)$ --- *Braja M. Das, Principles of Foundation Engineering Seventh Edition*

(2) Saturated unit weight of soil (γ_{sat})

Saturated unit weight of soil (γ_{sat}) can be obtained from laboratory test as Bulk density in case of taking undisturbed sample. For the case of non-taking undisturbed sample, saturated weight of soil (γ_{sat}) is referred to Table-5.1 and also can be evaluated from the following formula.-

$\gamma_{sat} = (G_s\gamma_w + e\gamma_w) / (1+e)$ --- *Braja M. Das, Principles of Foundation Engineering Seventh Edition*

Where- γ_{sat} = saturated unit weight of soil (kN/m^3)

γ_w = unit weight of water (kN/m^3)
G_s = specific gravity of soil
w = water content
e = void ratio of soil (e = wG_s for saturated clayey soil)

Remarks; *This formula can be used only under groundwater level and clayey soil. G_s and w can be obtained from laboratory tests results of collected "Disturbed Samples".*

(3) Effective unit weight of soil (γ')

The effective unit weight of soil under water table can be evaluated from the equation-

$\gamma' = \gamma_t - \gamma_w$ for Clay/Silt -------- Japanese Code

$\gamma' = \gamma_t - 9.0$ for Sand/Gravel -------- Japanese Code

Where-

γ' = effective unit weight of soil (kN/m^3)
γ_w = unit weight of water (kN/m^3)

Table - 5.1 Recommended Soil Parameter by NEXCO*

Soil Type		Condition of Soil		Bulk Density γt (tf/m³)	Internal Friction Angle φ (°)	Cohesion Cu (tf/m²)	Remarks (Soil Name)
Fill Material	Gravel Gravelly Sand	Compacted one.		2.0	40	0	(GW), (GP)
	Sand	Compacted one.	Well graded one.	2.0	35	0	(SW), (SP)
			Poor graded one.	1.9	30	0	
	Silty Sand Clayey Sand	Compacted one.		1.9	25	Less than 3	(SM), (SC)
	Silt, Clay	Compacted one.		1.8	15	Less than 5	(ML), (CL) (MH), (CH)
	Kanto Loam	Compacted one.		1.4	20	Less than 1	(VH)
Natural Ground	Gravel	Dense or Well graded one.		2.0	40	0	(GW), (GP)
		Not dense and Poorly graded one.		1.8	35	0	
	Gravelly Sand	Dense one.		2.1	40	0	(GW), (GP)
		Not dense one.		1.9	35	0	
	Sand	Dense or Well graded one.		2.0	35	0	(SW), (SP)
		Not dense and Poorly graded one.		1.8	30	0	
	Silty Sand Clayey Sand	Dense one.		1.9	30	Less than 3	(SM), (SC)
		Not dense one.		1.7	25	0	
	Sandy Silt Sandy Clay	Stiff one.		1.8	25	Less than 5	(ML), (CL)
		Firm one.		1.7	20	Less than 3	
		Soft one.		1.6	15	Less than 1.5	
	Silt Clay	Stiff one.		1.7	20	Less than 5	(CH), (MH), (ML)
		Firm one.		1.6	15	Less than 3	
		Soft one.		1.4	10	Less than 1.5	
	Kanto Loam	—		1.4	5	Less than 3	(VH)

: Reference value of Clay-I, II, Silty SAND-I, II, CLAY-III and IV

*Nippon Expressway Company Limited

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(4) Cohesion strength (c)

The cohesive strength, also known as undrained shear strength of cohesive soil is normally evaluated from the unconfined compression test. The cohesive strength (c) can be derived from-

$c = q_u / 2$ (kN/m^2) ---- *Braja M. Das, Principles of Foundation Engineering Seventh Edition*

Where-

c = cohesive strength (kN/m^2)
q_u = unconfined compressive strength (kN/m^2)

However, undrained cohesive strength can also be determined from direct shear test (for reference) and unconsolidated undrained triaxial compression test of undisturbed soil samples.

For sandy soil and hard clayey soil, as the undisturbed sample cannot be easily collected, the cohesive strength can be reliably derived from SPT N-value as following equation –

$c = 50N/8$ (kN/m^2) --------- *(Terzaghi and Peck)*

The relation of SPT N-value and unconfined compressive strength (q_u) is illustrated in Figure-5.1.

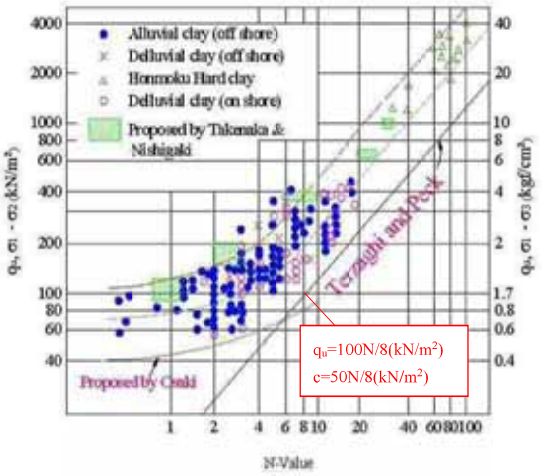

Figure - 5.1 Empirical Relation of N-value and Unconfined Compressive Strength for Clay

(5) Internal friction angle (ϕ)

The internal friction angle of the granular soil can be directly evaluated from the SPT N-value. The internal friction angle of granular soils is evaluated from their average SPT N-value, in accordance with Figure-5.2. The internal friction angle of such deposits can be also evaluated from equation and the recommended design parameters by NEXCO (See Table-5.1). In case of granular soil, the internal friction angle of soil is estimated from following equation- (Refer to Figure-5.2)

$$\emptyset = \sqrt{20N} + 15 \qquad \text{--------- ② in Figure: From Osaki, 1979)}$$

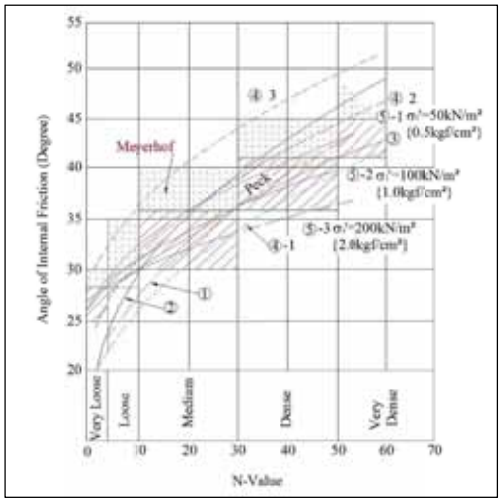

Figure - 5.2 Empirical Relations between N-value and Internal Friction Angle for Sand

(6) Deformation modulus of soil (E)

The deformation modulus of cohesive soil is usually evaluated from the unconfined compression test. For sandy soil and hard clayey soil, as the undisturbed sample cannot be easily taken, the deformation modulus of soil can be evaluated by following equation -

$$E = 700N \ (kN/m^2) \qquad \text{--------- } \textit{Japanese Code}$$

Where-

E = Deformation modulus of soil (kN/m^2)
N = Number of SPT N-value (measured)

Recommended geotechnical design parameters

Figure-5.3 to Figure-5.6 show the laboratory soil test results and field test results.

Figure-5.7 to Figure-5.10 show the consolidation test results.

Table-5.2 shows the recommended geotechnical design parameters.

Table - 5.2 Recommended geotechnical design parameters

No.	Soil Name	N Value	Unit Weight			Internal Friction Angle	Unconfined Compressive Strength	Cohesive Strength	Deformation Modulus
			γ_t (kN/m^3)	γ_{sat} (kN/m^3)	γ' (kN/m^3)	φ (°)	qu (kN/m^2)	c (kN/m^2)	E_{50} (kN/m^2)
1	Surface CLAY	5[1)]	18.0[2)]	18.0	8.0	-	60[3)]	30[3)]	3500[3)]
2	CLAY-I	2[1)]	17.0[1)]	17.0	7.0	-	30[1)]	15[1)]	1400[1)]
3	CLAY-II	3[1)]	17.5[1)]	17.5	7.5	-	40[1)]	20[1)]	2000[1)]
4	Silty SAND-I	4[1)]	17.0[2)]	18.0	8.0	25[2)]	-	-	2800[3)]
5	Silty SAND-II	8[1)]	17.0[2)]	18.0	8.0	25[2)]	-	-	5600[3)]
6	CLAY-III	12[1)]	17.0[2)]	17.0	7.0	-	150[3)]	75[3)]	8400[3)]
7	CLAY-IV	4[1)]	17.0[1)]	17.0	7.0	-	50[1)]	25[1)]	2000[1)]

1) These values were set up by field test or soil laboratory test result.
2) These values were set up by the reference value shown in NEXCO.
3) These values were set up by formula of SPT N-value.
4) These values were set up by formula.

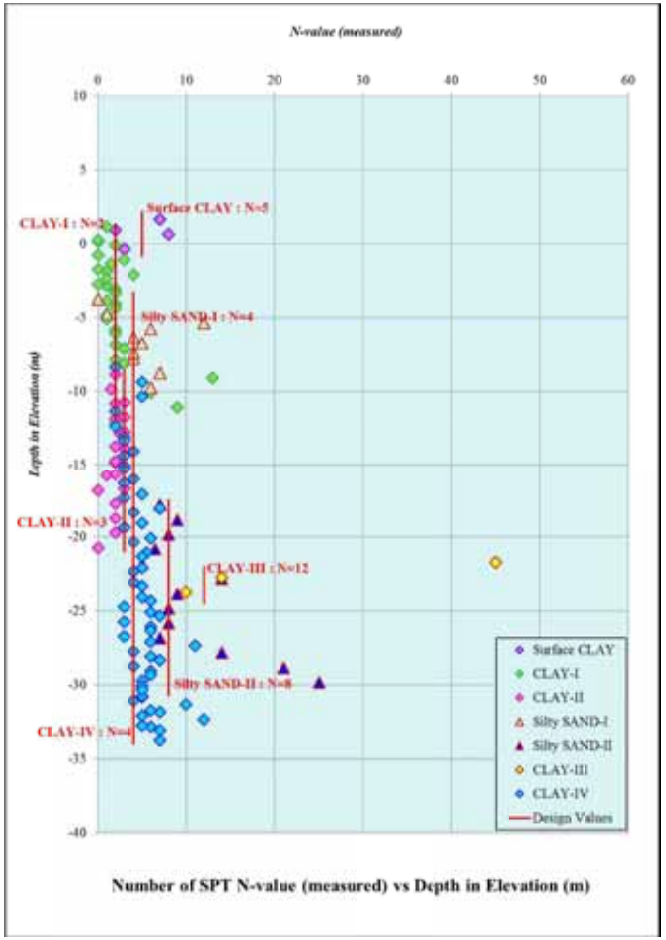

Figure - 5.3 Distribution of SPT N-values

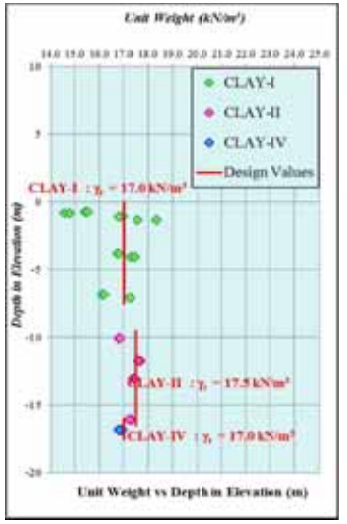

Figure - 5.4 Distribution of Unit Weight

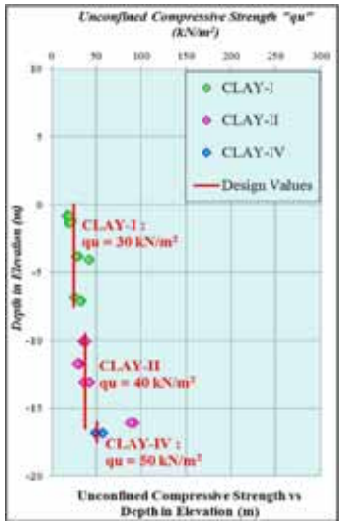

Figure - 5.5 Distribution of Unconfined Compression Strength

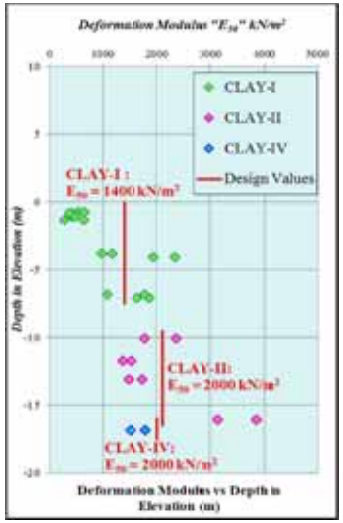

Figure - 5.6 Distribution of Deformation Modulus

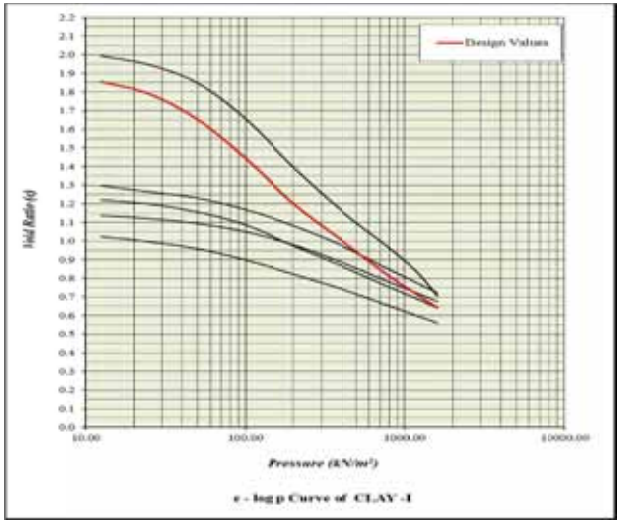

Figure - 5.7 e – log p Curve of CLAY-I Layer

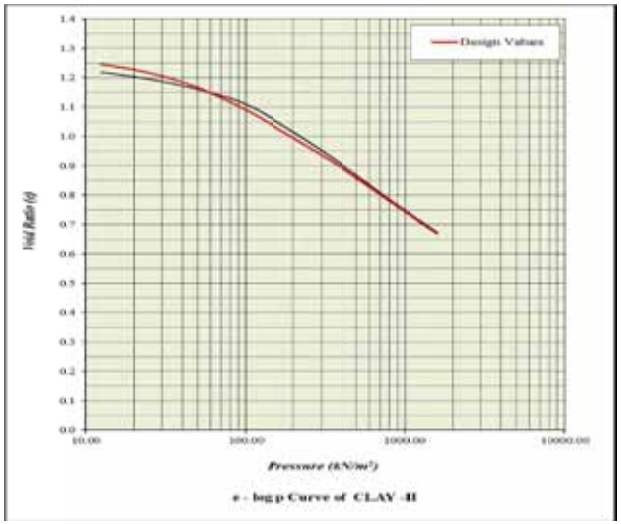

Figure - 5.8 e – log p Curve of CLAY-II Layer

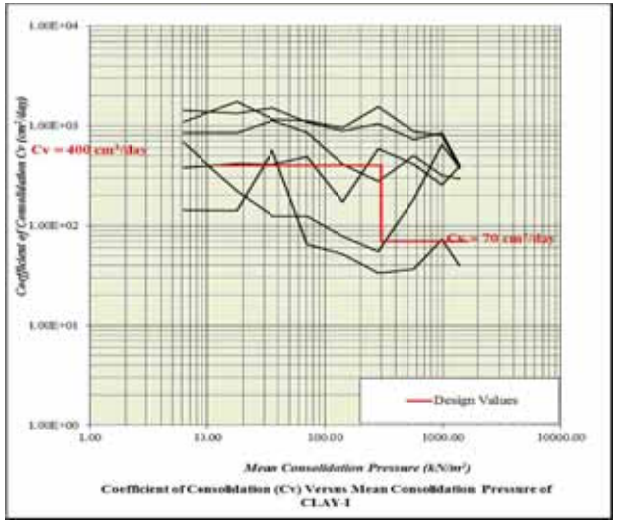

Figure - 5.9 Cv – Mean P Curve of CLAY-I Layer

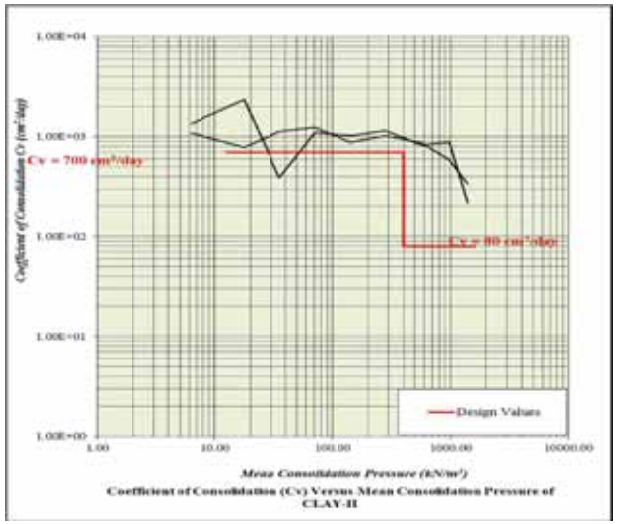

Figure - 5.10 Cv – Mean P Curve of CLAY-II Layer

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5.2 Examination for Consolidation Settlement

In this project area, filled SAND with 3.0m thick is planned for obtaining construction platform. According to the investigation results, very soft to soft CLAY-I layer is observed as top soil layer. The second sub-soil layer is also very soft to soft CLAY-II layer. And then, third sub-soil layer, Silty SAND-II layer, is underlying the CLAY-II layer.

Therefore, the consolidation settlement should be considered upper CLAY-I, CLAY-II layers. In this calculation, settlement is calculated by layer to layer.

5.2.1 Calculation Method of Consolidation Settlement

(1) Calculation of Final Consolidation Settlement

The calculation method of consolidation settlement has the following three kinds;

- e method (Calculation by relationship between void ratio and consolidation pressure)

$$S = \frac{e_0 - e_1}{1 + e_0} \cdot H$$

- Cc method (Calculation by relationship between compression index, initial effective Stress and increasing stress)

$$S = \frac{Cc}{1 + e_0} \cdot log\frac{p_0 + \Delta p}{p_0} \cdot H$$

- m_v method (Calculation by relationship between coefficient of volume compressibility and increasing stress)

$$S = m_v \cdot \Delta p \cdot H$$

Here;

S	: Total Settlement (m)
e_0	: Initial Void Ratio
e_1	: Void Ratio after Increasing Strength
H	: Thickness of Consolidation Layer (m)
Cc	: Compression Index
p_0	: Initial Effective Stress (kN/m^2)
p_1	: Increasing Effective Stress (kN/m^2)
m_v	: Coefficient of Volume Compressibility (m^2/kN)

Since the result of Cc method is influenced by setting of yield stress, this method tends to come out of individual difference. Although m_v method can take exact result for small settlement, it tends to take a calculation error in large consolidation settlement. The e method is calculable in consideration of each stress state. Therefore, the e method is selected in this examination.

Conditions of Settlement calculation at BH-A-2

1) Calculation Point Borehole No. A-2
2) Assumed thickness of embankment: 3m (18 kN/m^{3}x3m = 54 kN/m^2 = $\Delta\sigma_z$)
3) Target layer for consolidation settlement: CLAY-I and CLAY-II layer

Final Settlement

CLAY-I and CLAY-II layers are distributed with thickness of 5.0m and 11.0m respectively. So, the effective overburden stress before loading and after loading at the center of CLAY I & CLAY-II layer are as follow:

σ_{1z} = Overburden Stress before loading

σ_{2z} = Overburden Stress after loading

For CLAY-I Layer,

σ_{1z} = (17 kN/m^3 x 0.1m) + (7 kN/m^3 x ((5/2)- 0.1m) = 18.5 kN/m^2

σ_{2z} = σ_{1z} + $\Delta\sigma_z$

σ_{2z} = 18.5 + 54.0 = 72.5 kN/m^2

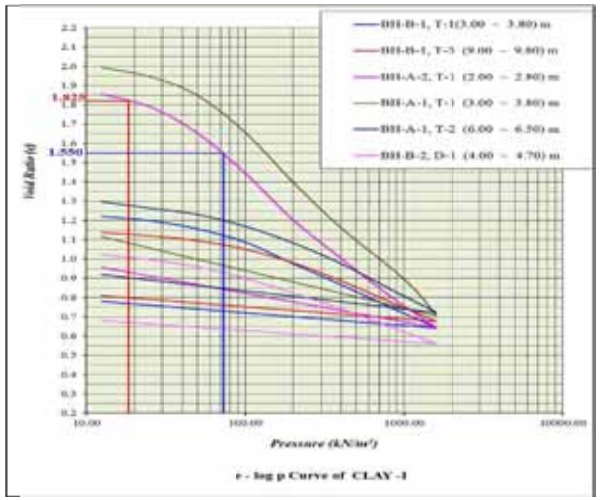

Figure - 5.11 e - log p curve of CLAY-I

Consolidation Settlement (S_f)

$$S_f = \frac{e1 - e2}{1 + e_1} x\ H$$

$$S_{f1} = \frac{1.825 - 1.550}{1 + 1.825} x\ 500$$

= 48.67cm

For CLAY-II Layer,

σ_{1z} = (17 kN/m^3 x 0.1m) + (7.157 kN/m^3 x (17.5-0.1m) = 126.231 kN/m^2

σ_{2z} = σ_{1z} + $\Delta\sigma_z$

σ_{2z} = 126.231 + 54.0 = 180.231 kN/m^2

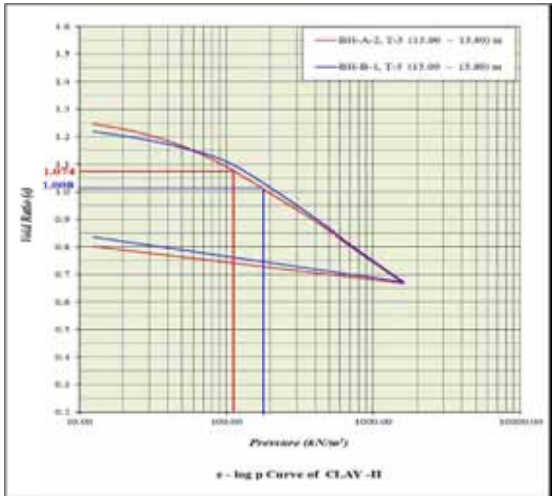

Figure - 5.12 e - log p curve of CLAY-II

Consolidation Settlement (S_f)

$$S_{f2} = \frac{1.074 - 1.008}{1 + 1.074} x\ 1100$$

= 35.00cm

Total settlement at BH-A-2 = $S_{f1+}S_{f2}$ = 48.67 + 35.00 = 83.67cm

(2) Calculation for Time and Settlement Relation

It usually takes time for clay layer to dissipate the excess pore water pressure generated with overburden load due to very small permeability. Therefore, the relation between time and consolidation settlement is important to plan the consolidation schedule.

Time and consolidation settlement relation for clay layer are calculated with Terzaghi's theory. In case that there are variation of soil properties with depth in clay layers, it is dealt with as multi-clay layers in settlement calculation.

Terzaghi's one-dimensional consolidation theory is used for the calculation of time and settlement relation as water in clay flows in vertical as shown in Figure-5.13.

Those equations are shown as follows;

$S_t = U \cdot S_f$

$$U = 1 - \frac{8}{\pi^2} \cdot \sum_{n=0}^{\infty} \frac{1}{(2n+1)^2} \cdot \exp\left\{ -\left(\frac{2n+1}{2} \cdot \pi\right)^2 \cdot T_v \right\}$$

$$T_V = \frac{c_v \cdot t}{D^2}$$

Here;

St : Settlement at time t (m)
S_f : Final settlement (m)
U : Cosolidation degree (%)
T_v : Time factor
C_v : Coefficient of consolidation (cm^2/day)
t : Time (day)
D : Length of drainage (cm)

A7-3-38

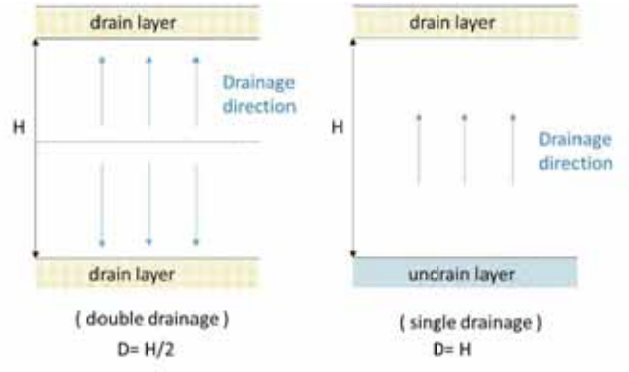

Figure - 5.13 Schematic Diagram of One-dimensional Consolidation

For consolidation degree calculation, equivalent layer thickness method is used as follows;

Among the Cvs for clay layers, any C_{V1} is selected as a representative Cv. Then it is dealt with as one clay layer with C_{V1} and thickness of H_0 as shown in the following formula.

$$H0 = H1 + H2\sqrt{\frac{Cv1}{Cv2}}$$

This formula shows a sample case like the clay layers as shown in Figure-5.14.

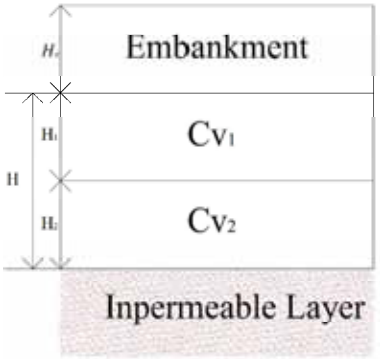

Figure - 5.14 Sample of Clay Layers with Cvi and Hi for Consolidation

In this calculation,

H_I = 500cm, C_{vI} = 400 cm^2/day

H_{II} = 1100cm, C_{vII} = 700 cm^2/day

Representative H = 1,331.52 cm

Representative C_v = 400 cm^2/day

Table - 5.3 Variation of Time Factor with Degree of Consolidation

Degree of Consolidation U (%)	10%	20%	30%	40%	50%	60%	70%	80%	90%
Time Factor T	0.008	0.031	0.071	0.126	0.197	0.287	0.403	0.567	0.845

Table - 5.4 Summary of consolidation settlements and consolidation time for 3m height filled SAND

Consolidation Degree U (%)		10%	20%	30%	40%	50%	60%	70%	80%	90%
Layer Name	Time (Days)	35	137	315	558	873	1272	1786	2513	3745
Total	83.67cm	8.367	16.734	25.101	33.468	41.835	50.202	58.569	66.936	75.303

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Conditions of Settlement calculation at BH-B-1

1) Calculation Point Borehole No. B-1
2) Assumed thickness of embankment: 3m (18 kN/m^3x3m = 54 kN/m^2 = $\Delta\sigma_z$)
3) Target layer for consolidation settlement: CLAY-I and CLAY-II layer

Final Settlement

CLAY-I and CLAY-II layers are distributed with thickness of 11.0m and 9.0m respectively. So, the effective overburden stress before loading and after loading at the center of CLAY I & CLAY-II layer are as follow:

σ_{1z} = Overburden Stress before loading

σ_{2z} = Overburden Stress after loading

For CLAY-I Layer,

σ_{1z} = (17 kN/m^3 x 1.3m) + (7 kN/m^3 x ((11/2)-1.3m) = 51.5 kN/m^2

σ_{2z} = $\sigma_{1z} + \Delta\sigma_z$

σ_{2z} = 51.5 + 54.0 = 105.5 kN/m^2

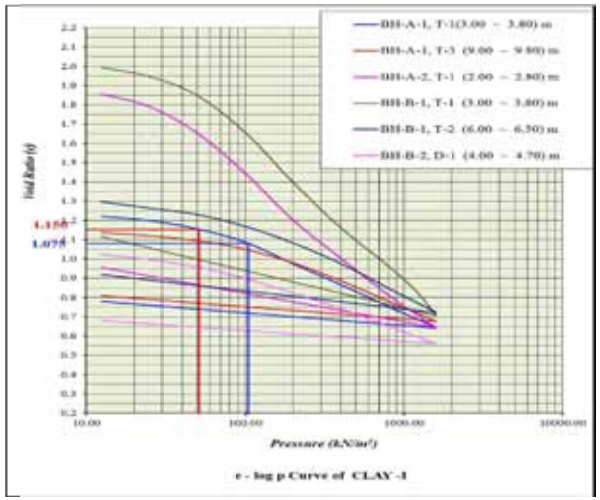

Figure - 5.15 e - log p curve of CLAY-I

Consolidation Settlement (S_f)

$$S_f = \frac{e1 - e2}{1 + e_1} x\ H$$

$$S_{f1} = \frac{1.150 - 1.075}{1 + 1.150} x\ 1100$$

= 38.37cm

For CLAY-II Layer,

σ_{1z} = (17 kN/m^3 x 1.3m) + (7.225 kN/m^3 x (15.5-1.3m) = 124.695 kN/m^2

σ_{2z} = $\sigma_{1z} + \Delta\sigma_z$

σ_{2z} = 124.695 + 54.0 = 178.695 kN/m^2

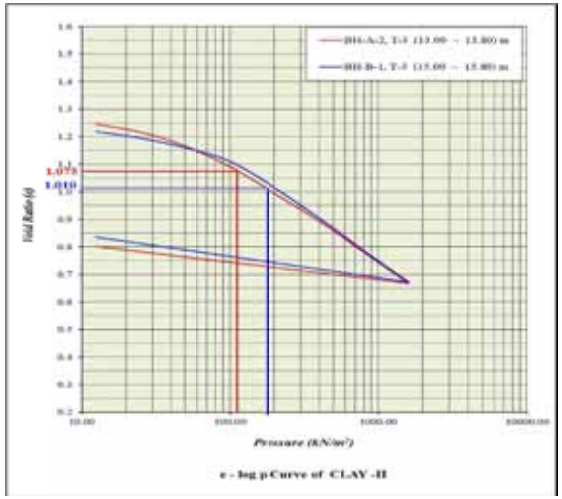

Figure - 5.16 e - log p curve of CLAY-II

Consolidation Settlement (S_f)

$$S_{f2} = \frac{1.075 - 1.010}{1 + 1.075} x\ 900$$

= 28.19cm

Total settlement at BH-B-1 = $S_{f1+} S_{f2}$ = 38.37 + 28.19 = 66.56cm

Terzaghi's one-dimensional consolidation theory is used for the calculation of time and settlement relation as water in clay flows in vertical as shown in Figure-5.13.

For consolidation degree calculation, equivalent layer thickness method is used as follows;

Among the Cvs for clay layers, any C_{V1} is selected as a representative Cv. Then it is dealt with as one clay layer with C_{V1} and thickness of H_0 as shown in the following formula.

$$H0 = H1 + H2\sqrt{\frac{Cv1}{Cv2}}$$

This formula shows a sample case like the clay layers as shown in Figure-5.17.

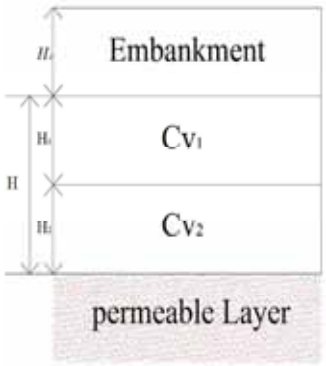

Figure - 5.17 Sample of Clay Layers with Cvi and Hi for Consolidation

In this calculation,

H_I = 1100cm, C_{vI} = 400 cm^2/day

H_{II} = 900cm, C_{vII} = 700 cm^2/day

Representative H = 1,780 cm

Representative C_v = 400 cm^2/day

Table - 5.5 Summary of consolidation settlements and consolidation time for 3m height filled SAND

Consolidation Degree U (%)		10%	20%	30%	40%	50%	60%	70%	80%	90%
Layer Name	Time (Days)	16	61	141	250	390	568	798	1123	1673
Total	66.56 cm	6.656	13.312	19.968	26.624	33.280	39.936	46.592	53.248	59.904

The relationship between settlement and times are shown in Figure-5.18.

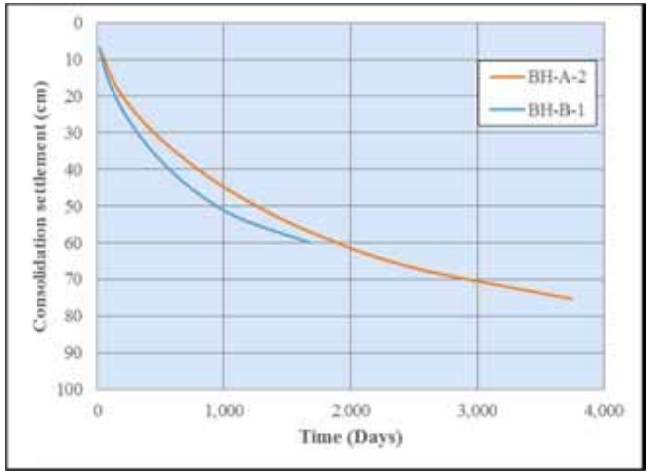

Figure - 5.18 The relationship between settlement and time of BH-A-2 & BH-B-1

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5.3 Bearing Capacity of Pile Foundation

Driven pile foundation can be used if the bearing capacity of shallow foundation is not enough for required building. The bearing capacities of driven pile (end bearing capacity and skin friction) are estimated from boring results especially from SPT-N value.

For the evaluation of bearing capacity of pile foundations, the formula for calculation of bearing capacity of bored pile, derived from "Recommendation for Design of Building Foundations (2001) by Architectural Institute of Japan" would be applied for this analysis.

In calculation of end bearing capacity not only in bore pile but also in driven pile, N < 4 will not be considered because it represents soft condition of soil and it is not enough to calculate skin friction of piles.

Driven Pile

$$R_u = R_p + R_f \text{ (kN)}$$

$$R_p = q_p A_p,\ R_f = R_{fs} + R_{fc} \text{ (kN)}$$

Where,

R_u = Ultimate bearing capacity of pile (kN)
R_p = End bearing capacity of pile (kN)
q_p = End bearing capacity per square meter (kN/m^2)
A_p = Area of pile (m^2)
R_f = Skin friction of pile (kN)
R_{fs} = Skin friction of sandy soil layer (kN) = $\tau_s L_s \psi$
R_{fc} = Skin friction of cohesive soil layer (kN) = $\tau_c L_c \psi$
L_s = Length of sandy soil layer portion surrounding pile (m)
L_c = Length of cohesive soil layer portion surrounding pile (m)
τ_s = Skin friction of sandy soil layer portion surrounding pile per square meter (kN/m^2)
τ_c = Skin friction of cohesive soil layer portion surrounding pile per square meter (kN/m^2)
ψ = Length of circumference of pile (m)

End bearing (q_p)

q_p = 300 N′ (kN/m^2) for sandy soil
N′ = Average Converted N-value between upper 4D and lower 1D from pile end
D = Pile diameter (m)
Converted N = 100 as a maximum value is acceptable for the above formula
q_p = 18,000 kN/m^2 as a maximum value is acceptable for the above formula
q_p = 6 C_u (kN/m^2) for cohesive soil
C_u = cohesion of cohesive soil at the pile end (kN/m^2)
q_p = 18,000 kN/m^2 as a maximum value is acceptable for the above formula

Skin friction (τ)

τ_s = 2 N (kN/m^2) for sandy soil
N = 50 as a maximum value is acceptable for the above formula
τ_c = 0.6C_u (kN/m^2) for cohesive soil
C_u = cohesion of cohesive soil at the pile end (kN/m^2)
C_u = 100 kN/m^2 as a maximum value is acceptable for the above formula

In this calculation, the diameter of pile is estimated Φ (250x250) mm for driven pile. The average SPT N-value for each meter is calculated for each borehole during calculation of bearing capacity of driven pile. Table-5.6 is shown the summary of allowable bearing capacity, skin friction and end bearing capacity of each borehole for driven pile respectively. Figure-5.19 is shown the distribution of allowable bearing capacity of driven pile with depth in elevation (m). Moreover, Figure-5.20 shows the allowable bearing capacity, skin friction and end bearing of driven pile for each borehole. The detailed calculation sheet is attached in Appendix-F.

Table - 5.6 The allowable bearing capacity, end bearing capacity and skin friction for Driven Pile

BH-No.	Bottom depth of Borehole GL-(m)	End Bearing Capacity (kN)/Pile	Skin Friction (kN)/Pile	Allowable Bearing Capacity (kN)/Pile
BH-A-1	35.00	9.00	321.00	110.00
BH-A-2	35.00	9.00	296.00	101.67
BH-B-1	35.00	9.00	325.00	111.33
BH-B-2	35.00	9.00	316.00	108.33

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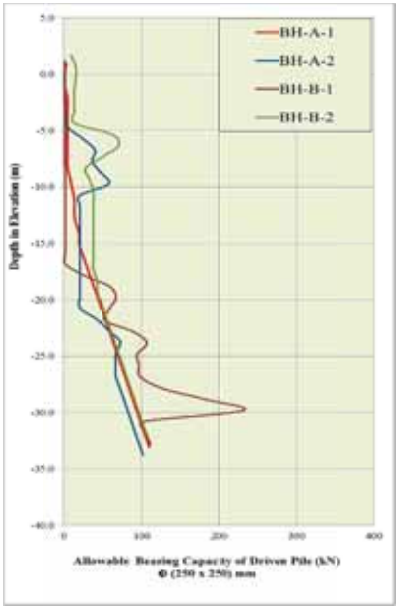

Figure - 5.19 Distribution of allowable bearing capacity for driven pile vs depth in elevation (m)

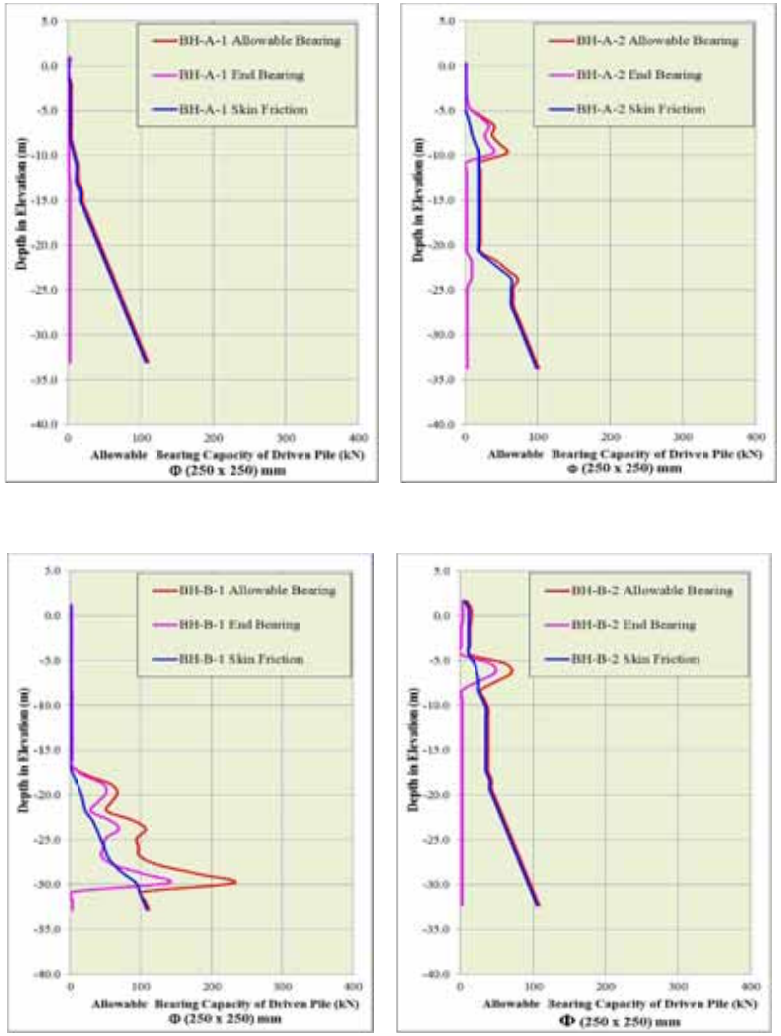

Figure - 5.20 Distribution of allowable bearing capacity, end bearing and skin friction for driven pile with depth in elevation of BH-A-1, BH-A-2, BH-B-1 and BH-B-2

5.4 Earthquake Consideration

By the global scope of geology, Myanmar lies in one of the great earthquake provinces called the Alpine Earthquake Belt. Therefore, minor to catastrophic earthquakes has occurred many times in the territory of Myanmar since long ago. The central and eastern part of Myanmar lies on the Burma Plate which has a convergent boundary with Indian Plate in the western most part of Myanmar. The Burma Plate has been relatively moving 2 to 3 cm per year to the north. Due to this unstable activity of ground earthquake occurrences can expect at any time in Myanmar.

5.4.1 Earthquake Intensity of Myanmar

The origin and occurrence of earthquakes occurred in southern part of the country can be interpreted as below.

Earthquake intensity in the area can be seen in Figure-5.18. The map is an earthquake probable intensity zoning map. The approach is mainly empirical and historical in the sense that it makes use of past seismic event and history to make educated guesses about region wide intensities in the future. It is hoped that a probabilistic seismic risk (or earthquake hazard map) on horizontal ground acceleration should be taken into account in the design.

As shown in the map, five seismic zones are demarcated and named (from low to high) Zone I (Low Zone), Zone II (Moderate Zone), Zone III (Strong Zone), Zone IV (Severe Zone), and Zone V (Destructive Zone), mainly following the nomenclature of the European Macro seismic Scale 1992. For each zone, a probable range of ground acceleration in g values and equivalent Modified Mercalli (MM) Scale classes are given. The highest intensity zone designated for Myanmar is the Destructive Zone (with probable intensity range of 0.4-0.5 g) which is equivalent to MM class IX. There are four areas in that zone; namely, Bago-Phyu, Mandalay-Sagaing-Tagaung, Putao-Tanaing, and Kale Myo-Homalin areas. The latter two, however, would not have major earthquake hazards as they are only sparsely populated. Important cities and towns that lie in Zone IV (Severe Zone, with probable intensity range of 0.3-0.4 g) are Taungoo, Taungdwingyi, Bagan-Nyaung-U, Kyaukse, PyinOoLwin, Shwebo, Wuntho, Hkamti, Haka, Myintkyina, Taunggyi, and Kung long. Yangon straddles the boundary between Zone II and Zone III, with old and new satellite towns in the eastern part in Zone III, and the original city in Zone II. Regarding the Modified Mercalli (MM) Scale classes, the level of probable damage and destruction may be summarized as in Table-5.7.

Table - 5.7 The Level of Probable Damage and Destruction

Zone	MM Class	Probable Damage	Examples of Damage
V	IX	Major damage	Considerable damage in specially designed structures Major damage in good RC buildings
IV	VIII-IX	Considerable damage	Considerable damage in good RC buildings Major damage in ordinary brick buildings
III	VIII	Moderate damage	Moderate damage in good RC buildings Considerable damage in ordinary brick buildings
II	VII	Minor damage	Minor damage in good RC buildings Moderate damage in ordinary brick buildings
I	VI	Slight damage	Minor damage in ordinary brick buildings

According to the seismic zone map of Myanmar (after Dr. Maung Thein et.al, 2005 Dec), the project area is shown in Figure-5.21.

A7-3-44

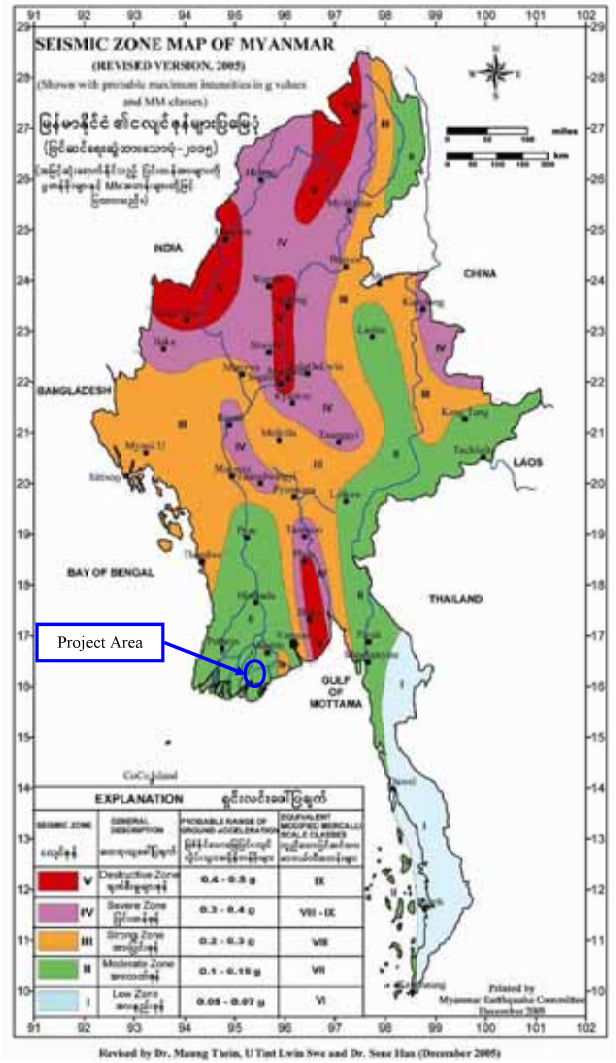

Figure - 5.21 Seismic Zone Map of Myanmar (after Dr. Maung Thein et.al, 2005 Dec)

5.4.1.1 General

Liquefaction is one of the catastrophic of earthquake related hazards. According to the investigation results, engineering properties of some soil layers have been identified as potential of liquefaction. According to the theoretical research, the quicksand is high potential to liquefaction. The term quicksand (after Terzaghi, 1925) is referred to three conditions. First the sand or silt concerned must be saturated and loosely packed. Second, on disturbance of constituents grains become more closely packed, which leads to an increase in pore water pressure, reducing the forces acting between the grains. This brings about a reduction in strength. The third condition requires that pore water cannot escape readily. This is fulfilled if the sand or silt has a low permeability and/or the seepage path is long. As the above reasons, poorly graded sand of fine to medium grained and silty sand of saturated condition have high potential to liquefaction. Liquefaction potential of quicksand may also be brought about by sudden shocks caused by the action of heavy machinery and blasting.

According to the investigation results for a lot of earthquake experience in the world, it is said that the liquefaction can occur easily under the following condition.

1) Lower fine content of saturated soil (Fine content is meant the size less than 0.07 mm)
2) Lower SPT blow count (N) of saturated soil (SPT N-value < 20 blows per 30 cm)
3) Shallow groundwater table
4) Bigger maximum peak acceleration

5.4.1.2 Liquefaction Analysis Procedure

In this analysis, magnitude of earthquake and peak acceleration at ground surface is assumed as 0.15g, and MM Class is 7.0 in this area. And, water table is actual water level from investigation results.

Liquefaction analysis is performed by following two methods:

"Highway Bridge Design Guideline, Anti-earthquake design Chapter" Japan Road Association, 2012.3

Method by Highway Bridge Design Guideline

① Object Soil Layers for Liquefaction Analysis
   (a) The soil layer of which groundwater level is less than 10m from ground surface, and exists in the depth within 20m from ground surface
   (b) The soil layer of which fine content (FC) is less than 35% or even if fine content (FC) exceeds 35%, plasticity Index (Ip) is less than 15.
   (c) The soil layer which is D_{50} [50% particle diameter] is below 10mm, and D_{10} [10% particle diameter] is a soil layer below 1 mm".

② Calculation of Safety factor against Liquefaction

$$F_L = {}^{R}/_{L}$$

$$R = c_w R_L$$

$$L = r_d k_{hgL} {}^{\sigma_v}/_{\sigma_v'}$$

$$r_d = 1.0 - 0.015x$$

$$k_{hgL} = c_z k_{hgL0}$$

Since a horizontal seismic coefficient is about 0.2, level 1 earthquake motion is assumed.

$$c_w = 1.0$$

Where,

F_L = Liquefaction resistance ratio
R = Liquefaction strength ratio
L = Earthquake shear stress ratio
c_w = Correction factor by earthquake vibration properties
R_L = The repetition triaxiality strength ratio
r_d = Reduction coefficient of the depth of the earthquake shear stress ratio
k_{hgL} = Design horizontal seismic intensity of the ground surface to use for a judgment of the liquefaction (assumed to be 0.2 for the project area)
c_z = Seismic zone factor. Here, it was set with 1.0.
k_{hgL0} = Standard value of the design horizontal seismic intensity of the ground surface to use for a judgment of the liquefaction
σ_v = The total pressure exerted by earth
σ_v' = The effective overburden pressure
x = Depth from an earth surface

The repetition triaxiality strength ratio "R_L" is computed by following formula:

$$R_L = 0.0882\sqrt{N_a/1.7} \quad (Na < 14)$$

$$R_L = 0.0882\sqrt{N_a/1.7} + 1.6 \times 10^{-6} \cdot (N_a - 14)^{4.5} \quad (Na \geqq 14)$$

<In case of a sandy soil>

$$N_a = c_1 N_1 + c_2$$

$$N_1 = 170\, {}^{N}/_{(\sigma_{vb}' + 70)}$$

Where,

$c_1 = 1$ (0%≦FC＜10%)
$c_1 = {}^{(FC+40)}/_{50}$ (10%≦FC＜60%)
$c_1 = {}^{FC}/_{20} - 1$ (60%≦FC)
$c_2 = 0$ (0%≦FC＜10%)
$c_2 = {}^{(FC-10)}/_{18}$ (10%≦FC)

<In case of a gravely soil>

$$N_a = \left\{1 - 0.36 \log_{10}\left({}^{D_{50}}/_{2}\right)\right\} N_1$$

Where,

R_L = The dynamic shear strength ratio
N = N-value
N_1 = N-value converted into the effective overburden pressure 100kN/m^2

σ_{vb}' = The effective overburden pressure in the depth of SPT (kN/m^2)
c1,c2 = The correction factor of N-value by the content for an infinitesimal grain
FC (%) = Fines Content (Percent less than 0.075mm)
D_{50}(mm) = 50% particle size

5.4.1.3 *Potential of* Liquefaction *(P_L)*

P_L was originally developed in Japan to estimate the potential of liquefaction to cause foundation damage at a site (Iwasaki, 1978). P_L assumes that the severity of liquefaction is proportional to the:

(1) Thickness of the liquefied layer;
(2) Proximity of the liquefied layer to the surface; and
(3) Amount by which the factor of liquefaction (F_L)

The potential of liquefaction can be calculated by following formula;

$$PL = \int_0^{20} (1 - FL)(10 - 0.5z)\, dz$$

Where,

P_L = potential of liquefaction

F_L = factor of liquefaction

z = Depth in meters

Potential of liquefaction condition is shown in Table-5.8.

Table - 5.8 Potential of Liquefaction condition

$15 < P_L$	High Possibility of Liquefaction
$5 < P_L \leq 15$	Possibility of Liquefaction
$0 < P_L \leq 5$	Low Possibility of Liquefaction

5.4.1.4 Except Expected Ground Acceleration at site

According to the seismic zone map of Myanmar, the probable ground peak acceleration when earthquake occur will be 0.15g. In addition, the Modified Mercalli (MM) class of Ayeyarwaddy can be regarded as 7.0.

5.4.2 Liquefaction Analysis Results

Generally, if the earthquake occur in this area, the liquefaction potential will be high in Silty SAND layers. According to the liquefaction analysis results, the liquefaction potential is high in sandy soil layers. Because of the water table is shallow (around GL-1.3m from the ground level), and the

relative density of sandy soil layer very loose to medium dense. These layers are lying between 5.0m and 12.0m from ground level. Summary of liquefaction analysis results are shown in Table-5.9, and the distribution of liquefaction potential are shown in Figure-5.22 and Figure-5.23. The detailed calculation is attached in Appendix-G.

Table - 5.9 Summary of Liquefaction Analysis Results

Depth (m)	BH-A-1		BH-A-2		BH-B-1		BH-B-2	
	Soil Layer Name	Possibility of liquefaction	Soil Layer Name	Possibility of liquefaction	Soil Layer Name	Possibility of liquefaction	Soil Layer Name	Possibility of liquefaction
1.300	Surface CLAY	Low	CLAY-I	Low	CLAY-I	Low	Surface CLAY	Low
2.300	CLAY-I	Low	CLAY-I	Low	CLAY-I	High	Surface CLAY	Low
3.300	CLAY-I	Low	CLAY-I	Low	CLAY-I	High	Surface CLAY	Low
4.300	CLAY-I	Low	CLAY-I	Low	CLAY-I	High	CLAY-I	Low
5.300	CLAY-I	Low	Silty SAND-I	Low	CLAY-I	High	CLAY-I	Low
6.300	CLAY-I	Low	Silty SAND-I	High	CLAY-I	High	CLAY-I	Low
7.300	CLAY-I	Low	Silty SAND-I	High	CLAY-I	High	CLAY-I	Low
8.300	CLAY-I	Low	Silty SAND-I	High	CLAY-I	High	Silty SAND-I	Low
9.300	CLAY-I	Low	Silty SAND-I	High	CLAY-I	High	Silty SAND-I	High
10.300	CLAY-I	Low	Silty SAND-I	High	CLAY-I	High	Silty SAND-I	High
11.300	CLAY-I	Low	Silty SAND-I	High	CLAY-II	High	ClAY-IV	Low
12.300	CLAY-I	Low	CLAY-II	High	CLAY-II	High	ClAY-IV	Low
13.300	CLAY-I	Low	CLAY-II	High	CLAY-II	High	ClAY-IV	Low
14.300	CLAY-I	High	CLAY-II	High	CLAY-II	High	ClAY-IV	Low
15.300	CLAY-IV	Low	CLAY-II	High	CLAY-II	High	ClAY-IV	Low
16.300	CLAY-IV	Low	CLAY-II	Low	CLAY-II	High	ClAY-IV	Low
17.300	CLAY-IV	Low	CLAY-II	Low	CLAY-II	High	ClAY-IV	Low
18.300	CLAY-IV	Low	CLAY-II	Low	CLAY-II	Low	ClAY-IV	Low
19.300	CLAY-IV	Low	CLAY-II	Low	CLAY-II	Low	ClAY-IV	Low

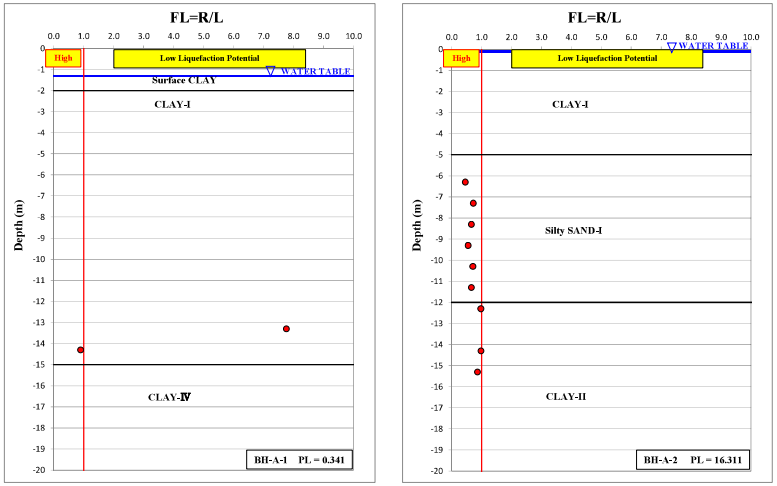

Figure - 5.22 Distribution of liquefaction potential of BH-A-1 & BH-A-2

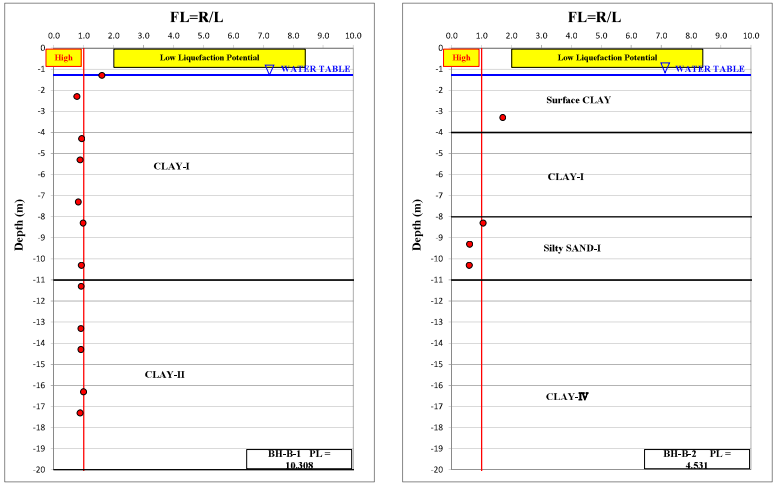

Figure - 5.23 Distribution of liquefaction potential of BH-B-1 & BH-B-2

6 CONCLUSION AND RECOMMENDATION

6.1 General Information

YACHIO ENGINEERING CO., LTD. is planning to develop the rural infrastructures in Bogalay Township, Ayeyarwady Region. Therefore, Fukken Co., Ltd. was assigned to conduct preparatory survey works to obtain soil properties of selected locations in the project area. The survey work was carried out to obtain the information about the stratigraphic composition at site, the distribution of the reliable bearing layer and geotechnical design parameters. Total four boreholes were carried out on the proposed project area. According to the preparatory survey works, three portions are included in this report. There are as follows:

(1) Field Test includes SPT test, Disturbed and Undisturbed Soil Sampling

(2) Laboratory Test Results (Physical Properties Test, Mechanical Properties Test)

(3) Report with geotechnical assessments

6.2 Ground Conditions

According to the investigation results, seven different soil layers are observed in this investigation project. These different layers are described from top to bottom as follows.

(1) Surface CLAY
(2) CLAY-I
(3) CLAY-II
(4) Silty SAND-I
(5) Silty SAND-II
(6) CLAY-III
(7) CLAY-IV

According to the Standard Penetration Test “SPT” results, the distribution of SPT N-value for each soil layer is illustrated in Table-6.1 and Figure-6.1. Moreover, soil profile through the project area is shown in Figure-6.2.

Table - 6.1 Distribution of SPT N-value for each soil layer

Sr No.	Soil layer	N-value (Measured) 10 20 30 40 50 60	Minimum	Maximum	Average
1	Surface CLAY		2	8	5
2	CLAY-I		0	13	2
3	CLAY-II		0	3	2
4	Silty SAND-I		0	12	5
5	Silty SAND-II		5	25	11
6	CLAY-III		10	45	23
7	CLAY-IV		2	12	5

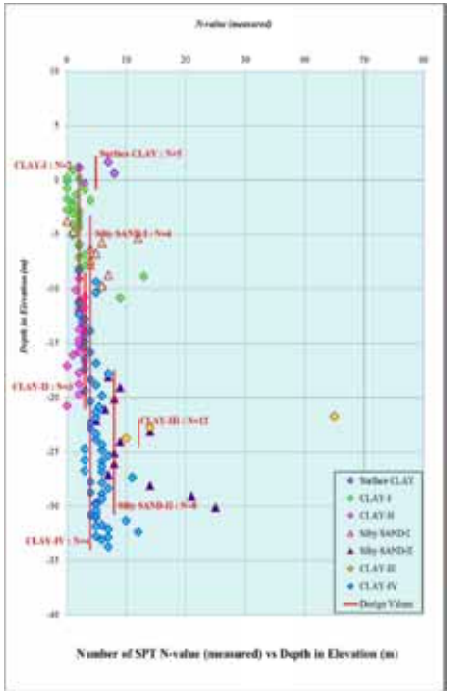

Figure - 6.1 Distribution of SPT N-values of the project area

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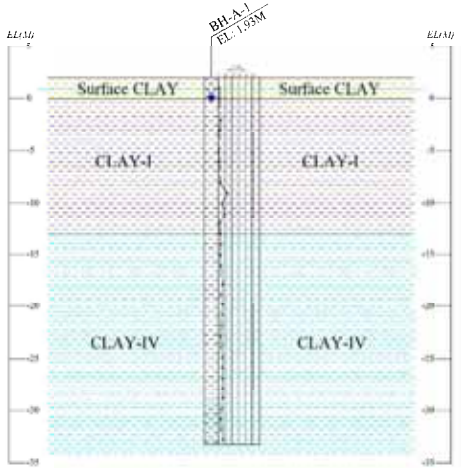
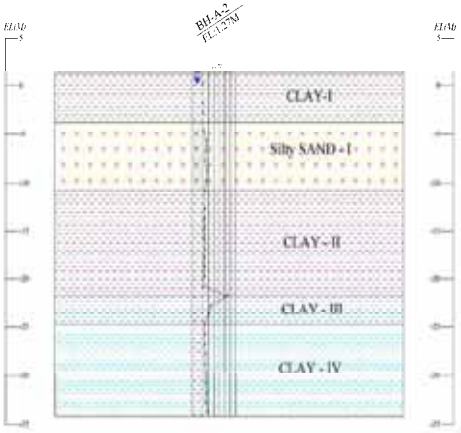
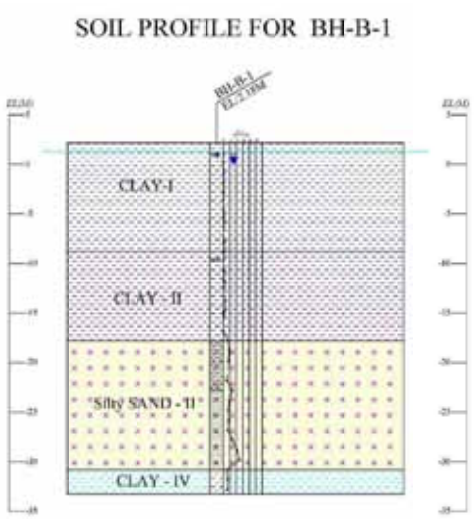
SOIL PROFILE FOR BH-A-1



SOIL PROFILE FOR BH-A-2





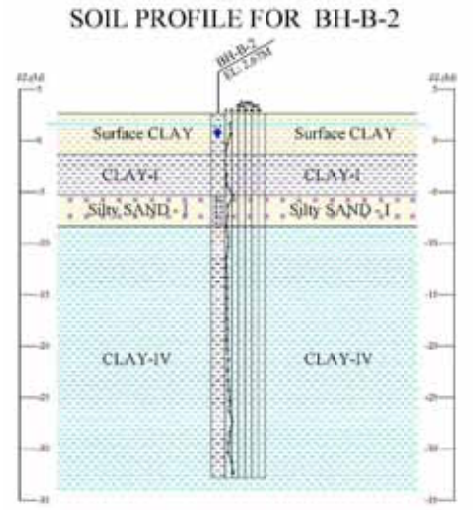


Figure - 6.2 Soil profile through the project area

6.3 Consolidation Settlement

The possible soil layer for consolidation settlement is clayey soil layers. According to the soil investigation results, clayey soil layer is well observed in this project area.

SPT N-values of clayey soil layers (CLAY-I, CLAY-II, CLAY-II and CLAY-IV) are 2/30 to 23/30 blows. Therefore, the consistency of soil layer are not uniformed in this area.

Target layer of consolidation settlement is CLAY-I and CLAY-II. According to the settlement analysis results, the settlement is 83.67cm for BH-A-2 and 66.56cm for BH-B-1 due to 3m height filled sand. Therefore, it is taken that a problem will be occurred because the settlement is more than 60cm. However, if a countermeasure of consolidation settlement will be carried out, the cost of construction becomes high. Therefore, it is thought that it is better to consider the maintenance or the repair of road.

6.4 Type of Foundation

If the proposed construction is heavy load structure, pile foundation is recommended for proposed construction project. In this report, the driven pile Φ (250x250) mm square pile is calculated as a general estimation for each borehole by using SPT N-values and design parameters. Therefore, the calculation results may have a little different value due to different calculation conditions. However, these estimated values can use general information for proposed construction project. According to the soil investigation results, the bearing layer could not be found until GL-35m. Therefore, a friction pile foundation shall be selected. At the design stage, a size of pile foundation shall be determined based on the required bearing capacity. The distribution of allowable bearing capacity for driven pile and depth in elevation (m) for each borehole are presented in Figure-6.1.

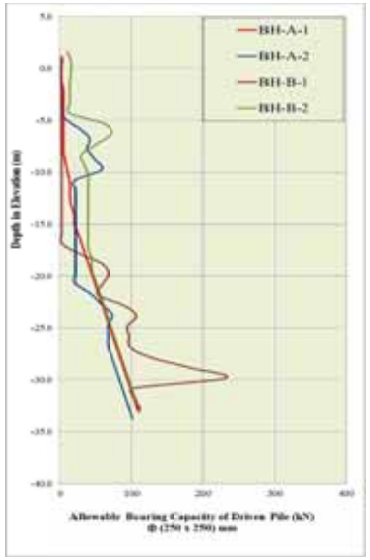


Figure - 6.1 Distribution of allowable bearing capacity for driven pile vs depth in elevation (m)

6.5 Seismic Consideration

The detailed calculation are presented in Appendix-G. According to the investigation results, the clayey soil layers are well observed in this project area. Generally, if the earthquake occur in this area, the liquefaction potential will be high in silty sand layers. According to the liquefaction analysis results, the liquefaction potential is spotted high in Silty SAND layer at BH-A-2. Because the relative density of this layer is loose, and fine content is low content. According to the liquefaction analysis results, liquefaction is happened in which layer thickness of BH-A-2 and BH-B-1 are more than 10m.

Potential of liquefaction (P_L) is calculated based on the results of liquefaction analysis (F_L). According to the calculation of P_L, BH-A-1 is 0.341, BH-A-2 is 16.311, BH-B-1 is 10.308 and BH-B-2 is 4.531. Therefore, it is evaluated that is high possibility of liquefaction for BH-A-2. Although clayey layer is well observed in this project area, plasticity Index (Ip) of some clayey layers are low. Hence, it is considered that liquefaction is occurred in this project area.

--------- End of Document ---------

７－４　社会経済調査結果（チン州）

TOTAL BUSINESS SOLUTION CO., LTD.
No. 54, Room. 704, Waizayantar Tower, Waizayantar Road
Thingangyun Township, Yangon, Myanmar

SOCIO-ECONOMIC SURVEY I

CHIN STATE

UNDER

PREPARATORY SURVEY ON THE PROJECT FOR RURAL INFRASTRUCTURE DEVELOPMENT IN LOCAL AREAS IN THE REPUBLIC OF THE UNION OF MYANMAR

A7-4-1

PROJECT NO.:	102 P-2018	DISTRIBUTION:	
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Socio-Economic Survey I, Project No.: 102 P-2018

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ABBREVIATIONS

DRD	Department of Rural Development
GAD	Government Administration Department
HH	Household
LPG	Liquefy Petroleum Gas
MMK	Myanmar Kyat
USD	United State Dollar
YEC	Yachiyo Engineering Co., Ltd
UN- Habitat	United Nation Human Settlements Programme

CHAPTER 1
SCOPE OF SURVEY

1.1. STUDY AREA

The Socio-economic study is focused on establishing baseline information on socio-economic components of communities within the study area. The information is also collected from primary sources. The Socio-economic survey (I) has been done based on the household level of the living condition as a baseline data of two villages, Dollung and Swond Dot villages in Dolluang village tract of Tedim Township in Chin State. It is presented in Figure 1-1.

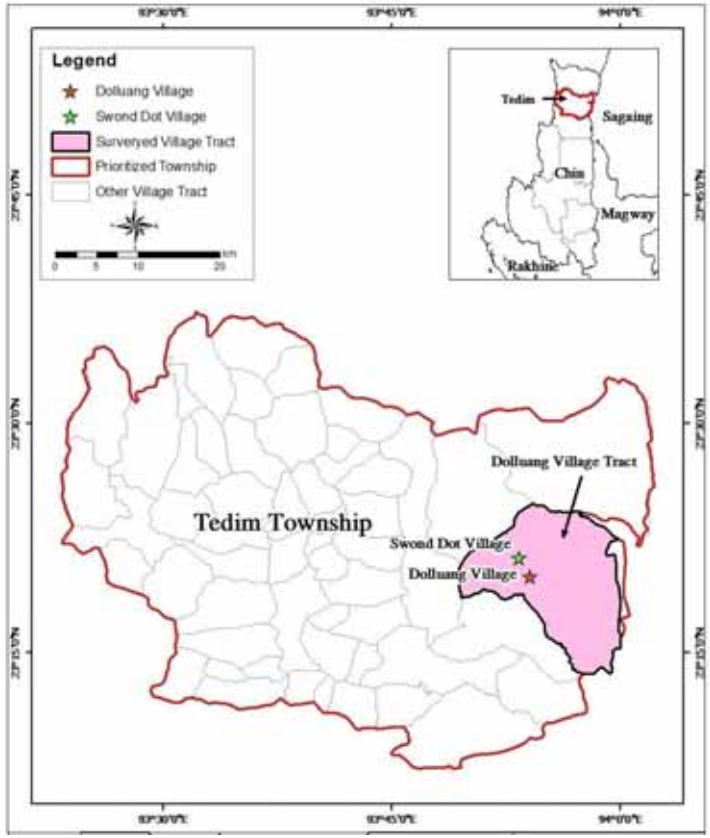

Figure 1-1 Location of Dollaung Village and Swond Dot village of Tedim Township in Chin State

1.2. POPULATION

Based on General Administration Department of Tedim Township, the population of two study villages is 322. All households are surveyed during survey period in both villages. There are ten villages under Dolluang village tract administration. Of these villages, four villages such as Zo Zang, Tan Zang, Zo Nuam Zang and Mai Nwel villages were surveyed in 243 households among the total 290 households in October 2017. For this second time survey, it is covered for two villages, Dolluang and Swond Dot villages. Population and households in second time survey are presented in Table 1-1.

Table 1-1 Population and household in study area

Name of survey villages	Dolluang Village	Swond Dot Village	TOTAL
No.of population	154	168	322
Household	23	34	57

Source: Survey Team

1.3. ETHNICITY AND RELIGION

In the study area, almost all respondents are Chin ethnicity and Christian religion but six families are Bamar/Myanmar in Swond Dot village. All villagers are Chin ethnicity and practice in Christianity of Dolluang village. Ethnicity in both villages shows in Table 1-2.

Table 1-2 Ethnicity distribution in studied villages

Ethnicity	Dolluang Village	Swond Dot Village	TOTAL
Bamar/Myanmar	-	6	6 (10.5%)
Chin	23	28	51 (89.5%)

CHAPTER 2
HOUSEHOLD INFORMATION

2.1. HOUSEHOLDS

In Chin state, there are many predominately male headed families distribution system. According to survey, male headed household is 77% and female headed household is 13% in the study area shown in Table 2-1. There are 151 male and 171 female in total 322 family members in both studied villages. Gender disaggregated family members are also presented in as shown in Table 2-2. The survey result has shown that female members are slightly higher than male members. On the other hand, in gender of respondents, male respondents are higher than female respondents, it is shown in Table 2-3.

Table 2-1 Household Head by gender in study area

Villages	Gender of Household Head		TOTAL
	Male	Female	
Dolluang Village	19	4	23
Swond Dot Village	25	9	34
TOTAL	44(77.2%)	13(22.8%)	57 (100%)

Source: Study team

Table 2-2 Household Member by gender in study area

Villages	Gender		TOTAL
	Male	Female	
Dolluang Village	68	86	154
Swond Dot Village	83	85	168
TOTAL	151 (46.9%)	171 (53.1%)	322

Table 2-3 Nos of respondent by gender in study area

Villages	Gender		TOTAL
	Male	Female	
Dolluang Village	19	4	23
Swond Dot Village	12	22	34
TOTAL	31(54.4%)	26(45.6%)	57

Source: Study team

Average family size is 6 persons in one family. But it is 7 in Dolluang village while 5 persons in Swond Dot village. Family size in study area is shown in Table2-4.

Table 2-4 Family size in study area

Family size	Dolluang Village	Swond Dot Village	TOTAL
1-3	4 (17.4%)	9 (26.5%)	13 (22.8%)
4-6	6 (26.1%)	15 (44.1%)	21 (36.8%)
7-9	10 (43.5%)	10 (29.4%)	20 (35.1%)
>9	3 (13.0%)	-	3 (5.3%)
Average	7	5	6

Source: Study team

2.2. AGE

Age of family members is presented in Table 2-5. Average age is 25 years in the study area. Under 5 years children are not schooling yet and almost all of the children age between 5 and 15 years are school children.

Table 2-5 Age group of family members in study area

Age group of family members	Dolluang Village	Swond Dot Village	TOTAL
<5 years	16	21	37
%	10.4%	12.5%	11.5%
5-15	42	48	90
%	27.3%	28.6%	28.0%
>15 years	96	99	195
%	62.3%	58.9%	60.6%
Average	25	25	25

Source: Study team

2.3. WORKING SITUATION

Out of total 184, 124 are students and under 5 years children who are not schooling yet. About half of family members 52% are working and about 48% of family members are not working in the study area as shown in Table 2-6.

Migrant working people in both villages are few number and about 4% of the total population. A summary table of migrant working members is presented in Table 2-7.

Table 2-8 has showed the situation of family members who are working at home. According to the villagers, few family members are working at home in both villages. Of these family members, one person is running small shop at Swond Dot village and the rest persons working as home gardening in Dolluang village respectively.

Table 2-6 Working family members in study area

Working Household members	Dolluang Village	Swond Dot Village	TOTAL
Working members	43	53	96 (52.2%)
Not working	48	40	88 (47.8%)
Total	91	93	184 (100.0%)

Source: Study team

Table 2-7 Migrant working family members in study area

Migrant Working members	Dolluang Village	Swond Dot Village	TOTAL
Migrant working	5	3	8 (4.3%)

Source: Study team

Table 2-8 Situation of family member working at home

Working Household members	Dolluang Village	Swond Dot Village	TOTAL
Working at home	2 (8.7%)	1(2.9%)	39(5.3%)
Not working at home	21 (91.3%)	33 (97.1%)	54 (94.7%)
Total	23	34	57

Source: Study team

2.4. OCCUPATIONS

Most of household heads run their own business as agriculture. Most of the time occupied with their agricultural activities and community activities therefore they cannot stay and working away from home. Existing employment situation of study area is presented in Table 2-9. Most of the respondents depend on their crop farming as main occupation. Among the respondents, about 80% are agricultural farm owners and few household heads work as wage workers in farm land, causal and seasonal workers, pastors and home industry etc. in both villages. It can be seen as detail description in Table 2-10.

Table 2-9 Employment Status of Household Head

Employment status of HH Head	Dolluang Village	Swond Dot Village	TOTAL
Self-employed (business owner)	17	29	46
%	73.9%	85.3%	80.7%
Wage worker	5	4	9
%	21.7%	11.8%	15.8%
Dependent person (stay alone)	1	1	2
%	4.3%	2.9%	3.5%
Total	23	34	57

Source: Study team

Table 2-10 Employment Types of Household Head

Employment Type of HH Head	Dolluang Village	Swond Dot Village	TOTAL
Crop farming	17	27	44
Animal husbandry	-	1	1
Home industry	-	1	1
Pastor	1	1	2
Dependent person	1	1	2
Mechanic for motorbike/carry	-	1	1
Seasonal worker/casual labour	1	1	2
Carpenter	2	-	2
Teacher	1	-	1
Retired person	-	1	1

Source: Study team

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CHAPTER 3
ECONOMIC SITUATION

3.1. HOUSEHOLD INCOME

At study area of Chin State, average household income is about 100,000 Kyat per month. Table 3-1 showed that 58% of households have less than 100,000 Kyat per month. It means that average in-come was less than 100 US Dollar in both studied villages.

Agricultural household income in study area is presented in Table 3-2. Based on the interviews, average household agricultural income for the study area is 45,052 Kyat per month. All of rice paddy and corn have been use as staple foods for domestic use in the studied area. Some respondents have animal husbandry but in-come is very low. Animals are raise for domestic consumption as food and some other special occasions like Christmas, New Year's Day and other ceremonies etc.

Table 3-1 Household Income per month

HH Income Per month Kyat/month (MMK)	Dolluang Village	Swond Dot Village	TOTAL
<10000	1	3	4(7.0%)
10001-100000	15	18	33 (57.9%)
100001-300000	5	7	12(21.1%)
300001-500000	1	4	5(8.8%)
500001-700000	-	1	1(1.8%)
No income because dependent person	1	1	2(3.5%)
Average	95,000	130,576	116,345

Exchange rate 1USD=1360MMK

Table 3-2 Agricultural Household Income per month

HH Income Per month Kyat/month (MMK)	Dolluang Village	Swond Dot Village	TOTAL
<10000	6	10	16
10001-100000	13	16	29
100001-300000		3	3
Average	30,895	54,328	45,052

Exchange rate 1USD=1360MMK

About half of households in both villages have non-agricultural in-come like government staff, pastors and home-industry etc. It is presented in Table 3-3. Among off-farm jobs, migrant working is lowest in number.

Table 3-3 Household Income per month by Non-agricultural sector

HH Income Per month Kyat/month (MMK)	Dolluang Village	Swond Dot Village	TOTAL
<10000	-	3	3
10001-100000	5	5	10
100001-300000	6	5	11
300001-500000	-	3	3
Average	127,909	149,375	140,630

Source: Study team

Some female family members are working mostly in crop farming. Few are working as government staff. Animal husbandry and grocery are carried out at home but it is not much in both villages. Average women household income is about 70,000Kyat per month. However average in-come of women in Swond Dot village is high in about 95,000 Kyat/month while in Dolluang is about 57000 Kyat/month. Women income is shown in Table 3-4. Most women spend 4-6 hours in their works. But for government staff like teachers are using some more hours about 7-9 at schools. Some of the women spend very short duration at home especially animal husbandry, home gardening and green tea leave drying process. Spending time for working female household in the study area is different from each other in line with their jobs. It is presented in Source: Study team

Table 3-5.

Table 3-4 Household Income by Women (Kyat per month)

Female Income Kyat/day (MMK)	Dolluang Village	Swond Dot Village	TOTAL
<10000	4	3	7
10001-100000	9	8	17
100001-200000	3	3	6
200001-300000	-	2	2
>300000	-	1	1
Average	57,313	95,882	77,182

Source: Study team

Table 3-5 Spending times for working by female HH members

Female work done hours per day	Dolluang Village	Swond Dot Village	TOTAL
1-3Hrs	-	3	3
4-6 Hrs	12	8	20
7-9 Hrs	3	6	9
> 10 Hrs	1	-	1

Source: Study team

CHAPTER 4
AGRICULTURAL SECTOR

4.1. LAND OWNERSHIP STATUS

Average land ownership in both villages is 3.5 acre per household while in 4 acre per household in Dolluang and 3.3 acre in Swond Dot village. One household owns more than 10 acre in Dollung village. Land ownership status is shown in Table 4-1. It is currently cultivated land acreage. But it is not fixed always because their farm lands are shifting year by year.

Table 4-1 Land ownership status

Land ownership acreage	Dolluang Village	Swond Dot Village	TOTAL
<1 acre	5 (26.3%)	7 (29.2%)	12 (27.9%)
1.01-4.0 acre	9 (47.4%)	9 (37.5%)	18 (41.9%)
4.01-7 acre	2(10.5%)	6 (25.0%)	8 (18.6%)
7.01-10 acre	2 (10.5%)	2 (8.3%)	4 (9.3%)
>10 acre	1 (5.3%)	-	1 (2.3%)
Total owners	19 (82.6%)	24 (70.6%)	43 (100.0%)
Average	3.74	3.33	3.51

Source: Study team

4.2. CROPS

Most villagers cultivated their land in study area of both villages. In terms of location, crop types are not different from each other. In both villages, green tea leaves is a main cash crop. Paddy rice and corn are the staple food for both villages. Other cash crops are also cultivated in study villages.

Both villages have many crops including Wa Oo (White Yam), Petai and other seasonal vegetables. During dry season because of water shortage and soil type, some crops are not suitable in highland agriculture. Corn could be cultivated in every village in high land and low land. Types of crops by households in both villages are shown in Table 4-2.

Table 4-2 Types of crops by Households

Types of crops	Dolluang Village	Swond Dot Village	TOTAL
Tea leaf	16	24	40
Rice	6	5	11
Wa-Oo (White Yam)	1	8	9
Lemon	2	1	3
Petai	1	1	2
Banana	2		2
Corn	-	2	2
Cabbage	-	1	1

Source: Study team

4.3. PRODUCTION AND MECHANIZATION SITUATION

Green tea leave as a main cash crop which average production volume per acre is less than 1 ton/acre in both Dolluang and Swond Dot villages. Out of 47 households in total, 24 households in Swond Dot village and 16 households in Dolluang village have green tea leave plants. It shows that two third of households in each village own green tea leave as major crop. Most households own less than 1 acre but some households have 1-4 acre and few own 4-7 acre and one household has more than 7 acre in Swond Dot village. However villagers do not use all of their farm area for cultivation. Acreage owned by household is shown in Table 4-3 .

Table 4-3 Tea leave planting acre by Household in study area

Acre for Tea Leaf	Dolluang Village	Swond Dot Village	TOTAL
<1.00	8	11	19
1.01-4.00	6	7	13
4.01-7.00	2	5	7
7.01-10.00		1	1
Average	1.88	2.67	2.35

Source: Study team

4.4. MICROFINANCE SITUATION

There is no agricultural loan programme in Dolluang village for their agricultural activities. Availability of some other loans and microfinance assistance are very limited in both survey villages.

Although Swond Dot village received as maximum rate loan 500,000 kyat per acre with 12 months duration and interest rate is 1.0% for agricultural financial assistance from Mya Sein Yaung.

4.5. MARKET ACCESS

Most villagers get market access in Kale city and all products selling there but less villager market access within village for buying things. Market access of both villages is presented in Table4-4.

Table 4-4 Main market access in studied area

Main market	Dolluang Village	Swond Dot Village	TOTAL
Kale	12	26	38
Within village	7	4	11
Within village tract	-	1	1

Source: Study team

4.6. TRANSPORT MEAN FOR MARKET ACCESS

Motorcycles are used as transportation mean not only to bring stuffs but also as transportation for the villagers in both villages. Following the trailer-jeep and truck are used for commodities to bring. But less people use truck. There is no one use animal cart in the villages. Sometimes particularly during rainy season, some villagers walk to Kale for selling and buying stuffs. Transport mean for market access is shown in Table 4-5.

Table 4-5 Transport mean for market access

Transportation mean by main market	Dolluang Village	Swond Dot Village	TOTAL
motorcycle	11	15	26
trailer-jeep	-	8	8
truck	1	2	3
walking	7	6	13

Source: Study team

4.7. TRANSPORTATION ROUTE AND DURATION FOR MARKET ACCESS

4.7.1. Dolluang village

Most villagers use route A, D and E to go Kale for market access. It is called “Nine mile” route till Khai Kam Village of Kale Township. Most villagers use motorcycle to go via “Nine mile” route 160-180 minutes to Kale. Route map of Dolluang village is shown in Figure 4-1Figure 4-2.

Figure 4-1 Transportation route for main market of Dolluang village

4.7.2. Swond Dot village

Similarly in Dolluang village, Swond Dot villagers also use “Nine mile” route, A, B, C and D. Most villagers use motorcycle to go via “Nine mile” route 160-180 minutes like Dolluang villagers. Transportation route and duration for the market show in Table 4-6 and Source: Study team

Table 4-7 and Figure 4-2.

Table 4-6 Transportation route for main market in studied villages

Route for main market	Dolluang Village	Swond Dot Village	TOTAL
A	19	31	50
D	13	26	39
B	-	27	27
C	-	26	26
E (Kale)	13		13

Source: Study team

Table 4-7 Duration for main market access

Time during from main market (Minute	Dolluang Village	Swond Dot Village	TOTAL
30-60 Min	-	1	1
61-90 Min	-	1	1
91-120 Min	-	1	1
151-180 Min	11	21	32
>180 Min	2	2	4

Source: Study team

Figure 4-2 Transportation route for main market of Swond Dot village

CHAPTER 5
EUCATION

5.1. SCHOOLS AND STUDENTS

There are one primary school in Swond Dot village and Sub-high school in Dolluang village. Sub-high school located between Dolluang and Swond Dot village so that high school and middle school students share in the Sub-high school in Dolluang village. Every primary student attends their school within their village and middle and high school students attend in Dolluang Sub-high School which is within village tract. It is presented in Table 5-1.

Table 5-1 School locations and student distribution in study area

Locations of School (Village)	Dolluang Village			Swond Dot Village		
School categories	P	M	H	P	M	H
within village	12	8	7	14	-	-
within village tract	-	-	-	-	14	5
Private school at Township	-	-	1	-	-	3

Source: Study team, P=Primary School, M=Middle School, H=High School

Route for education in both villages is also simple and walking from their villages to school every day. Students from Dolluang village use route A to go Dollung Sub-high School but one high school student attend in private school in Kale. Almost all of Swond Dot village students also attend in Sub-high school within their village and few students access their education in private school of Kale city. Location of school and religious centers are presented in Figure 5-1 for Dolluang and Figure 5-2 for Swond Dot villages respectively.

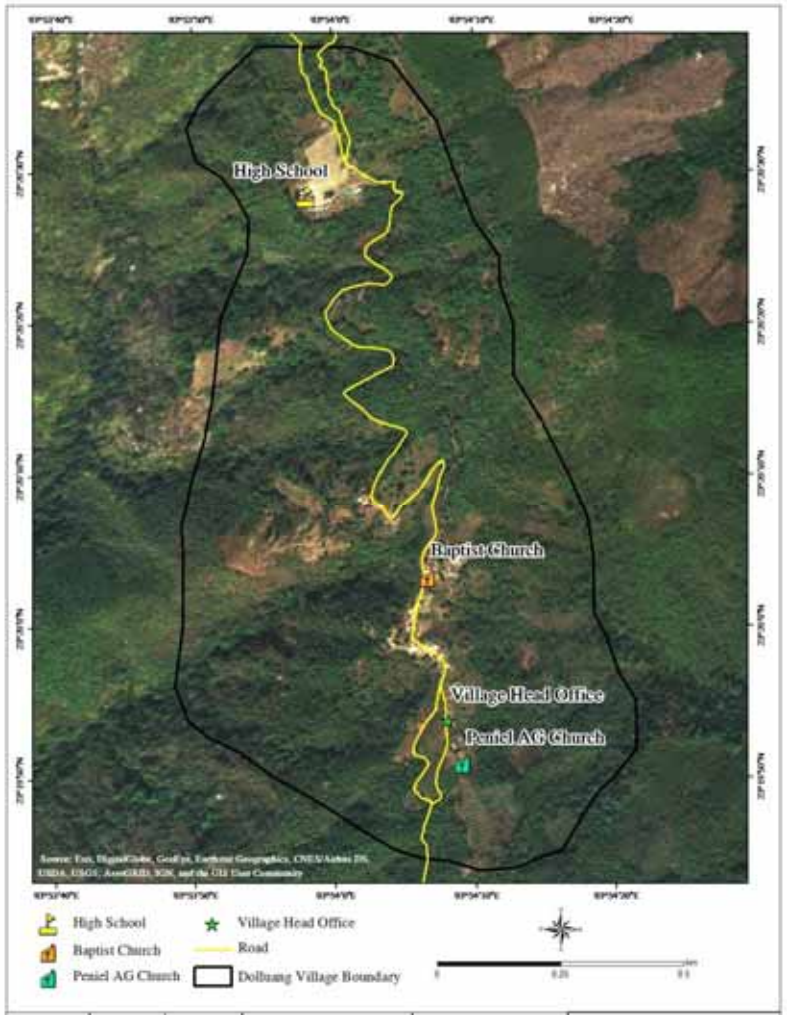


Figure 5-1 Location of Schools and Religious of Dolluang Village

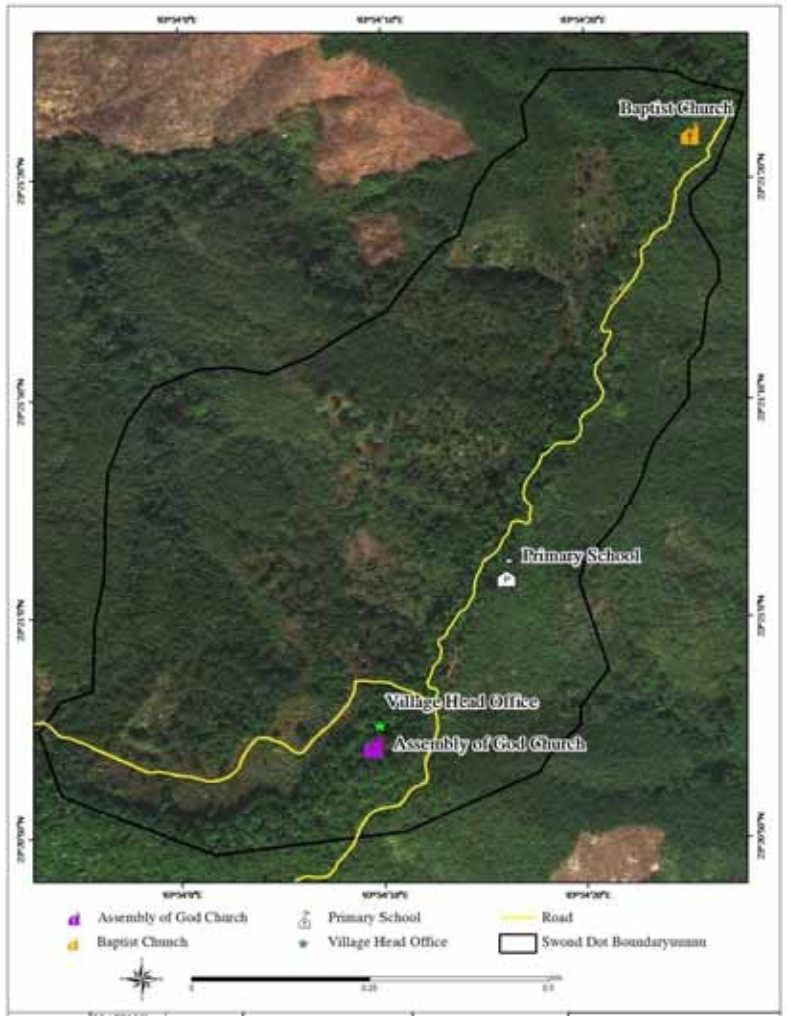


Figure 5-2 Location of Schools and Religious of Swond Dot Village

5.2. TRANSPORTATION MEAN AND DURATION FOR EDUCATION

Students in every village have to go to school by walking every day except the students study in Kale city. Route for their education shows in Table 5-2. If school is located within village, most students spend about 15 minutes by walking mostly in Dolluang village and about 30 minutes for Swond Dot students. It is presented in Table 5-3.

Table 5-2 Route for Education

Route for Education	Dolluang Village	Swond Dot Village
A	28	35
B	-	22
C	-	3
D	1	3
E	1	-

Source: Study team

Table 5-3 Time duration for Education

Time duration for schooling	Dolluang Village			Swond Dot Village		
Minutes	P	M	H	P	M	H
< 15	3	2	3	14	1	-
> 15	9	6	4	-	13	5

Source: Study team

CHAPTER 6
HEALTH

6.1. HEALTH CARE SERVICE

There is a sub-rural health center in Dolluang village which is not far from sub-high school. There is no health care center in Swond Dot village.

Most villagers can access health care within village 20--30 minutes walking distance in Dolluang village. In serious case they have to go other township such as Kale hospital. They have very rare option to go Tedim hospital for health problem.

In Dolluang health care center, one nurse and only mid-wife is available so that most of villagers rely on them for common health problem but if it is serious they go to Kale city. Healthcare service use and commute time was shown in Table 6-1 and Figure 6-1.

Table 6-1 Health care center locations and commute time

Location of hospital or medical center	Dolluang Village		Swond Dot Village	
	No of HH	min	No of HH	min
within village	16	<30	-	<30
within village tract	-	30-90	33	30-90
Kale	7	>90	1	>90

Source: Study team

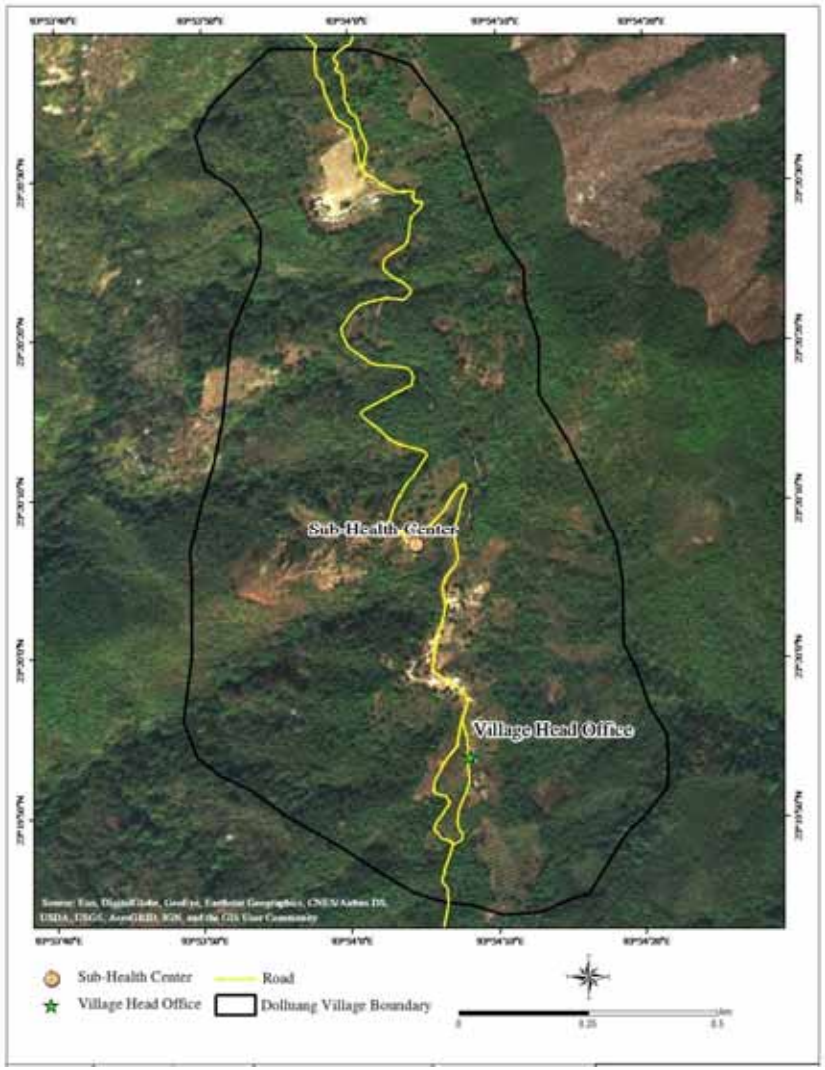


Figure 6-1 Location of Health Center within Dolluang Village

6.2. TRANSPORTATION MEAN AND ROUTE FOR HEALTH CARE SERVICES

Most of villagers in both villages go to solve their health problems by motorcycle and on foot. In serious cases, they have to go other township such as Kale hospital in Sagaing division by car. Some people use bicycle to go to health care centers nearby village. Transportation mean by health care is shown in Table 6-2.

Table 6-2 Transportation mean by hospital or medical center

Transportation mean by hospital or medical center	Dolluang Village	Swond Dot Village	TOTAL
walking	15	20	35
motorcycle	7	14	21
car	1	-	1

Source: Study team

6.2.1. Dolluang village

Dolluang village people mostly go to Dolluang sub-health care center where is nearby the village for their health problem by route A. It means within village and in serious cases to Kale by D, E route.

6.2.2. Swond Dot village

Swond Dot villagers also go to Dolluang sub-health care center where is not far from the village but the problem is absent of nurse and community health assistant. Therefore when the staffs are not in the health center, both villagers have to go Kale to solve their health problems.

Transportation routes for health care in both village tracts are shown in Table 6-3.

Table 6-3 Transportation route for Health care

Route for Clinic or Hospital	Dolluang Village	Swond Dot Village
A	23	34
D	23	34
B	-	34
C	-	34
E	23	-

Source: Study team

CHAPTER 7
INFRASTRUCTURE

7.1. WATER SUPPLY SYSTEM

In both studied villages have water distribution system for every household by United Nation Human Settlements Programme (UN-Habitat). Water supply facility collects spring water from the mountain and distributes water through PVC pipes throughout the village. Villagers get water from the pipe/tap in front of the house. Existing water supply system in Dolluang and Swond Dot villages is seen in

Water supply system provided by UN-HABITAT within Dolluang and Swond Dot Village.

Tap Water/ Piped (House Connection) within Dolluang and Swond Dot Village.

Tap Water/ Piped (House Connection) within Dolluang and Swond Dot Village.

Spring water collect point and storage in Swond Dot Village.

Figure 7-1, Table 7-2 and Figure 7-3. During summer, if the villagers face water shortage by UN-Habitat pipe of house connection, they have to collect some water from stream/spring nearby village area. Other water sources such as rain water and stream water are also collected for domestic use. The study has revealed that on average a household do not waste a lot of time for fetching water except during summer 1-2 months.

Water supply system provided by UN-HABITAT within Dolluang and Swond Dot Village.

Tap Water/ Piped (House Connection) within Dolluang and Swond Dot Village.

Tap Water/ Piped (House Connection) within Dolluang and Swond Dot Village.

Spring water collect point and storage in Swond Dot Village.

Figure 7-1 Existing water supply system in Dolluang and Swond Dot villages

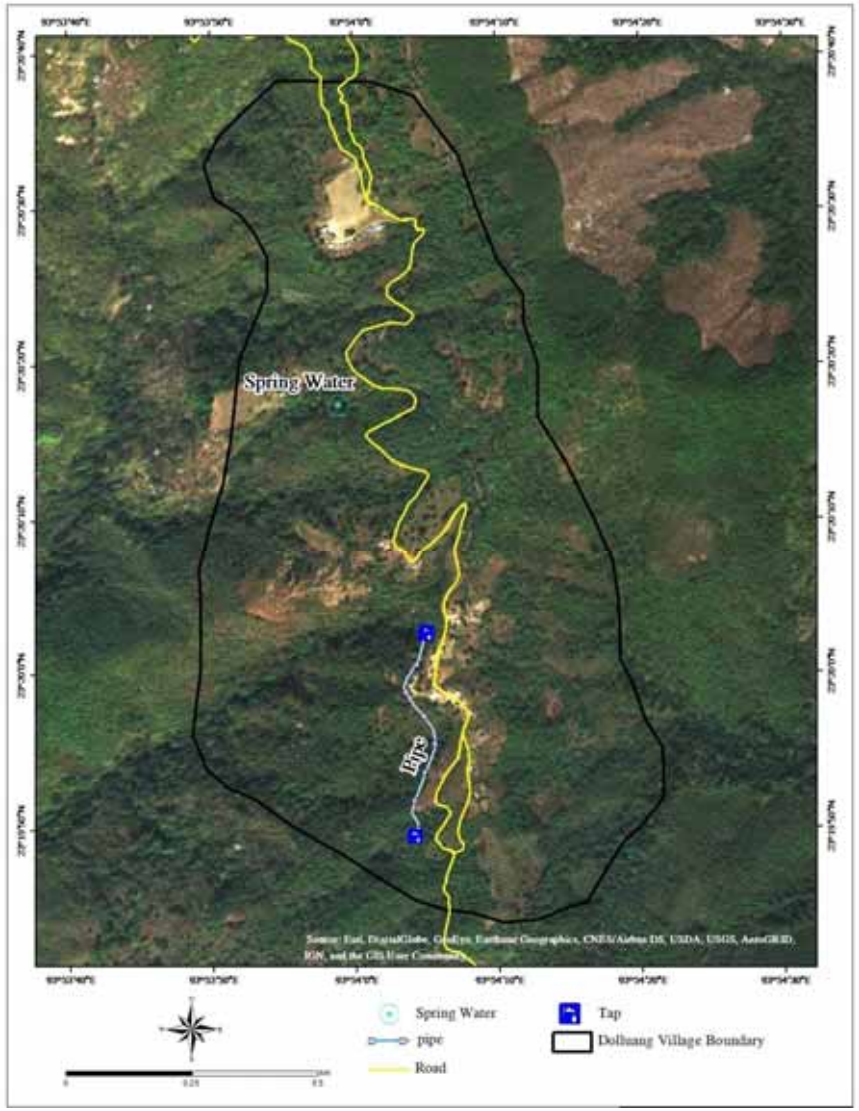


Figure 7-2 Map of existing water supply system in Dolluang village

Figure 7-3 Map of existing water supply system in Swond Dot village

7.2. SOURCE OF ENERGY

Study area in Chin State has not been covered by government electricity grid. Villagers used other energy sources for cooking and lighting. Firewood is used as main source of energy for cooking in almost all households except one household which using LPG in Swond Dot village.

For lighting in study area, every household access by solar energy in both villages. It can be seen in below

Figure 7-4.

Figure 7-4 Use of solar electricity within Dolluang and Swond Dot Villages

CHAPTER 8
MOBILE COVERAGE

Most villagers about 75% could access mobile phone in both villages. But few households have not used mobile phone in the studied area.

APPENDIX A
Meeting Photo

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. January , 2018
Socio-Economic Survey I, Project No.: 102 P-2018

Socio-Economic Survey I Dolluang Village






APPENDIX B
Field Record Photo

Socio-Economic Survey I at Swond Dot Village






Agricultural and Animal Husbandry at Dolluang Village

	
Drying Corn	Drying Corn and Sticky Rice
	
Wa-Oo (White Yam)	Petai
	
Tea leaf farm nearby Dolluang Village	Tea leaf farm nearby Dolluang Village

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. Chin State
Socio-Economic Survey I,
January , 2018
Project No.: 102 P-2018

Agricultural and Animal Husbandry at Dolluang Village

	
House farming within Dolluang Village	House farming within Dolluang Village
	
Small agro-processing industry (Dry tea)	Small agro-processing industry (Dry tea)
	
Animal husbandry within Dolluang Village	Animal husbandry within Dolluang Village

Agricultural and Animal Husbandry at Swond Dot Village

	
Drying maize	Drying maize
	
Wa-Oo (White Yam)	Petai
	
Tea leaf farm nearby Swond Dot Village	Tea leaf farm nearby Swond Dot Village

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. Chin State
Socio-Economic Survey I,
January , 2018
Project No.: 102 P-2018

Agricultural and Animal Husbandry at Swond Dot Village

	
House farming within Swond Dot Village	House farming within Swond Dot Village
	
Small Agro-processing Industry (Dry tea)	Small Agro-processing Industry (Dry tea)
	
Animal Husbandry within Swond Dot Village	Animal Husbandry within Swond Dot Village

Electrification Condition (Dolluang Village)

	
Solar Electricity (Dolluang Village)	Solar Electricity (Dolluang Village)
	
Solar Electricity (Dolluang Village)	Solar Electricity (Dolluang Village)
	
Solar Electricity (Dolluang Village)	Solar Electricity (Dolluang Village)

Electrification Condition (Swond Dot Village)

	
Solar Electricity (Swond Dot Village)	Solar Electricity (Swond Dot Village)
	
Solar Electricity (Swond Dot Village)	Solar Electricity (Swond Dot Village)
	
Solar Electricity (Swond Dot Village)	Solar Electricity (Swond Dot Village)

Existing Land Use Photos within Dolluang Village

	
Village Administration Office	Basic Education Primary School
	
Basic Education Primary School	Basic Education Primary School
	
Basic Education Primary School	Basic Education Primary School

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. Chin State
Socio-Economic Survey I,
January , 2018
Project No.: 102 P-2018

Existing Land Use Photos within Dolluang Village

	
Church	AG Church

Existing Land Use Photos within Swond Dot Village

	
Village Administration Office	Basic Education Primary School

	
Existing condition of School building	Existing condition of School building
	
School building extension under construction	School building extension under construction
	
School building extension under construction	Small dry tea factory

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. Chin State
Socio-Economic Survey I,
January , 2018
Project No.: 102 P-2018

	
Baptist Church	Assembly of God Church

Existing Road Condition within Dolluang Village

	
Access road within Dolluang Village	Access road within Dolluang Village

	
Access road within Dolluang Village	Access road within Dolluang Village
	
Access road within Dolluang Village	Access road within Dolluang Village

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. Chin State
Socio-Economic Survey I,
January , 2018
Project No.: 102 P-2018

Existing Road Condition between Dolluang and Zo Zang Village

	
Access road between Mwalnuam and Zo-Zang	Access road between Mwalnuam and Zo-Zang
	
Access road between Mwalnuam and Zo-Zang	Access road between Mwalnuam and Dolluang

	
Access road between Mwalnuam and Dolluang	Access road between Mwalnuam and Dolluang

Existing Road Condition within Swond Dot Village

	
Access road within Swond Dot Village	Access road within Swond Dot Village

	
Access road within Swond Dot Village	Access road within Swond Dot Village
	
Access road within Swond Dot Village	Access road within Swond Dot Village

Existing Road Condition between Dolluang and Swond Dot Village

	
Access road between Dolluang Village and Swond Dot Village	Access road between Dolluang Village and Swond Dot Village
	
Access road between Dolluang Village and Swond Dot Village	Access road between Dolluang Village and Swond Dot Village

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. Chin State
Socio-Economic Survey I,
January , 2018
Project No.: 102 P-2018

	
Access road between Dolluang Village and Swond Dot Village	Access road between Dolluang Village and Swond Dot Village

Existing Bridges Located on the way to Dolluang and Swond Dot Villages

	
The bridge between Tuisau and Dolluang-Swond Dot constructed by DRD.	

Mwalzum (Kwel) Bridge connected from Khaikam to Nine Mile Road constructed by Ministry of Construction (Bridge Department).

Mwalzum (Kwel) new bridge construction on going progress by Ministry of Construction.

Existing Road Condition between Khai Kam and Kale

Existing road condition between Khai Kam and Kale.

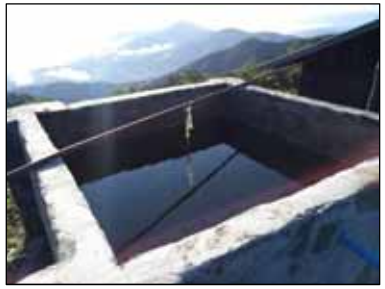
Existing road condition between Khai Kam and Kale.

Underground fiber cable beside the access road.

Water Supply Condition (Dolluang Village)

	
Tap water supply by UN-HABITAT	Water storage
	
Tap Water/House Connection	Tap Water/House Connection
	
Tap Water/House Connection	Tap Water/House Connection

Water Supply Condition (Swond Dot Village)

	
Tap Water/House Connection	Tap Water/House Connection
	
Water storage	Water storage tank
	
Tap water supply by UN-HABITAT	Spring water collect point and storage

TOTAL BUSINESS SOLUTION CO., LTD.
No. 54, Room. 704, Waizayantar Tower, Waizayantar Road
Thingangyun Township, Yangon, Myanmar

SOCIO-ECONOMIC SURVEY II

CHIN STATE

UNDER

PREPARATORY SURVEY ON THE PROJECT FOR RURAL INFRASTRUCTURE DEVELOPMENT IN LOCAL AREAS IN THE REPUBLIC OF THE UNION OF MYANMAR

PROJECT NO.:	102P-2018	DISTRIBUTION:	
DATE:	January, 2018	YACHIYO:	4 COPIES
DOCUMENT NO.:	SS/01/2018	TBS:	1 COPY

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ABBREVIATIONS

AMS	Agricultural Mechanization Service
DRD	Department of Rural Development
GAD	General Administrative Department
HH	Household
MOC	Ministry of Construction
YEC	Yachiyo Engineering Co., Ltd

CHAPTER 1
GENERAL INFORMATION

1.1. POPULATION

Dolluang village tract is selected to study for Tedim Township. In this Township, population is 87623. Dolluang village tract has high population of 4912 in 764 households. In Dolluang village tract, there are (10) villages. Of these villages, Dolluang and Swond Dot villages are studied in December 2017. Population, household and farm household situation in these two villages is shown in Table 1-1.

Table 1-1 Population, Household and Farm Household by village tract

Name of State and Region	**Chin State**	
Name of Township	**Tedim**	
Population	87623	
Name of Village Tract	**Dolluang**	
Population	4912	
Household	764	
Name of Village	**Dolluang village**	**Swond Dot village**
Population	154	168
Household	23	34
No. of Farm HH	19	29

Source: General Administrative Department (GAD)

This study covered for all households according to focus group discussion in village heads and village elders of survey villages.

1.2. WORKING STRUCTURE

In both villages most households have earned on agricultural work. Farmers are occupied with their farms round the year so that there is no farmer who works away from home in both villages. In few families, family members are working as Government staff or in religious activities. Working situation especially in agriculture in both villages is seen in Table 1-2.

Table 1-2 Agricultural work-force in study villages

Composition of farm household	**Dolluang village**	**Swond Dot village**
Full time farmer (HH)	19	29
Farmer with site job (HH)	-	-
Farmer with work away from home (HH)	-	-

CHAPTER 2
AGRICULTURAL PRODUCTION SYSTEM

2.1. CROPS

In both villages rice paddy and green tea leave are main crops in most farm households; some households have cultivated paddy with corn and lemon are mixed cultivation. There are varieties of mixed crops such as rice, corn, coffee, Wa Oo and Petai etc. together with some seasonal plants in most households. Crop production system of both villages has been shown in Table 2-1 and

Drying corn

Green Tea Leave plants

Wa-Oo (White Yam)

Petai Fruits

House farming

Seasonal vegetables

Figure 2-1.

Table 2-1 Agricultural Production system in study area

Agricultural production system	Dolluang village		Swond Dot village	
	Farm HH	Products	Farm HH	Products
No.of farm HH for Monoculture	6	Green Tea	7	Green Tea
No.of farm HH for Monoculture (twice a year)	-	-	-	-
No.of farm HH for Double cropping	-	-	-	-
No.of farm HH for Mixed cropping	13	Paddy/Corn/Lemon/ Green Tea	22	Corn/Paddy/Green Tea/Coffee/Lemon/Wa Oo/Petai
No.of farm HH for Other	-	-	-	-

Source: Survey team

Drying corn

Green Tea Leave plants

Wa-Oo (White Yam)

Petai Fruits

House farming

Seasonal vegetables

Figure 2-1 Major Crops in both villages

2.2. CROPPING CALENDAR

According to respondents and village heads in both villages, rice seedling time is in June and harvesting in November and December. For green tea leave, planting time is in March and April then harvesting time is in February but some peoples harvest twice per year. However green tea Leave growing six to seven years to wait for harvesting. Corn is seedling in May and harvesting in September respectively. Wa Oo (White Yam) is economic product for that study area. It planting time is in March and harvest in February and March after two to three years. Similarly in Lemon, planting in June or July and harvesting in March after four or five years. For Petai also like lemon and green tea, planting in June and July and harvesting in March after six or seven years.

Seasonal cropping calendar is the same in both villages in Dolluang village tract presented in Table 2-2.

Table 2-2 Cropping Calendar in both studied villages

Dolluang and Swond Dot Villages												
Month / Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Green Tea Leave		H	P									
Paddy						S					H	
Corn					S				H			
Seasonal					P				H			
Wa-Oo		H	P									
Lemon			H			P						
Petai		H				P						

S –seedling P – planting H – harvesting

2.3. CROP PRODUCTION

Due to hillside cultivated area in both villages, paddy rice cultivation areas are not much large and productivity is low. Selling price is also not different between in both villages. However the planting area of each plant item is different in two villages particularly in Wa Oo (White Yam) planting area is large about 10 acre in Swond Dot village while about 1 acre in Dolluang village.

Most products of rice and corn are domestic consumption for the village. Sometimes when they need rice, the villagers practice barter system to exchange rice and green tea leave or corn etc. Therefore, rice selling price/acre is not calculated in both villages. It is estimated price by green tea leave exchange rate. Wa Oo (White Yam) is suitable and demanding crop item for the study area but it is invested for two to three years to get market price.

Cultivated land area, crop production rate and profit per acre showing in Table 2-3.

Table 2-3 Farm land area, average productivity and profit by crops

Crop type	Dolluang village				Swond Dot village			
	Farm Area (Acre)	Average productivity (Ton/Acre)	Selling Price/ acre	Profit (kyat/ acre	Farm Area (Acre)	Average productivity (Ton/Acre)	Selling Price/ acre	Profit (kyat/ acre)
Paddy	10	0.82 ton	200,000	-	12	0.82 ton	200,000	-
Corn	3	0.49 ton	140,000	-	3	0.49 ton	140,000	-
Wa-Oo (White Yam)	1	0.50 ton	1,200,000	300,000	10	0.50 ton	1,200,000	300,000
Green Tea Leave	30	0.06 ton	21,000	10,000	58	0.06 ton	21,000	10,000
Lemon	2	0.31ton	240,000	50,000	1	0.31ton	240,000	50,000
Petai	1	0.12ton			1	0.12ton		

Source: Survey team

CHAPTER 3
ECONOMIC SITUATION

3.1. MARKET ACCESS

Agricultural products, mainly Green Tea leave from these villages are marketed outside village tract like Kale in Sagaing region. But sending market to Kale is about 70% from Dolluang village and 60 % from Swond Dot village respectively. Another main cash crop, Wa Oo (White Yam) is also 100% marketed to Kale from both villages. Petai, potential main market demand is sending to sell in Kale by 100% from both villages but currently it is few plants and still small amount. Concentrated lemon juice is marketed at Kale from both survey villages, although it is not big amount. Situation of agricultural products market access is shown in Table 3-1.

Table 3-1 Agricultural Products market access

Agricultural market	Dolluang village	Swond Dot village
Agricultural product item- 1	**Paddy**	**Paddy**
Broker at village or nearby village	-	-
Broker at village or nearby village %	-	-
Market Location	-	-
Market%	-	-
Agricultural product item- 2	**Green Tea Leave**	**Green Tea Leave**
Broker at village or nearby village	within village	within village
Broker at village or nearby village %	30%	40%
Market Location	Kale	Kale
Market%	70%	60%
Agricultural product item- 3	**Wa-Oo (White Yam)**	**Wa-Oo (White Yam)**
Broker at village or nearby village _Location	-	-
Broker at village or nearby village %	-	-
Market Location	Kale	Kale
Market%	100%	100%
Agricultural product item- 4	**Petai**	**Petai**
Broker at village or nearby village _Location	-	-
Broker at village or nearby village %	-	-
Market Location	Kale	Kale
Market%	100%	100%
Agricultural product item- 5	**Lemon**	**Lemon**
Broker at village or nearby village _Location	-	-
Broker at village or nearby village %	-	-
Market Location	Kale	Kale
Market%	100%	100%

3.2. TRANSPORT MEANS TO MARKET

Most green tea leave, Wa Oo (White Yam) and Petai are transported by motorcycle but sometimes some villagers carry by walking themselves to Kale. Detail transportation means of agricultural products in both villages are seen in Table 3-2.

Table 3-2 Transport mean for agricultural products in survey area

Transport means to market	Dolluang village	Swond Dot village
Agricultural product item- 1	**Green Tea Leave**	**Green Tea Leave**
motorcycle	70%	60%
walking	30%	40%
Agricultural product item- 2	**Wa-Oo (White Yam)**	**Wa-Oo (White Yam)**
motorcycle	100%	100%
walking	-	-
Agricultural product item- 3	**Petai**	**Petai**
motorcycle	100%	100%
walking	-	-
Agricultural product item- 4	**Lemon**	**Lemon**
motorcycle	100%	100%
walking	-	-

3.3. ACCESS TO FINANCING

Although Swond Dot village received as maximum rate loan 500,000 kyat per acre with 12 months duration and interest rate is 1.0% for agricultural financial assistance from Mya Sein Yaung. There is no agricultural loan programme in Dolluang village for their agricultural activities. Availability of some other loans and microfinance assistance are very limited in both survey villages.

3.4. ACCESS TO AGRICULTURAL MECHANIZATION SERVICE

There is no Agricultural Extension Service (AES) in both villages since hillside location of the villages where farm land condition is very difficult for reclamation on hilltop of Swond Dot and on the slope of Dolluang village. In addition, there is no irrigation supply for their agricultural land particularly in Swond Dot village. In terms of village location on hillside, it is impossible to use agricultural mechanization system in both villages. Situation and possibility of Agricultural extension, mechanization and financial provision are shown in Table 3-3.

Table 3-3 Possibility of Agricultural improvement situation in study area

Land condition improvement or mechanization	Dolluang village	Swond Dot village
Reclamation	**No**	**No**
(Please provide detailed information	Existing farm land condition is very bad to do reclamation	Existing farm land condition is very bad to do reclamation
Provision of irrigation system	**Yes**	**Yes**
(Please detailed information	Irrigation supply for hillside needed	Irrigation supply for hillside needed
Access road improvement	**Yes**	**Yes**
(Please detailed information	Existing access roads are not wide enough to pass cars and heavy machine	Existing access roads are not used in rainy season
Agricultural mechanization	**No**	**No**
(Please detailed information	There is no AMS and AES at present.	There is no AMS and AES at present.
Expansion of farm workers	**No**	**No**
(Please detailed information	-	-
Financing	**Yes**	**Yes**
(Please detailed information	There is no funding source for upland	There are no other funding sources except from Mya Sein Yaung

CHAPTER 4
POSSIBILITY OF INCOMES INCREASE

Based on group discussion with village heads and villagers, there are possibility of income increase options for both villages. All of them expected to increase on their agricultural related options such as diversification of agriculture, technological trainings for highland crops, systematic terrain agricultural system and improvement of distributive for market etc. Both villages have lack of agricultural related business. Both villages especially in Swond Dot village do not have a lot of cultivable soil on the mountain but it has a lot of free land. Moreover, mechanization and good seed acquisition cannot produce increase productivity along with the other reasons illustrated below.

4.1. AGRICULTURAL LAND EXPANSION

Since Sownd Dot village is located on top of the mountain and Dolluang village also on the hillside, it is difficult to reach agricultural machines to these target villages. It can increase its productivity if there is technology for step irrigation, terrain agricultural system and other suitable cash crops rather than corn and green tea leave plantation.

. The villagers do not apply fertilizer on their farms and they prefer organic farm in their area. Thus, the villagers prefer to cultivate potential productive cash crops like Petai and Wa Oo (White yam) which can have high market demanding crops. Moreover, Wa Oo (White Yam) can be accommodated more than 2000 per acre as underground plant so that on the ground some coffee trees can be planted. Coffee trees also like shady places and cold weather so some Petai trees plant mix together with coffee in the same farm land. On the other hand, it can be squeezed planting area of the mountain for crop plantation if the old farmland is no longer good for crop plantation.

4.2. FINANCIAL ASSISTANCE

There is no loan scheme in Dolluang village for their Agricultural activities. Availability of some other loans and microfinance assistance are very limited in both villages.

Swond Dot village received as maximum rate loan 1,000,000 kyat for the whole village so different loan assistant in line with their different possession in agricultural farm land area, cows, pig and chicken etc. from 300,000-500,000 Kyat/HH. Interest rate is 1.0% with 12 months duration for agriculture financial assistance from Mya Sein Yaung loan program.

4.3. PRODUCTIVITY EXPANSION AND DISTRIBUTIVE SYSTEM IMPROVEMENT

Dolluang village has less cultivable soil condition, small production volume and lack of financing available, it is not possible to further develop agricultural related businesses.

Similarly in Swond Dot village, most households have small production volume and keep for their domestic use particularly paddy rice and green tea leave, it is not possible to further develop agricultural related business.

But both villages have keen interest to improve their agricultural system and productivity by systematic trainings and suitable cash crops for their area. They cannot imagine their productivity with mechanization improvement, financial assistant and some other factors since they have lack of experience. Therefore, they expect that if they have possible irrigation system for their farm lands, improvement of road condition to the main market, Kale, productivity will be increased double as 200%.

It is possible to further develop agricultural related businesses such as Green Tea Leave processing technology and have a keen interest to develop coffee and green tea processing factories in their village tract. In addition, there is no Agricultural training and providing excellent seeds, they have to keep from their own farm for next season. It is also difficult to calculate and improve for their farm land.

Not only to keep for their domestic consumption but also bad access road condition in their villages, it is difficult to improve their products distribution system. Situation and estimation of agricultural expansion improvement is shown in Table 4-1.

Table 4-1 Productivity Expansion and Distributive System Improvement in studied villages

Agricultural expansion improvement in terms of production volume	Dolluang village		Swond Dot village	
	Cost per acre for major crop	Expected production increase (%)	Cost per acre for major crop	Expected production increase (%)
Agricultural mechanization	Agricultural machines are not used.	-	Agricultural machines are not used.	-
Provision of irrigation system	There is no irrigation system currently used.	200%	There is no irrigation system currently used.	200%
Road improvement to farm land and market	It will vary depends on the distance	200%	It will vary depends on the distance	200%
Excellent seed acquisition	30000-100,000(depends on the type of crop)	50%-100%	30000-100,000(depends on the type of crop)	50%-100%
Excellent fertilizer acquisition	Not using fertilizer.	-	Not using fertilizer.	-
Irrigation Supply	Too difficult to calculate.	200%	Too difficult to calculate.	200%
Training (knowledge and agricultural technics)	100,000	30%	100,000	30%

CHAPTER 5
INFRASTRUCTURE

5.1. ROADS

5.1.1. Dolluang village

Earth roads within Dolluang village are in good condition and access road to Thangsan village is also moderate condition. Everybody uses the access road called “Nine mile road” from the Dolluang village to Khai Kam Village of Kale Township. It is the shortest way (Route A, D of Figure 5-1) to connect Kale which is moderate condition during dry season, walking hours as about ten hours to Khai Kam village. Some section of the road is not suitable to pass by car about four miles. According to the villagers, the rest section of five miles can pass by car in both rainy and dry seasons. Another access road from Dolluang to Mualnuan village is bad condition with stones and gravels (Route A, B) which is impossible by pass even with motorcycle. On the other hand, it can be used by walking for two hours. Road condition from Mualnuan to Zo Zang village is good by car (Route B)

during dry season as seen in below

Figure 5-1.

Figure 5-1 Map of existing road situation around Dollung village (including route)

Access road between Mwalnuam and Zozang

Access road between Mwalnuam and Dolluang

Bridge between Tuisau and Dolluang-Swond Dot Junction

Mwalzam (Kwel) Bridge connected from Khai Kam to Nine mile road.

Mwalzam (Kwel) new bridge construction

Access road between Dolluang and Swond Dot

Figure 5-2 Existing road condition around Dollung village

5.1.2. **Swond Dot village**

Villagers from Swond Dot also use “Nine mile road” through the Dolluang village to Khai Kam village, Kale Township. It is the shortest way (A, B, C of Figure 5-3) to connect Kale which is moderate condition during dry season. If walking during rainy season, it takes about twelve hours to reach Khai Kam. Another access road from Swond Dot village to Nine mile road which passing through Tuivial, Vando and Pimpih villages (A,G,C) by motorcycle but it is a little bit longer than passing Dolluang and Thangsan villages.

The roads are narrow from the junction of Dolluang and Swond Dot village to Tuisau village (Route G) as seen in the Figure 5-4. It is impossible to pass by car. The time it takes for villagers to by motorcycle is mostly two hours. Road from the Tuisau village to the junction near Mount Kanadi is moderate condition to pass by car but still narrow for one lane. It is connected to Kale-Tedim Highway road just base of the Mount Kanadi. When Swond Dot villagers go to Zo Zang, they use the same route from Dolluang village (Route A, B, E of below Figure 5-3).

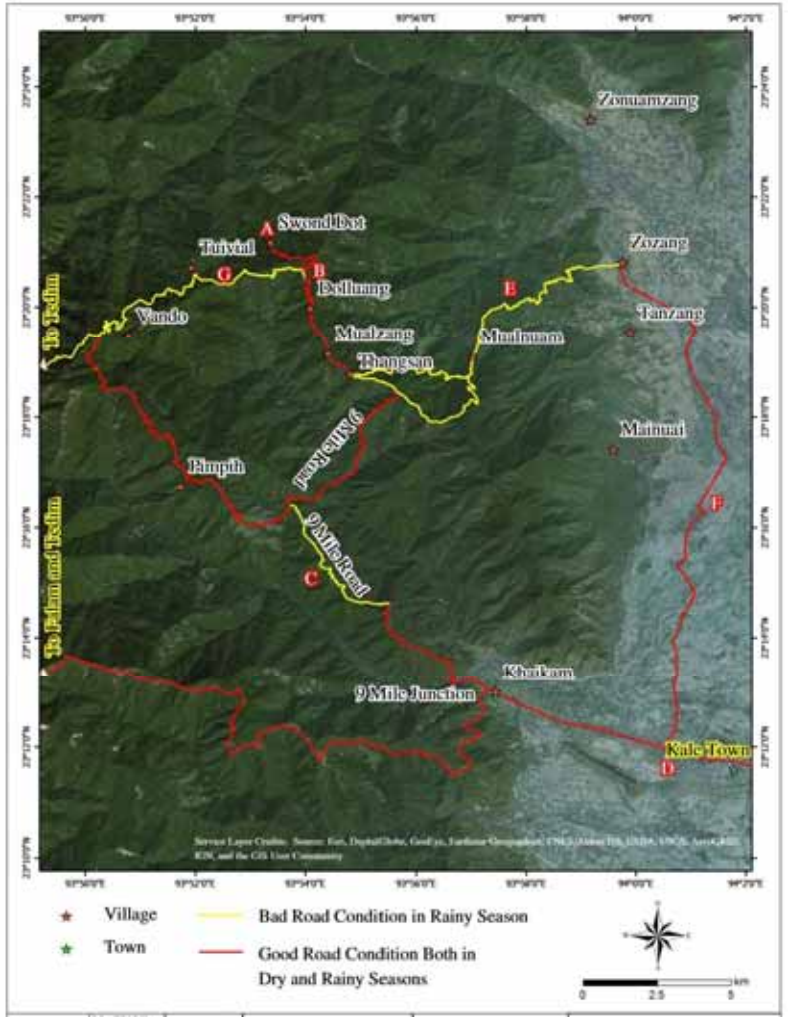

Figure 5-3 Map of existing road situation around Swond Dot village (including rout)

	
Access road within Swond Dot Village	Access road between Dolluang Village and Swond Dot Village
	
Access road between Dolluang Village and Swond Dot Village	Access road between Dolluang Village and Swond Dot Village
	
Access road between Tuisau and Swond Dot	Access road between Tuisau and Swond Dot

Figure 5-4 Existing road condition around Swond Dot village

5.2. SCHOOLS AND HOSPITALS

Students in both villages access to high school and middle school education in Dolluang village Sub-high School which is located in between both villages. Swond Dot village has only primary school. Most children go to school by walking.

Village health care center is also in Dolluang village not far from the Sub-High School. Therefore, it is more convenient for Dolluang villagers to access health care services. But sometimes, absence of Nurse and Community Health Assistant, both villagers face difficulties in health problems. School and health care services location are presented in

Table 5-1, Figure 5-5,

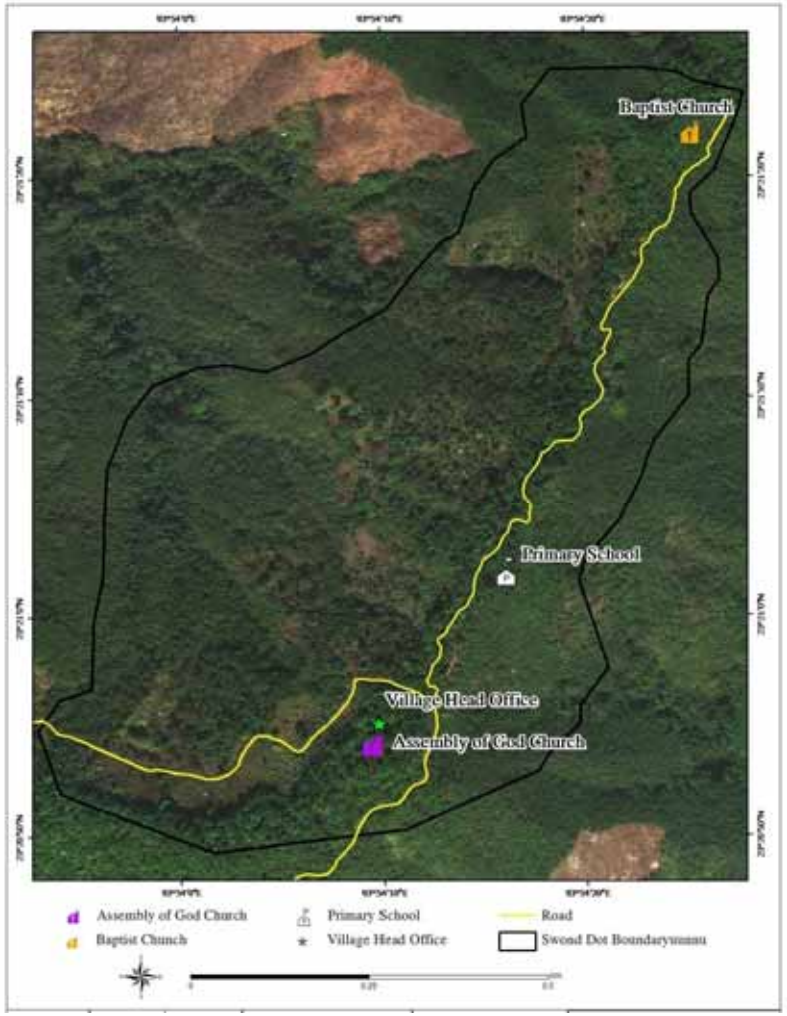

Figure 5-6 and Figure 5-7.

Table 5-1 Location of school and student distribution in study area

Education	Dolluang village		Swond Doh village		
	Middle School	High School	Middle School	High School	Primary School
Place	Within Village	Within Village	Dolluang Sub-High School	Dolluang Sub-High School	Within Village
Distance	30 minutes walking	30 minutes walking	30 minutes walking	30 minutes walking	15 minutes walking
No. of schools	1 No	1 No	-	-	1 No

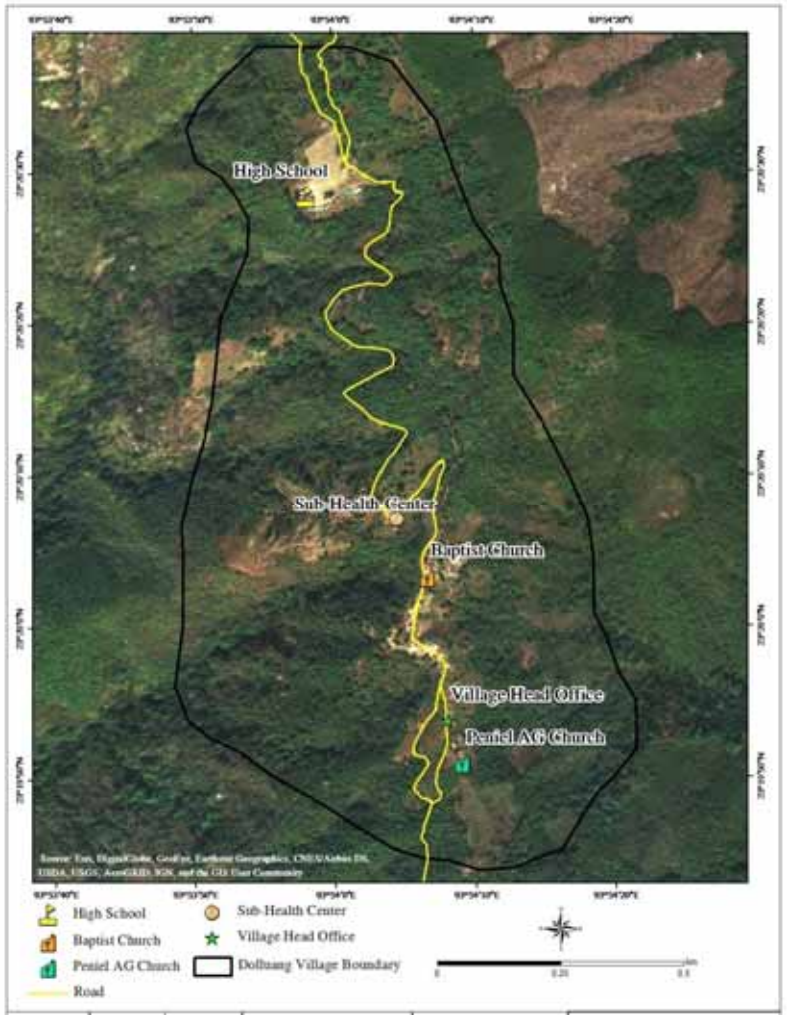

Figure 5-5 Location Map of School, Health Center and Religious facilities within Dolluang Village

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January, 2018
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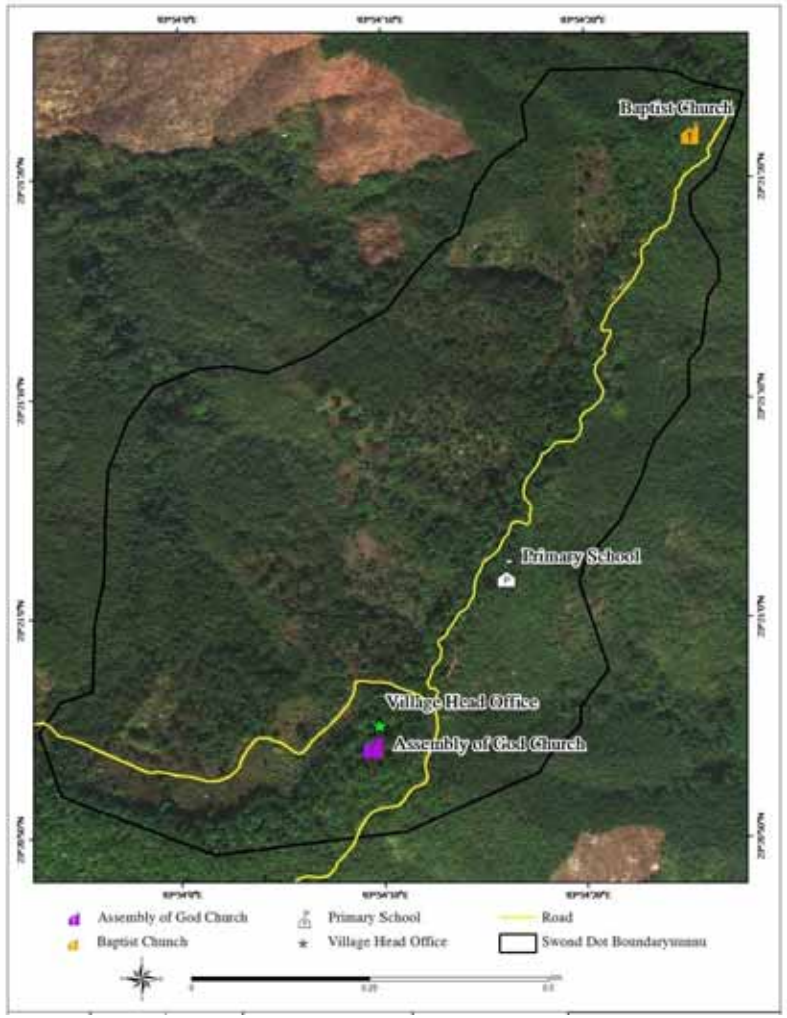

Figure 5-6 Location Map of School and Religious facilities within Swond Dot Village

Basic Education High School (Dolluang)

Basic Education High School (Dolluang)

Sub-Health care center (Dolluang)

Basic Education Primary School (Swond Dot)

Figure 5-7 School, Health Center and Religious facilities in Dolluang and Swond Dot village

5.3. WATER SUPPLY

UN-Habitat has supplied with domestic water distribution facility in both villages. It collects spring water from the mountain during summer about 15 minutes walking distance from Swond Dot village when it is not enough water by UN-Habitat.

Tap Water (House connection)

Tap Water (House connection)

Spring water collect point (Swond Dot)

Spring water collect point (Swond Dot)

Figure 5-8 Water supply facilities in Dolluang and Swond Dot village

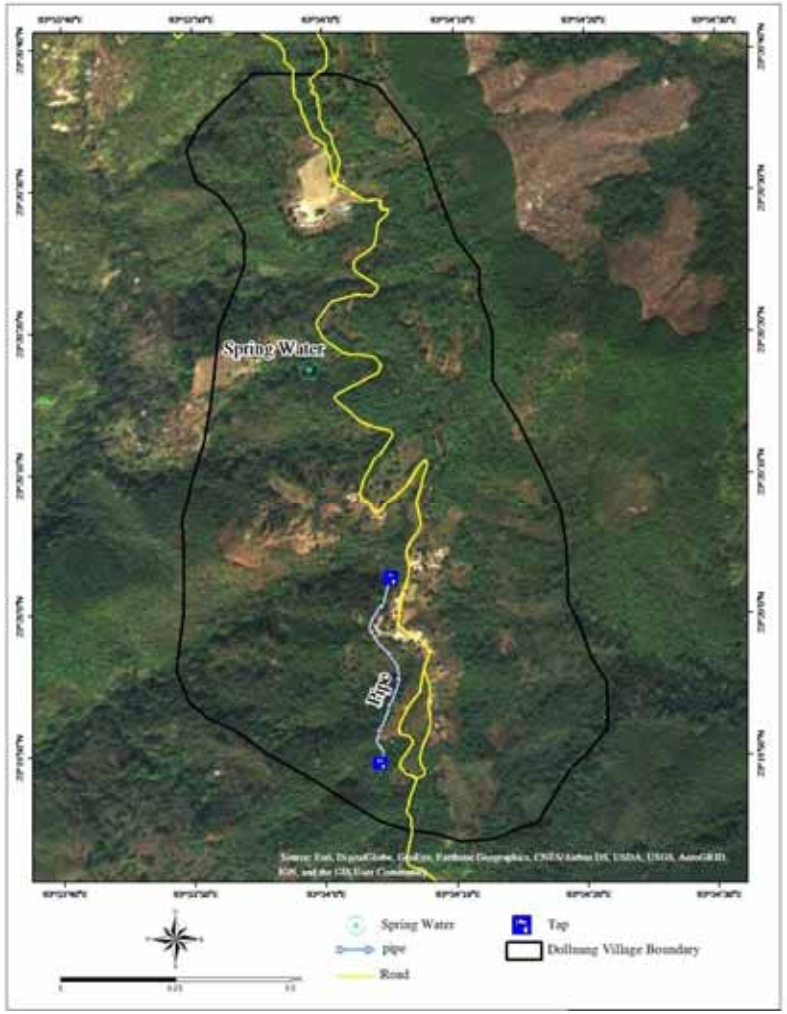

Figure 5-9 Map of water supply facility within Dolluang Village

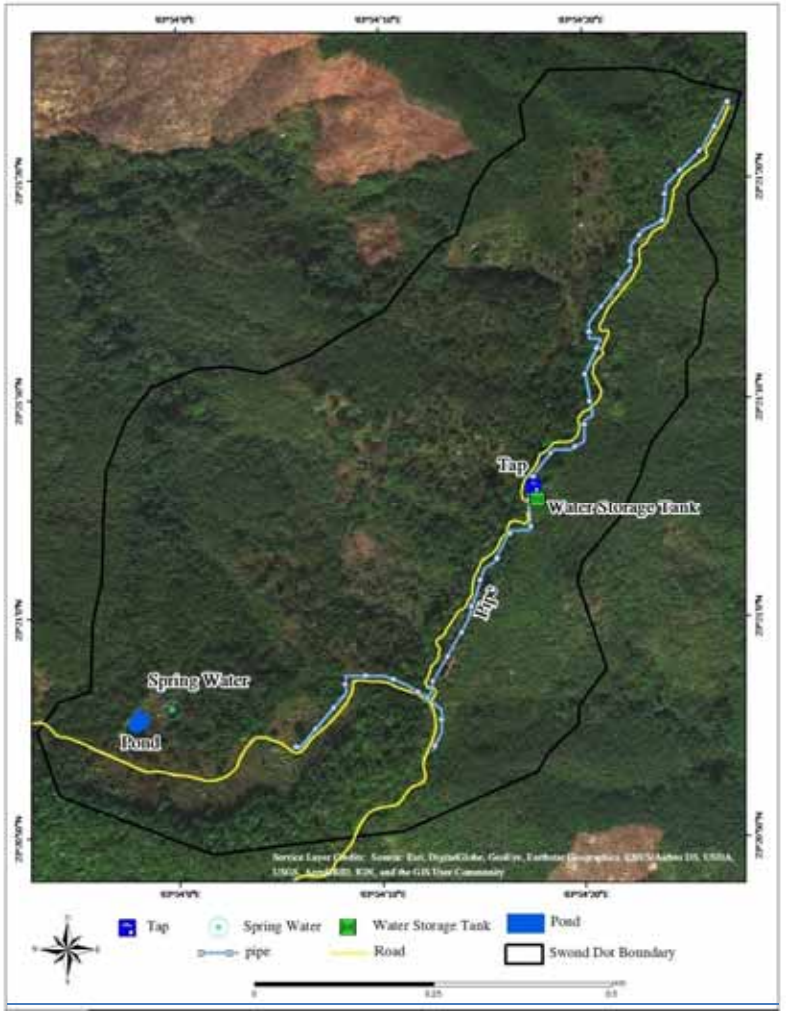

Figure 5-10 Map of water supply facility within Swond Dot Village

CHAPTER 6
PRIORITY OF INFRASTRUCTURE

6.1. MAIN ISSUES

Ministry of Construction (MoC) in Tedim Township does not own any heavy construction machines. During the time of need, the ministry needs to get approval from other Ministries of Roads and Bridges Department to get construction machines. In this regards, Ministry of Construction (MoC) Tedim Township office has one Roller, two tipper lorry and two trailor jeep.

Due to rain and erosion, the soils from the farmland are damaged. Some farmlands are completely destroyed by landslides. It can destroy village, farm lands and road in their area. Some sections of the road situation are narrow and impassable with full of mud during dry season as seen in below

Access road between Mwalnuam and Zozang	Access road between Mwalnuam and Zozang
Access road between Mwalnuam and Dolluang	Access road between Mwalnuam and Dolluang

Figure 6-1.

Access road between Mwalnuam and Zozang

Access road between Mwalnuam and Zozang

Access road between Mwalnuam and Dolluang

Access road between Mwalnuam and Dolluang

Figure 6-1 Access road impassable during rainy season

Major landslide is also a main issue in the surveyed area of Dollaung and Swond Dot villages. The public roads within villages are narrow due to the location of the village on the top of mountain of Swond Dot village and slope of Dolluang village damaged during heavy rain.

Heavy monsoon rain caused of landslides, destroying some homes especially in Swond Dot village, roads, and farmlands in 2015. Transportation is all but impossible by land, while roads linking districts within the state have also become mostly useless after severe damage. The surveyed villages also experienced difficulties obtaining goods in the main cities during the time due to bad road conditions. Although it has been two years since the disaster, the effect of the disaster is a reminder why infrastructure investment is badly needed in the area.

6.2. PRIORITY OF INFRASTRUCTURE DEMAND

Due to their main issue, both villages demand in priority is Agricultural Improvement as first priority. Second priority is road and bridge in terms of their bad situation and location the access road between Kale city and their villages. As third

priority for Dolluang village is Agricultural machines for their farms land while Health care service and Agricultural machine are third and fourth priority of the Swond Dot village respectively. Most of villagers need inter-cultivators to clean weeds on their farmlands during rainy season. Due to limited labours and mass of weeds, they have to shift their cultivation every year and use burning system.

6.3. ADDITIONAL QUESTIONS

In both surveyed villages, there is no one use fertilizer in their farms so their products can say as organic products. During seedling, planting and harvesting times, almost all cultivators work on their own farms. Mostly they help each other as cooperative work for their farms near or far away from the village.

If someone needs to hire as labour, it cost about 5000Kyat/day as labour charge. But it is difficult to hire in their area.

Among their products in both villages, green tea leave selling rate to the broker during a year is 3,000-3,500Kyat/viss so that profit is 500Kyat/viss in both Dolluang and Swdond Dot villages. It is also very few households who cannot go to Kale market and less amount about 0.05ton in the Swond Dot village. Average profit rate is about 1000Kyat/viss for Wa Oo (white Yam) in both villages.

On the other hand, Dolluang villagers go to Kale market directly for selling their products especially for Wa Oo and green tea. Whenever they got dried Wa Oo and need to buy some stuffs for their domestic use, they go to sell green tea leave and Wa Oo to Kale about ten times per year. For concentrated lemon juice and Petai selling is seldom like twice per year as few products. Profit for lemon juice is 500Kyat/1 liter and 1000 Kyat/viss for Petai. Selling time and profit of the products are shown in Table 6-1 and Table 6-2.

Table 6-1 Frequency to go Kale for selling products

Product item	Selling times to Kale (During a year)	
	Dolluang Village	Swond Dot Village
Paddy	-	-
Corn	-	-
Wa – Oo (White Yam)	10	2
Green Tea Plant	10	2
Lemon	2	2
Petai	2	2

Table 6-2 Profit of product items in Kale

Product item	Profit	
	Dolluang Village (MMK/viss)	Swond Dot Village (MMK/viss)
Paddy	-	-
Corn	-	-
Wa – Oo (White Yam)	1,000 Kyat	1,000 Kyat
Green Tea Plant	1,500 Kyat	1,500 Kyat
Lemon	500 Kyat/1 Liter	500 Kyat/1 Liter
Petai	500/viss Kyat	500/viss Kyat

During a year in both villages, their products selling to Kale are Wa Oo (white Yam), green tea leave, concentrated lemon juice and Petai. Different items of selling amount in terms of villages as seen in Table 6-3. At the same time, while the villager selling their products they buy for domestic use items and agricultural products for their farms. Selling price in Kale market is a little bit higher than selling to broker within village. It is presented in Table 6-4.

Table 6-3 Selling amount of products to Kale

Product item	Selling amount to Kale (During a year)	
	Dolluang Village	Swond Dot Village
Paddy	-	-
Corn	-	-
Wa – Oo (White Yam)	0.5 ton	2 ton
Green Tea Plant	1 ton	1.5 tonnes
Lemon	0.62 ton	0.31 ton
Petai	0.12 ton	0.12 ton

Table 6-4 Selling price in Kale during a year

Product item	Selling price in Kale during a year	
	Dolluang Village (MMK/ viss)	Swond Dot Village
Paddy	-	-
Corn	-	-
Wa – Oo (White Yam)	5,000/viss	5,000
Green Tea Plant	4,000- 4,500 Kyat/viss	4,000- 4,500 Kyat/viss
Lemon (1 liter)	4,000	4,000
Petai	1,500	1,500

CHAPTER 7
RECOMMENDATION

The surveyed areas in Dollaung and Swond Dot villages have painted a clear picture of socio-economic situation. The low productivity of farms is a concern for livelihood of full-time farmers. Many factors contribute to productivity of farmers. Accessibility to health facility, along with better financing programs, needs to improve. Some villagers cannot afford to go to hospitals because of bad road condition not only to go to Kale city but also Tedim where is far away from the villages.

There is no financial assistance scheme in Dolluang village for their Agricultural activities. In addition, there is no insurance program to protect the farms when the natural disaster destroys their farmland. Improvement in roads and bridges is needed in both Dolluang and Swond Dot villages for their agricultural products, health and education sectors. Landslide and transportation difficulties can contribute to low productivity due to no irrigation for their farms, inaccessibility to mechanization services and inability to expand crop items. Both villages have keen interest to improve their agricultural system and productivity by systematic trainings and suitable cash crops for their area.

In conclusion, infrastructure, education and agricultural technology investments are needed for long-term improvement in productivity. The agricultural related businesses along with other industries and small businesses could flourish if we invest in those sectors effectively.

Socio-Economic Survey Under "Preparatory Survey On The Project For Rural Infrastructure Development In Local Areas In The Republic Of The Union Of Myanmar"

Socio-Economic Survey II

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個人情報

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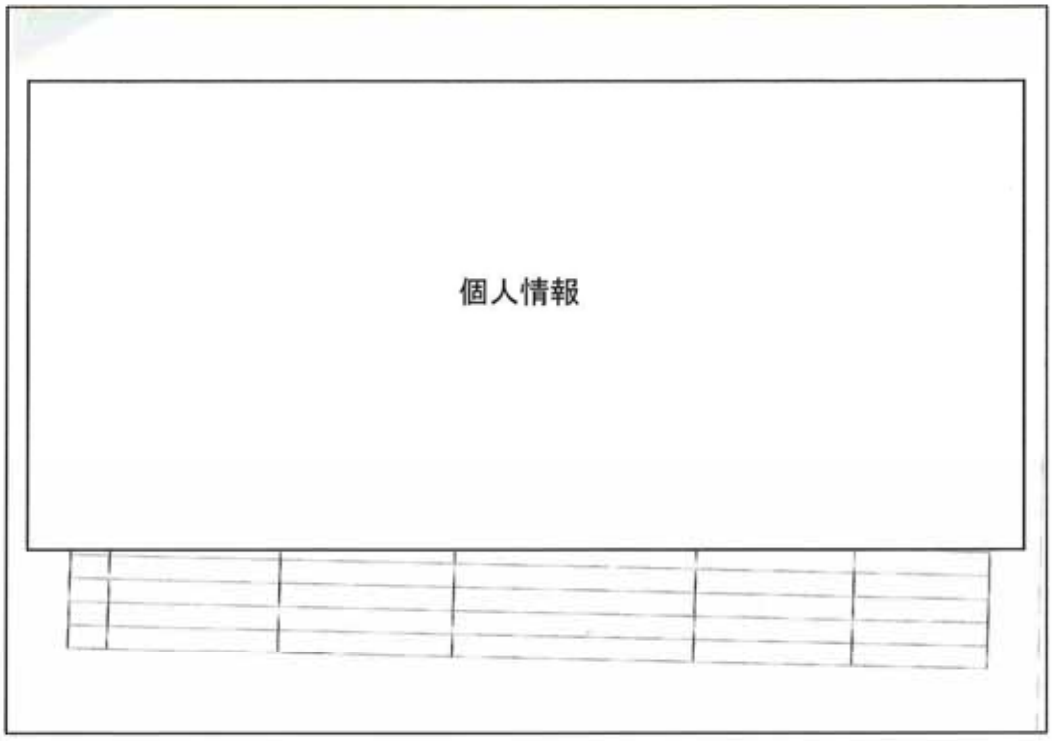
Socio-Economic Survey II,

January, 2018
Project No.: 102P-2018

APPENDIX A
Participant List



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Socio-Economic Survey II,
January, 2018
Project No.: 102P-2018

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APPENDIX B
Group Meeting Photo

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Socio-Economic Survey II,
January, 2018
Project No.: 102P-2018

Socio-Economic Survey II (Group Discussion) at Dolluang Village






Socio-Economic Survey II (Group Discussion) at Swond Dot Village






７－５　社会経済調査結果（エーヤワディー地域）

TOTAL BUSINESS SOLUTION CO., LTD.
No. 54, Room. 704, Waizayantar Tower, Waizayantar Road
Thingangyun Township, Yangon, Myanmar

SOCIO-ECONOMIC SURVEY I

AYEYARWADDY DIVISION

UNDER

PREPARATORY SURVEY ON THE PROJECT FOR RURAL INFRASTRUCTURE DEVELOPMENT IN LOCAL AREAS IN THE REPUBLIC OF THE UNION OF MYANMAR

PROJECT NO.:	094p-2017	DISTRIBUTION:	
DATE:	October 9, 2017	Socio Survey I:	4 COPIES
DOCUMENT NO.:	SS/02/2017	TBS:	1 COPY

A7-5-1

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ABBREVIATIONS

DRD	Department of Rural Development
GAD	Government Administration Department
LPG	Liquefy Petroleum Gas
MADB	Myanmar Agricultural Development Bank
MMK	Myanmar Kyat

YACHIYO ENGINEERING CO., LTD., AND NIPPON KOEI CO., LTD. October 9, 2017
SOCIO-ECONOMIC SURVEY I, AYEYARWADDY DIVISION, Project No.: 094p-2017

CHAPTER 1
SCOPE OF SURVEY

1.1. STUDY AREA

The Socio-economic study is focused on establishing baseline information on socio-economic components of communities within the study area. The information is collected from primary sources. The Socio-economic survey (I) has been done based on the household level of the living condition as a baseline data of four village tracts, Sit Sali Htone village tract from Mawlamyine Kyun township and Tha Kan Wa village tract, Sa Bal Kone village tract and Hpa Yar Thone Su village tracts from Bogalae township are selected survey area of this study It is presented in Table 1-1 and Figure 1-1.

Table 1-1 Name of survey villages in Ayeyarwaddy Region by township and village tract

Name of State and Region	Name of Township	Name of Village Tract	Name of Village
Ayeyarwaddy Region	Mawlamyine Kyun	1. Sit Sali Htone	1.Sit Sali Htone
	Bogalae	2. Tha Kan Wa	2.Tae Pin 1
		3.Sa Bal Kone	3.Sa Bal Kone
		4. Hpa Yar Thone Su	4.Hpa Yar Thone Su

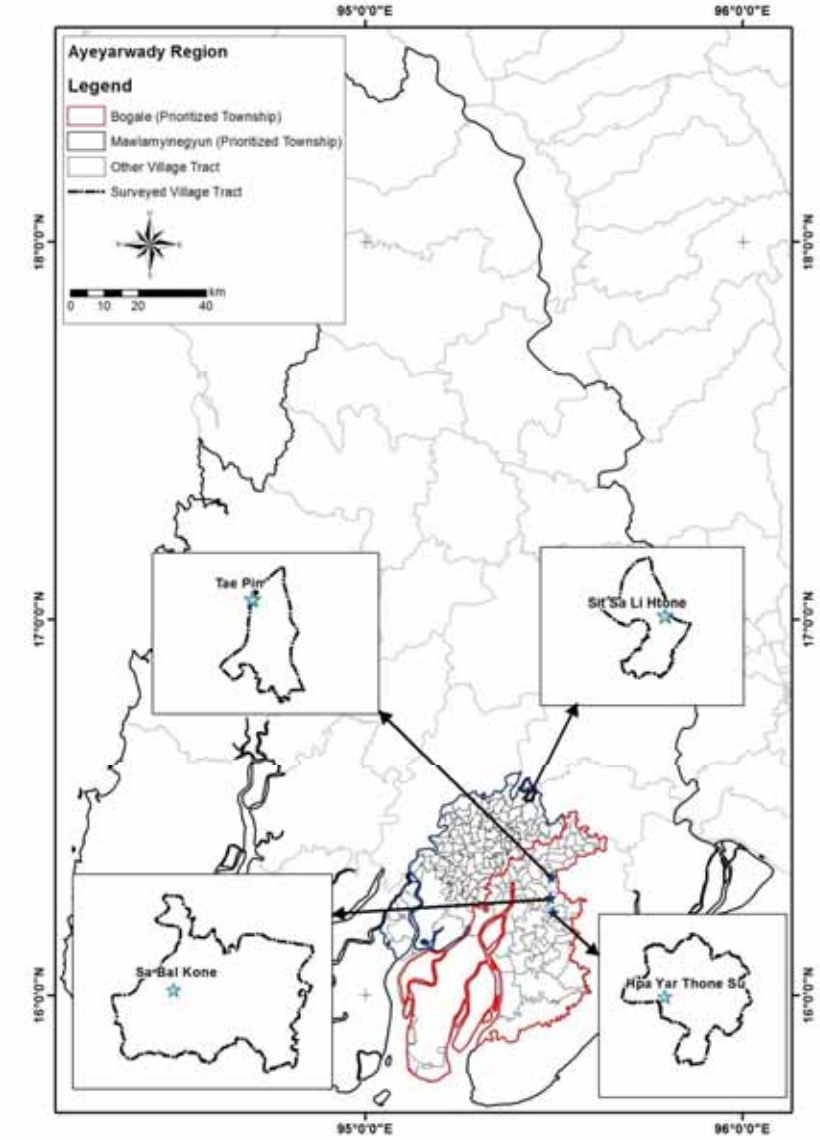

Figure 1-1 Location of studied village tracts of Ayeyarwaddy Region

1.2. POPULATION

There are 3148 households and 14,193 populations in four study village tracts from Bogalae Township and Mawlamyine Kyun Township. Sit Sali Htone village tract is under Mawlamyine Kyun Township. Under Bogalae village tract, there are many villages. Of these villages, three village tracts such as Tae Bin 1 village tract, Sa Bal Kone village tract and Hpayar Thone Su village tract are surveyed in total 2,549 households. In addition, Sit Sali Htone village tract has 3,405 populations in 599 households. Population and households in study area are presented in Table 1-2.

Table 1-2 Population and households in study area

Townships	Bogalae			Mawlamyine Kyun	Total
Village Tracts	Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	4
No.of population	3348	3492	3948	3405	14193
Name of survey villages	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	4
No.of population	3348	3492	3948	3405	14193
Household	867	797	885	599	3148

Source: General Administration Department from Bogalae and Mawlamyine Kyun Township

1.3. ETHNICITY AND RELIGION

There is unique ethnicity distribution of Kayin in Sit Sali Htone village of Sit Sali Htone village tract from Mawlamyine Kyun Township. Whole villagers are Kayin Christian but one Myanmar family is there. In contract, there is Myanmar peoples reside in other surveyed villages of Bagalae Township.

CHAPTER 2
HOUSEHOLD INFORMATION

2.1. HOUSEHOLDS

In Ayeyarwaddy Region, there are many predominately male headed families distribution system. Male headed household are about 90% and less than 20% female headed households in study area shown in Table 2-1. There are 150 male and 97 female in total 247 respondents participated in four villages of 4 village tracts as shown in Table 2-2. The survey result has shown that 65% female participants have been involved in this study.

Table 2-1 Household Head by gender in study area

Gender of Household Head	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Male	56	54	54	55	219
	91.8%	81.8%	90.0%	91.7%	88.7%
Female	5	12	6	5	28
	8.2%	18.2%	10.0%	8.3%	11.3%

Source: General Administration Department

Table 2-2 Nos of respondent by gender in study area

Gender	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Male	32	27	39	52	150
	52.5%	40.9%	65.0%	86.7%	60.7%
Female	29	39	21	8	97
	47.5%	59.1%	35.0%	13.3%	39.3%

Source: Study team

Average family size is 5 persons in one family. Maximum family size is 12 and minimum 1. Family size in study area as seen in Table 2-3 and gender disaggregated family members are presented in Table 2-4. Male and female family members are almost equal number but female members are slightly higher than male members.

Table 2-3 Family size in study area

Family size	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
1-3	22	24	15	9	70
	36.1%	36.4%	25.0%	15.0%	28.3%
4-6	34	31	42	30	137
	55.7%	47.0%	70.0%	50.0%	55.5%
7-9	5	10	3	18	36
	8.2%	15.2%	5.0%	30.0%	14.6%
> 9		1		3	4
		1.5%		5.0%	1.6%
Average	4	4	4	6	5
Maximum	9	11	7	12	12
Minimum	2	1	2	1	1

Source: Study team

Table 2-4 Family members by gender in study area

Gender of Household members	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Male	120	154	115	153	542(47.3%)
Female	135	135	142	191	603(52.7%)
Total	255	289	257	344	1154(100%)

Source: Study team

2.2. AGE

Age of family members was presented in Table 2-5. It is included under 5 years children who have not schooling yet. 99 years old is highest maximum age in Sabal Kone village from Bogalae Township. Average age was 31 years in the study area. Almost all of the children age between 5 and 15 years are school children.

Table 2-5 Age group of family members in study area

Age group of family members	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
< 5 years	13	12	20	25	70
	5.1%	4.2%	7.8%	7.3%	6.1%
5-15	40	71	49	65	225
	15.7%	24.6%	19.1%	18.9%	19.7%
>15 years	202	206	188	254	850
	79.2%	71.3%	73.2%	73.8%	74.2%
Average	34	30	31	31	31

Source: Study team

2.3. WORKING SITUATION

Out of total 14,193 population, 283 are students and under 5 years children who are not schooling yet. Out of 1,154 about half of members 62% are working and 38% of family members are not working in study area as shown in Table 2-6.

In terms of higher number working population in surveyed area, there is a high number of migrant working members as well. It has been presented in Table 2-7.

Table 2-8 has showed that most family members about 57% are not working at home. Some of family members are working with animal husbandry at home, less people working other different types of jobs like grocery, small shop at home.

Table 2-6 Working family members in study area

Working Household members	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Working members	130	118	127	119	494(62.4%)
Not working	61	73	56	108	298(37.6%)
Total	191	291	183	227	892(100%)

Source: Study team

Table 2-7 Migrant working family members in study area

Migrant working Household members	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Working members	22	27	12	26	87

Source: Study team

Table 2-8 Situation of family member working at home

Someone worked at home	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Working members	25	40	24	18	107
	41.0%	60.6%	40.0%	30.0%	43.3%
Not working members	36	26	36	42	140
	59.0%	39.4%	60.0%	70.0%	56.7%

Source: Study team

2.4. OCCUPATIONS

Most of household heads running their own business like farmers. Some of them are seasonal workers and other few members are wage or migrant workers who are working away from home. Few numbers are government staff in this study area. Existing employment situation of study area is presented in Table 2-9. Almost all of business owners about 75% are agricultural farm owners and many of household heads are seasonal workers in paddy fields. Less people have running small manufacture and grocery sale shops. Most types of employment are described in Table 2-10.

Table 2-9 Employment Status of Household Head

Employment status of HH Head	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Self-employed (business owner)	53	43	47	44	187
	86.9%	65.2%	78.3%	73.3%	75.7%
Wage worker	3	11	11	7	32
	4.9%	16.7%	18.3%	11.7%	13.0%
Seasonal worker away from home	2	5	-	1	8
	3.3%	7.6%	-	1.7%	3.2%
Seasonal worker within village tract	3	7	2	8	20
	4.9%	10.6%	3.3%	13.3%	8.1%

Table 2-10 Employment Types of Household Head

Employment Type of HH Head	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Crop farming	45	39	43	45	172
Casual labour/Seasonal worker	8	15	5	13	41
Small manufacture	5	-	1	-	6
Glocery		1	5		6
Others	3	11	6	2	22

CHAPTER 3
ECONOMIC SITUATION

3.1 HOUSEHOLD INCOME

At study area of Ayeyarwaddy region, average household income is about 200,000 Kyat per month. Table 3-1 has shown that about half of surveyed households 48% have 100,000-300,000 Kyat per month. Many households have earned less than 100,000 Kyat per month. Few households have received more than 300,000 Kyat and even less household income higher than 500,000 Kyat per month. Sabal Kone has highest average monthly income in 260,000 Kyat per month and lowest rate 130,000 Kyat per month in Tae Pin 1 respectively.

Agricultural household income in study area is presented in Table 3-2. Average income varies from one village to another village. Based on interviewed, average household income for the study area is about 170,000 Kyat per month. Some respondents have animal husbandry, which provides small income because animals are raise for domestic consumption as food.

Table 3-1 Household Income per month

HH Income Per month	Village				
Kyat/month (MMK)	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
< 10000		1			1
		1.5%			0.4%
10001-100000	32	22	12	21	87
	52.5%	33.3%	20.0%	35.0%	35.2%
100001-300000	24	36	32	26	118
	39.3%	54.5%	53.3%	43.3%	47.8%
300001-500000	5	6	13	7	31
	8.2%	9.1%	21.7%	11.7%	12.6%
500001-700000				2	2
				3.3%	0.8%
700001-900000			2	3	5
			3.3%	5.0%	2.0%
> 900000		1	1	1	3
		1.5%	1.7%	1.7%	1.2%
Average	131,705	187,837	262,197	232,104	202,791

Exchange rate 1USD=1360MMK

Table 3-2 Agricultural Household Income per month

Agricultural HH Income Kyat/month	Village Tract				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
<10000	1	3			4
10001-100000	34	20	21	18	93
100001-300000	12	20	18	20	70
300001-500000		5	3	2	10
500001-700000			2	3	5
> 900000	1	1	1		3
Average	101,885	182,097	216,304	182,924	169,798

Exchange rate 1USD=1360MMK

More than two-third of households have non-agricultural income like seasonal causal work, small manufacture and grocery etc. Most seasonal or casual workers have occupied with construction like carpenters and average income is less than 100,000 Kyat per month. Non-agricultural income description is shown in Table 3-3. Most migrant workers receive average income of less than 100,000 Kyat per month during off-farm season. Some of them have between 100,000-300,000 Kyat per month. It is presented in Table 3-4.

Table 3-3 Non-Agricultural Household income by village

Non-agricultural Income Per month Kyat/month	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
<10000	3	3	3	3	12
10001-100000	29	21	9	13	72
100001-300000	7	2	11	9	29
300001-500000			2	3	5
500001-700000			2	3	5
Average	68,808	59,885	154,808	136,276	101,813

Table 3-4 Migrant working Household income of by village

Migrant working income Per month Kyat/month	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
10001-100000	2	6	5	3	16
100001-300000	4	2	3	1	10
500001-700000				1	1
Average	126,667	100,000	112,500	194,000	127,037

Some female family members are working in crop farming (9.2%), matting (13.7%), small shop (5.9%) and grocery (10.5%). Many are working at animal husbandry industry (41.8%). Some teach at their village tracts (7.2%). Animal husbandry and grocery sale are carried out at home. Female employment types are seen in Table 3-5.Women participation in household income has averaged about 5,325 Kyat per day. If they can get regular job, household income level will be increased. However majority of women (64.7%) have earned less than 5,000 Kyat as shown in Table 3-6. Some female family members have been working in many sectors. Most women spent 1 to 3 hours (48.4%) in their work. Most of them spent very short duration at home especially animal husbandry work of feeding animals. Spending time duration distribution of women in study area is presented in Table 3-7.

Table 3-5 Employment Types of women

Employment Type of women	Village Tract				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Animal husbandry	5	30	13	16	64
Grocery	2	3	8	3	16
Small shop	3	2	3	1	9
Matting	21				21
Crop farming	5	4	4	1	14
Teacher	2		3	6	11

Table 3-6 Household Income by Women (Kyat per day)

Female In-come Kyat/day (MMK)	Village Tract				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
< 5000	31	26	25	17	99
5001-10000	5	8	7	12	32
10001-15000	3	2	2	1	8
>15000	1	10	2	1	14
Average	3,795	6,983	5,037	5,172	5,325

Table 3-7 Spending times for working by female HH members

Female work done per day	Village Tract				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
1-3	18	31	15	10	74
4-6	10	4	9	11	34
7-9	12	9	10	9	40
> 10		2	2	1	5
Average	4	3	5	5	4

CHAPTER 4
AGRICULTURAL SECTOR

4.1. LAND OWNERSHIP STATUS

Average land ownership acreage in Tae Pin village of Tha Kan Wa village tract is 5 acre per household while in Sabal Kone has 10 acre per household. In Hpa Yar Thone Su, average is11 acre per household, and Sit Sali Htone village of Sit Sali Htone village tract has 9 acre per household. Average land ownership area in surveyed villages has also 9 acre per household. Few people own less than 1 acre in every village in study area. It is illustrated in Table 4-1.

Table 4-1 Land ownership status by village in study area

Land ownership acreage	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
< 1.00	2	6	1	2	11
	4.7%	15.8%	2.6%	4.5%	6.7%
1.01-4.00	26	6	5	6	43
	60.5%	15.8%	12.8%	13.6%	26.2%
4.01-7.00	6	12	10	13	41
	14.0%	31.6%	25.6%	29.5%	25.0%
7.01-10.00	1	7	9	14	31
	2.3%	18.4%	23.1%	31.8%	18.9%
> 10.00	8	7	14	9	38
	18.6%	18.4%	35.9%	20.5%	23.2%
Average	5	10	11	9	9

4.2. CROPS

Most respondents are farmers in the study area of Ayawaddy region. In terms of location and irrigation system, their crop type varies from village to village. In all village tracts, rainy season rice is their main crop. Only 36% of the farmers cultivate summer rice plantation. Other cash crops are also cultivated in study villages such as coconut (17%), black and green gram (16%) and betelnut (9%). At Sit Sali Htone, beans are heavily cultivated (64%) after rainy season rice crops. Other village tracts do not depend on bean cultivation since they are closely located to the Ayawaddy River. Sabal Kone and Hpa Yar Tone Su village depend on summer rice cultivation at 48% and 59% of households respectively. Types of crops by households in surveyed village tracts of Ayawaddy is shown in Table 4-2.

Table 4-2 Types of crops by Households

Types of crops	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Rice (Rainy)	45	34	39	44	162
Rice (Dry)	13	19	24	6	62
Coconut	2	17	10		29
Black gram/Green gram				28	28
Betel nut		12	4		16
Others		4	5	5	14

4.3. PRODUCTION AND MECHANIZATION SITUATION

Average production volume of rainy season rice per acre in Hpa Yar Tone Su (69.2% of farms) is between 1-2 tons per acre, Tae Pin 1 (51.1% of farms) and Sit Sali Htone (75% of farms) mostly produce between 2-3 tons per acre. 61.8% of Sabal Kone farms produce the most between 3-4 tons per acre. Out of four study village tracts, average rainy season rice production in Sabal Kone and Tae Pin 1 village is the highest at 3 tons per acre. While average production in other villages is at 2 ton per acre as shown in Table 4-3. Summer season rice production is highest at Sabal Kone at 13 tons per acre, followed by Sit Sali Htone at 11 tons per acre.

Table 4-3 Rice Production by Household in study area

Production volume for rice (Ton/acre)	Village							
	Tae Pin 1		Sabal Kone		Hpa Yar Thone Su		Sit Sali Htone	
	Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain
<1.00				1		1		
1.01-2.00	13	8	19			27		7
2.01-3.00		23		12		11		33
3.01-4.00		14		21	24		6	4
Average	2	3	2	3	4	2	3	2

4.4. MICROFINANCE SITUATION

All study village tracts get 150,000 kyat per acre as a loan for agricultural financial assistance from PACT Myanmar. Although they own more than 10 acre, they get maximum loan not more than 1,500,000Kyat and interest rate was 0.8% with 6 months duration. The loan can only be obtained only if 3 farmers agree to get financial assistance together under one contract.

According to villagers, Sabal Kone and Sit Sali Htone do not have financial assistance programs available to them. Thus, some have to get high interest financial loans with private sector.

4.5. MARKET ACCESS

4.5.1. Tae Pin 1

Almost all villagers could get market access in Myin Ka Kone within mawlamyine kyun town to procure necessary items such as seeds and fertilizers. For selling paddy rice, animal husbandry and some other products, 97.8% of households depends on Myin Ka Kone market. Market access of study villages is illustrated in Table 4-4.

4.5.2. Sabal Kone

All villagers in Sabal Kone can seek market access in Bogalae village for buying necessary agricultural items. Only 4% of the household seeks market access to sell at main markets of Yangon and Pya Pon. 96% surveyed locate Bogalae as their main market.

4.5.3. Hpa Yar Tone Su

The villagers of Hpa Yar Tone Su procure agricultural items in Bogalae. Also, most of them (87%) sell their products in Bogalae. About 9% sell their argricultural products within the village along with 4.3% in Pya Pon.

4.5.4. Sit Sali Htone

The Sit Sali Htone main market is in Yone Daunt where they sell their agricultural products. 94% of villagers use the Yone Daunt market. A small volume is sold within the village or Kyiak Latt.

Table 4-4 Main market access in study area

Main market	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Yangon		1			1
Bogalae		49	40		89
Pya Pon		1	2		3
Kyaik Latt				1	1
Yone Dauk				48	48
Myin Ka Kone	45				45
Shan Kwin	1				1
Within village			4		4
Within village tract				2	2

4.6. TRANSPORT MEAN FOR MARKET ACCESS

Boats can be used as transportation mean for their commodities in all village tracts. Motorcycles are used not only to bring crop items but also to carry human beings. Trailer-jeep is used extensively at 39%, followed by the boat at 33% to carry most of their farm products in Sit Sali Htone. The transport mean to market is shown in Table 4-5.

Table 4-5 Transport mean for market access

Transportation mean by main market	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
motorcycle			1	9	10
trailer-jeep				20	20
truck				4	4
bus				1	1
boat	46	51	45	17	159

4.7. TRANSPORTATION ROUTE AND DURATION FOR MARKET ACCESS

4.7.1. Tae Pin 1

Most villagers of Tae Pin 1 village in Tha Kan Wa tract use route A, C. and less people go by route D and E shown in Figure 4-1. They mostly go to Myin Ka Kone market by route C. Most of them spend about half an hour as shown in Table 4-6.

Table 4-6 Route for market access in Tae Pin 1 village

Route for Main market Figure 4-1	A	B	C	D	E
	46		45	1	1

Figure 4-1 Route Map of Tha Kan Wa village tract

4.7.2. Sabal Kone tract

Sabal Kone villagers use route A, B, I, H and J. Most of them go to Bogalae market by route B then H. Many people use by route I to Bogalae but some people go to Pya Pon by route J. The routes used are shown in Table 4-7 and Figure 4-2. To go to Bogalae or Pya Pon, villagers spend more than 60 minutes. Many people use more than one hour to go outside village tract or other cities.

Table 4-7 Route for market access in Sabal Kone village

Route for Main market Figure 4-2	A	B	I	H	J
	50	51	33	51	18

Figure 4-2 Route Map of Sabal Kone village

4.7.3. Hpa Yar Tone Su

Hpa Yar Tone Su village tracts main market is located at Bogale as seen in Figure 4-3. Routes A, C and I are used to access the main market and the times it takes to go to Bogale is more than 120 minutes. Many people use more than two hours to go outside village tract or other cities. Few people go to Pya Pon by route E then H. It is presented in Table 4-8.

Table 4-8 Route for market access in Hpa Yar Thone Su village

Route for Main market Figure 4-3	A	C	E	H	I
	46	39	2	2	39

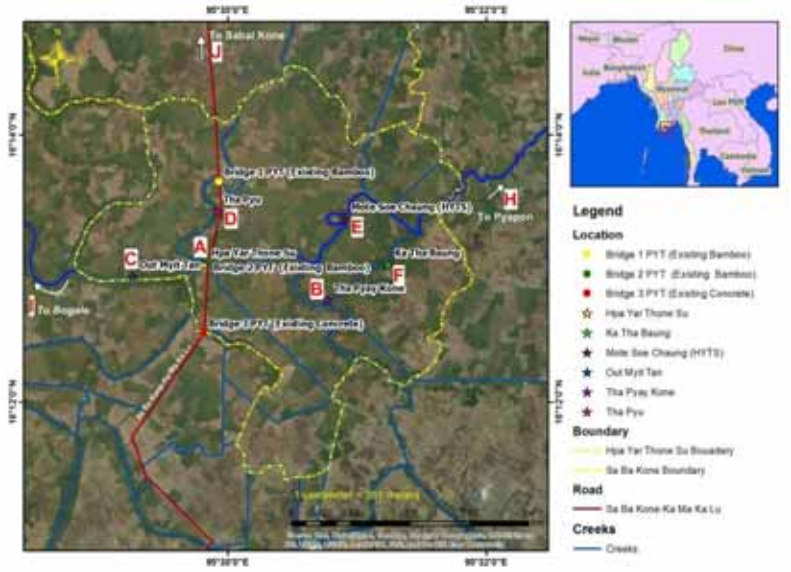

Figure 4-3 Route Map of Hpa Yar Thone Su village

4.7.4. Sit Sali Htone

Sit Sali Htone village tract mostly use routes A, E then B go to Yone Daunt especially during dry season. But during rainy season villagers go directly A to B by boat and as illustrated in Figure 4-4 and Table 4-9. Only a few uses D, F and G routes. Main market is in Yone Daunt and it takes about 25 minutes or less to go to Wae Daunt market.

Table 4-9 Route for market access in Sit Sali Htone village

Route for Main market Figure 4-4	A	B	D	E	F	G
	51	48	3	49	2	2

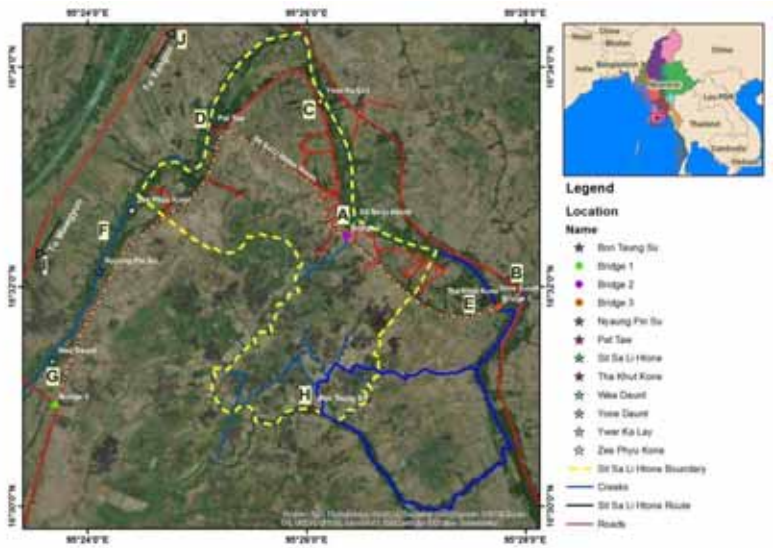

Figure 4-4 Route Map of Sit Sali Htone village

CHAPTER 5
EDUCATION

5.1. SCHOOLS AND STUDENTS

Every village has primary school in their village tracts so that all primary students attend their school within their village. However middle school students have to go outside village tract for Tae Pin 1, as most goes to Sayar Yoe. All others have middle school within their village tract. Sabal Kone middle school students can also go to Ngapi Chaung or Taung Ta Lae. Hpa Yar Tone Su has middle school and Sit Sali Htone also has sub-high school within village. Almost all Sit Sali Htone students go Yone Daunt village for matriculation examination of high school education. Tae Pin 1 and Sabal Kone high school students go to Shan Kwin or Taung Ta Lae.

Lack of access to education is a big barrier and in connection with difficulty of transportation hence to go other places for their education. About 9% of the students in the surveyed area take more than 60 minutes to go to school. In terms of school locations, distribution is high for Sabal Kone high school students. Students distribution in surveyed village tracts is as seen in Table 5-1.

Table 5-1 School locations and student distribution in study area

Access to Education	Village											
	Tae Pin 1			Sabal Kone			Hpa Yar Thone Su			Sit Sali Htone		
	P	M	H	P	M	H	P	M	H	P	M	H
within village	18			23			21	15	2	27	12	6
within village tract				2	5					2		1
Private school at township/other village/other division			5		1	9	1	1	4			5
Shan Kwin	2		5		1	3						
Ngapi Chaung					7							
Sayar Yoe		9										
Taung Ta Lae		3			4	3						
Yone Dauk												2

P=Primary School, M=Middle School, H=High School

5.2. TRANSPORTATION MEAN AND DURATION FOR EDUCATION

Students in every village have to go to school by boats everyday during rainy season but during dry season they go by walking. Primary students could ride neither bicycle nor motorcycle so that they have to go to school on foot. Similarly middle school students go to school on foot. However, half of high school students used motorcycle as transportation mean for schooling particularly to go beyond their village tracts. If school is

located within village, most students spend about 30 minutes by walk. If schools are outside of village tract, students spend between 45-60 minutes to go to school. About nine percent of the students spend more than 60 minutes to go to school.

5.2.1.1. Tae Pin 1

Students from Tae Pin 1 go to schools via route A and E. Both primary school and middle school are on the same route. Some students go to high school in Shan Kwin and Myin Ka Kone and it takes between 30-60 minutes commute time. All students from Tae Pin village routes, transportation mean and duration for education can be seen in Figure 5-1 and Table 5-2 to Table 5-4 for all surveyed villages.

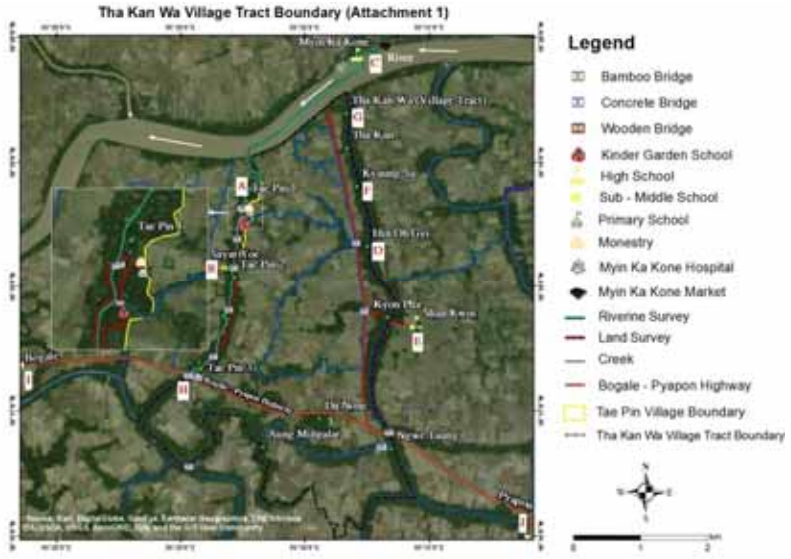

Figure 5-1 Schools used by Students of Tae Pin 1

Table 5-2 Route for Education in surveyed villages

Route for Education	Village											
	Tae Pin 1			Sabal Kone			Hpa Yar Thone Su			Sit Sali Htone		
	P	M	H	P	M	H	P	M	H	P	M	H
A	20	12	10	25	18	15	23	16	6	29	12	14
E		12	3	1	12	10						5
D			3		6	10						1
C			6		6			1	3			2
B				1	5	5						5
H			1		1	5						
I			1					1	3			
J						2						2
F												1
G												1

Table 5-3 Transportation Mean for students in surveyed villages

Transport mean for education	Village												TOTAL
	Tae Pin 1			Sabal Kone			Hpa Yar Thone Su			Sit Sali Htone			
	P	M	H	P	M	H	P	M	H	P	M	H	
walking	14	12	1	23	12	5	13	9	2	26	10	7	134
Boat			2	2	5	1	8	6		2	1		27
Motorboat	6									1	1		8
bicycle			2										2
motorcycle												2	2

Table 5-4 Duration for education of students

Time duration to go to school	Village												TOTAL
	Tae Pin 1			Sabal Kone			Hpa Yar Thone Su			Sit Sali Htone			
Minutes	P	M	H	P	M	H	P	M	H	P	M	H	
1-30	19	11	1	25	4		16	13	2	28	12	7	78
31-60	1	1	4		9	1	5	2		1		1	25
60-90					4	3							7
>90						2						1	3

5.2.2. Sabal Kone village tract

Most students from Sabal Kone village go to Sakar Lone Kone post-primary school by walking within the village. Walking time is less than 30 minutes as shown in Figure 5-2 and Table 5-2 to Table 5-4. Some goes by boats to school to Ngapi Chaung middle school. For middle and high school students, the commute duration can last for an hour or more.

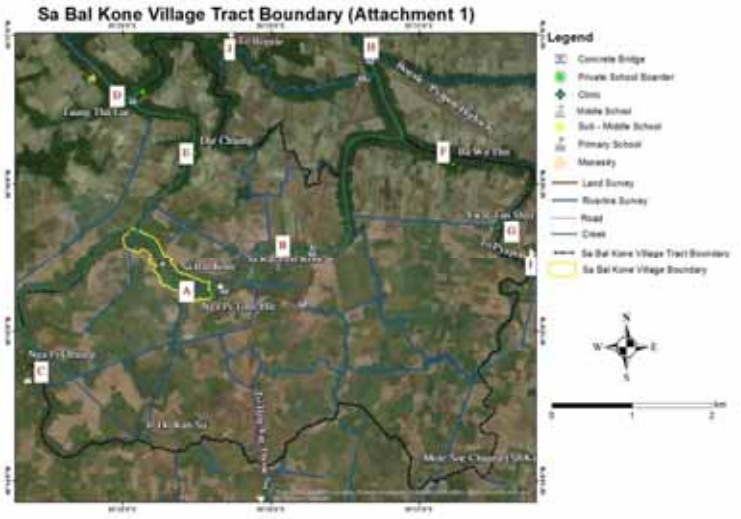

Figure 5-2 Schools used by Students of Sabal Kone village

5.2.3. Hpa Yar Tone Su

Most students go to school by walking. A significant number of students use boat to go to primary and middle school. The commute time is less than 30 minutes for most students according to Figure 5-3 and Table 5-2 and Table 5-4.

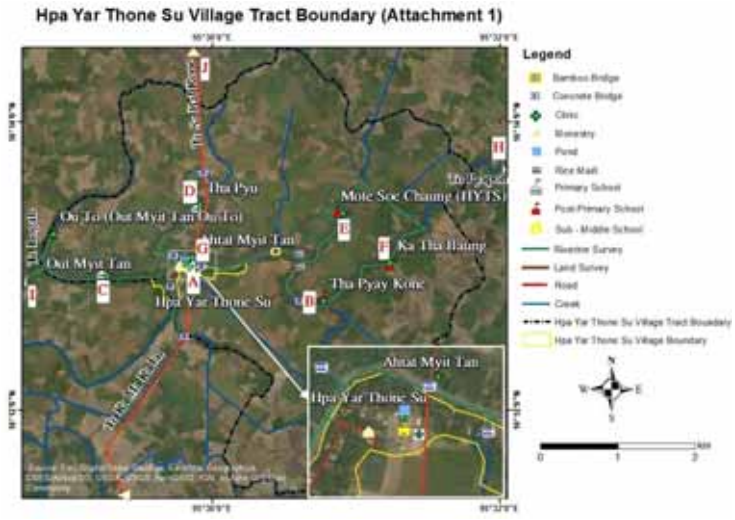

Figure 5-3 Schools used by Students of Hpa Yar Thone Su villagae

5.2.4. Sit Sali Htone

The nearby school that most students in Sit Sali Htone go to is Yone Dauk. From primary school to high school students, they go by walking. Only a small portion of students can go by motorcycle or boat according to Figure 5-4 and Table 5-2 and Table 5-4. Most students take less than 30 minutes to go to school.

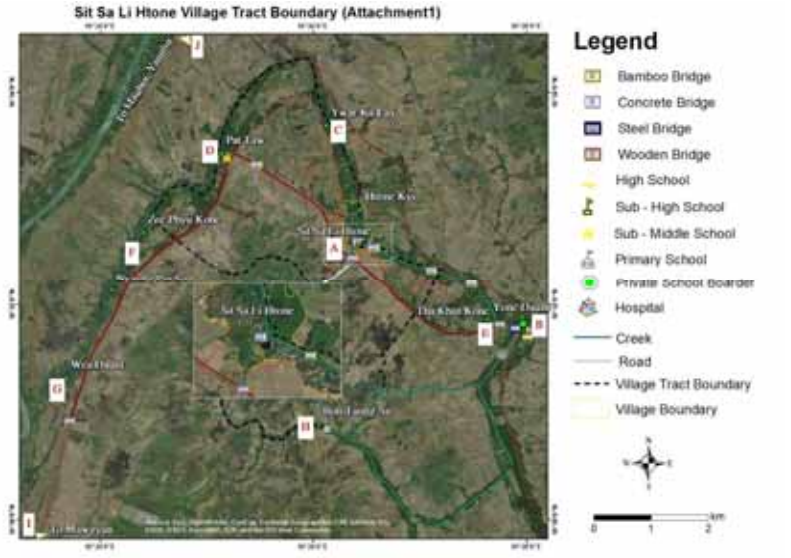

Figure 5-4 Schools used by Students of Sit Sali Htone village

5.3. HEALTH CARE SERVICE

There were sub-rural health centre in each and every village of the surveyed village tract.

Most villagers can access health care within village tract 30-60 minutes walking distance within village tract. But in serious case they have to go other township such as Myin Ka Kone, Bogalae and Yone Daunt hospital. Most people (80%) from Tae Pin 1 village go to Myin Ka Kone and the remaining 20% goes to Bogalae, Kyaik Latt, Kyone Pha and Sayar Yoe. All the villagers from Sabal Kone village tract have to go to Boaglae. On the other hand, most Hpa Yar Tone Su (58.3%) uses health services within the village or go to Bogalae (33.3%). In Sit Sali Htone, 85% of households healthcare service in Yone Daunt. Only a small portion of household goes to within the village, Pya Pon and Yangon. Healthcare service utilization and commute time is shown in Table 5-5. Duration for health care service is various in terms of their transportation mean, route and location of place. When villagers go within village tract or nearby take about 60 minutes while they go for better health care service will last more than 120-240 minutes. It can be seen in Table 5-6.

Table 5-5 Healthcare center locations and commute time

	Village

Location of Hospital or medical centers	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
within village			35	3
within village tract	1		1	2
Yangon				1
Bogale	4	66	20	
Pya Pon			4	3
Kyaik Latt	3			
Yone Dauk				51
Myin Ka Kone	49			
Kyone Pha	1			
Sayar Yoe	3			

Table 5-6 Duration from Hospital or medical centers

Time duration from Hospital or medical centers (Minute)	Village			
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
1-30	50		29	38
31-60	9	1	7	17
61-90	1		1	3
>90	1	65	23	2

5.4. TRANSPORTATION MEAN AND ROUTE FOR HEALTH CARE SERVICES

Most of villagers in all surveyed village tracts go to solve their health problems by motorboat. In serious cases, they have to go to other township especially Bogale, Myin Ka Kone and Yone Daunt. Some go to Pya Pon or Yangon by motorcycles or cars. Many people use boats to go to health care centers nearby village. Transportation mean by village tract is shown in Table 5-7.

Table 5-7 Transportation mean by hospital or medical center

Transportation mean by Hospital or medical centers	Village			
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
Walking	4		22	10
Bicycle				1
motorcycle	5		2	13
Car				3
Motorboat	43	66	35	30
Trailer Jeep				2
Boat	9		1	1

5.4.1. Tae Pin 1 village tract

People of Tae Pin 1 use route A and C the most to go to health facility. They go to Myin Ka Kone hospital the most. Mostly used routes for Tae Pin village are in Table 5-7 and transportation means are in Table 5-8.

5.4.2. Sabal Kone village tract

Transportation routes for health care for Sabal Kone village tracts are shown in Table 7-2-2. They use route A, B, H, I and J routes to go to Bogale for health service as illustrated in Table 5-8.

5.4.3. Hpa Yar Tone Su village tract

Most Hpa Yar Tone Su villagers go to Bogale via route A, C and I. Only a few use route H and E to go to Pyapon for health service. The Map of Hpa Yar Tone Su is shown in Figure 5-3. 37% of commute on foot and 58% of commute goes by motorboat according to surveyed data in Table 5-8.

5.4.4. Sit Sali Htone village tract

Most use routes A, B and E to go to Yone Dauk for health service as shown in Figure 5-4. Only a few use route D and F to go west to Mawgyun for health service.

Table 5-8 Transportation route for Health care

Route for Hospital or medical centers	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
A	60	67	59	60	246
B		66		50	116
C	56		30		86
H	2	65	6		73
I	2	41	29		72
E	3		6	51	60
J		25			25
D	3			7	10
F			1	6	7
G				6	6

(For routes, please refer to Figure 5-1 for Tae Pin 1, Figure 5-2 for Sabal Kone, Figure 5-3 for Hpa Yar Thone Su and Figure 5-4 for Sit Sali Htone village)

CHAPTER 6
INFRASTRUCTURE

6.1. WATER SUPPLY SYSTEM

The water source of Tae Pin 1 and Sabal Kone is rainwater and river nearby. There is no other source of water for those villages. Hpa Yar Thone Su has a man-made public drinking pond shared between nearby village tract. Sit Sali Htone has many small pool of water made in some houses for drinking and domestic use. Some household has tube well or protected well, and only a few households use tap water or bottled water for domestic use. The water supply of study area can be seen in Table 6-1.

Table 6-1 Water Supply system of study area

Water sources	Village			
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
Rainwater	61	66	58	52
River/stream/canal	61	66	60	36
Pool/pond/lake			14	9
Tube well, borehole				20
Protected well/spring				12
Tap water/piped (public tap)				3
Unprotected well/spring				2
Bottled/purified water				1

6.2. SOURCE OF ENERGY

The main source of energy for cooking is firewood. No other source is utilized as seen in Table 6-2.

Table 6-2 Source of energy for cooking

Main source of energy for cooking	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Firewood	61	66	60	60	247

For lighting in study area most villagers used solar system, few people used battery and generator by kerosene or diesel. Even fewer household use candles and Kerosene lamp as their main source of energy for lighting, Details of energy for lighting can be found in Table 6-3.

Table 6-3 Main source of energy for lighting

Main source of energy for lighting	Village				
	Tae Pin 1	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	TOTAL
Electricity (generator by Kerosene or Diesel)			7	14	21
Electricity (solar system)	36	45	37	28	146
Battery	21	18	12	8	59
Candle	4	3	4	7	18
Kerosene lamp				3	3

CHAPTER 7
MOBILE COVERAGE

Mobile phone penetration is high in study area of Ayeyarwaddy. 95% of the respondents live in the area covered by mobile network. More than 80% of the study population own a mobile phone. Tae Pin 1 and Sabal Kone average one mobile phone while Hpa Yar Tone Su and Sit Sali Htone average 2 mobile phones per household.

TOTAL BUSINESS SOLUTION CO., LTD.
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Thingangyun Township, Yangon, Myanmar

SOCIO-ECONOMIC SURVEY II

AYEYARWADDY DIVISION

UNDER

PREPARATORY SURVEY ON THE PROJECT FOR RURAL INFRASTRUCTURE DEVELOPMENT IN LOCAL AREAS IN THE REPUBLIC OF THE UNION OF MYANMAR

A7-5-20

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ABBREVIATIONS

DRD	Department of Rural Development
GAD	Government Administration Department
LPG	Liquefy Petroleum Gas
MADB	Myanmar Agricultural Development Bank
MMK	Myanmar Kyat

CHAPTER 1
GENERAL INFORMATION

1.1. POPULATION

Bagalae and Mawlamyine Kyun are selected townships for this study in Ayeyarwaddy Region of Myanmar. Of these two townships, Sit Sali Htone village tract is under Mawlamyine Kyun Township. Under Bogalae village tract, there are many villages. Of these villages, three village tracts such as Tha Kan Wa village tract, Sa Bal Kone village tract and Hpayar Thone Su village tract were surveyed as seen in Figure 1-1 and Table 1-1.

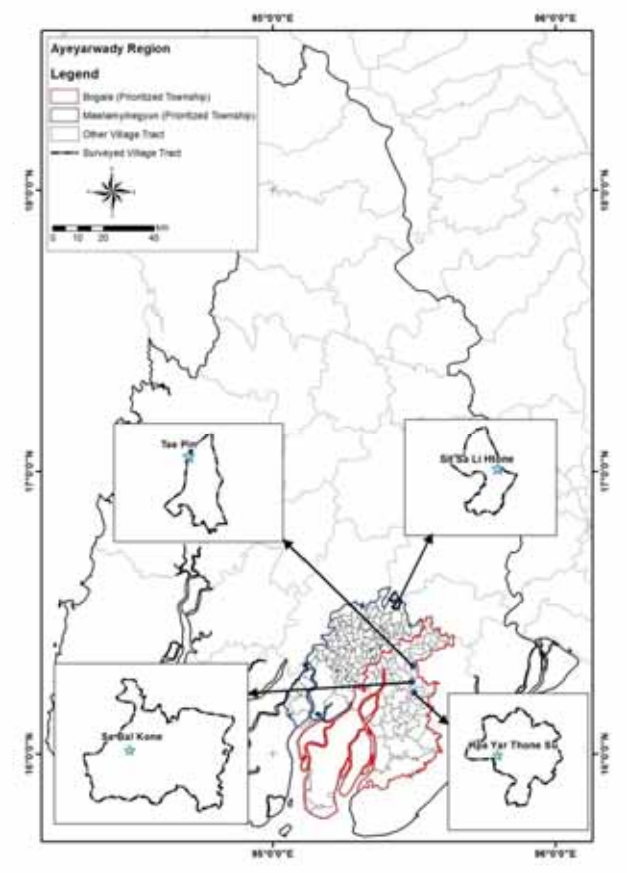

Figure 1-1 Locations of Surveyed Village Tract

Table 1-1 Population, Household and Farm Household by village tract

Name of Region	Name of Township	Name of Village Tract	Name of Village
Ayeyarwaddy Region	Mawlamyine Kyun	1. Sit Sali Htone	1.Sit Sali Htone
	Bogalae	2. Tha Kan Wa	2.Tae Pin 1
		3.Sa Bal Kone	3.Sa Bal Kone
		4. Hpa Yar Thone Su	4. HpaYar Thone Su

This study covered 3,148 households and 14,193 populations in four study village tracts from Bogalae Township and Mawlamyine Kyun Township. There are 1,481 farm households. Population and households in study area are presented in Table 1-2.

Table 1-2 Population and households in study area

Townships	Bogalae			Mawlamyine Kyun	Total
Village Tracts	Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	4
No. of population	3348	3492	3948	3405	14193
Household	867	797	885	599	3148
Farm Household	350	322	386	423	1481

Source: General Administrative Department

1.2. WORKING STRUCTURE

Most villagers have engaged in agricultural jobs but about half of them working along with agriculture and other jobs like casual labour, seasonal works and animal husbandry etc. Few people have been working away from home as casual labour while off farm season in all four village tracts.

Since Ayeyarwaddy region is a rice pot of Myanmar, all village tracts in this study most households have earned on agricultural work and other jobs while off-farm season. Almost half of households are full time farmers and once they have full time occupied in their paddy fields, they could not go away for other jobs like casual work. Small number of households engaged in small industry like small skill paddy mills. Working situation especially in agriculture in village tracts is seen in Table 1-3.

Table 1-3 Working structures in study area

Working structures	Village Tracts				Total
	Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone	
Full time farmer (HH)	350	322	386	423	1481
Other primary industry (HH)	1	-	4	5	10
Secondary industry (HH)	-	1	2	-	3
Tertiary industry (HH)	-	-	-	-	-

Source: Survey team

CHAPTER 2
AGRICULTURAL PRODUCTION SYSTEM

2.1. CROPS

2.1.1. Village tracts in Bogalae Township

All households of Tha Kan Wa village tract, Sabal Kone village tract and Hpa Yar Thone Su village tract under Bogalae Township have cultivated rice paddy as main crop and twice per year during dry and rainy seasons.

2.1.2. Sit Sali Htone village tract

Most households have cultivated paddy both rainy and dry seasons like in Bogalae township. Some households have rice and black gram as dry season crops in Sit Sali Htone village tract from Mawlamyine Kyun Township. Many farm households have seasonal vegetables such as banaba, betel for domestic consumption and household income.

2.2. CROPPING CALENDAR

2.2.1. Village tracts in Bogalae Township

According to village heads and elders from village tracts of Bogalae Township, all of them have a same crop calendar for paddy. Seedling time for dry season is in November and December but no planting is done and harvesting in March and April. For rainy season paddy, seedling time is also in April and May when finish harvesting time of dry season crop and planting in next month of June and July. Harvest is in October. Seasonal cropping calendar by village tracts in Bogalae is presented in Table 2-1.

Table 2-1 Cropping calendar for village tracts in Bogalae

Bogalae township village tracts												
Month / Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice (Dry)			H	H							S	S
Rice (Rainy)				S	S	P	P			H		

S –seedling P – planting H – harvesting

2.2.2. Sit Sali Htone village tract

Crop calendar of Sit Sali Htone under Mawlamyine Kyun is slightly different from Bogalae village tracts. Main crop is rice paddy, but some farmers have planted black gram and green gram instead of dry season rice. Dry season paddy rice seedling time is in November and December, harvesting in December like village tracts from Bagalae. Rainy season paddy crop seedling is April and May, planting in Jun and July, harvesting time is in October. Some farmers have cultivated Black gram or green gram instead of dry paddy crop. Seedling time is in November and December, no planting is done and

harvesting in March and April. Crop seasonal calendar of Sit Sali Htone is shown in Table 2-2.

Table 2-2 Cropping calendar of Sit Sali Htone village tract

Dolluang Village Tract												
Month Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice (Dry)			H	H							S	S
Rice(Rainy)				S	S	P	P			H		
Black gram			H	H							S	S
Green gram			H	H							S	S

S –seedling P – planting H – harvesting

2.3. PRODUCTION

2.3.1. Tha Kan Wa village tract

Ayeyarwaddy is the rice pot of Myanmar so it has large area of paddy fields in this region. In Tha Kan Wa village tract under Bogalae Township, there are 1,941.85 acre of paddy fields and average productivity rate about 3.27 ton per acre for dry season. Selling price per acre is 320,000 kyat/acre. Therefore average profit per acre in this village tract is 80,000 Kyat per acre.

For rainy season crop, although in the same area of land, due to low productivity about half 1.63 ton/acre, profit is also low in 40,000 Kyat per acre.

2.3.2. Sabal Kone village tract

It has 3615.27 acre paddy fields therefore it is the biggest land area in all four village tracts. Paddy rice cultivated twice per year during dry season and rainy seasons.

Average productivity rate about 3.27 ton per acre for dry season, selling price is higher than Tha kan Wa village tract but the profit is 80,000 Kyat per acre.

For rainy season, cultivated land area is the same as dry season but the selling price is 160,000 Kyat per acre and profit is about 40,000 Kyat per acre.

2.3.3. Hpa Yar Thone Su village tract

In this village tract, paddy land area and productivity are almost the same as Sabal Kone village tract, selling price per acre is 320,000 Kyat per acre but profit is about 80,000 Kyat per acre for rainy crop.

Average productivity is the same as other villages within village tract like about 3-4 ton per acre for dry season. Selling price per acre is higher than other villages 280,000 kyat because of the good quality rice. Profit is also higher a little bit as 42,000 Kyat per acre but it depends on weather and other situations are suitable, if not, farmers have lost more than 100,000 Kyat per acre.

2.3.4. Sit Sali Htone village tract

Farming area is 2,461 acre, average productivity of dry season crop is a little bit higher than other surveyed village tracts but selling price and profit are quite low as 30,000 Kyat per acre for rainy season crop.

In this village tract, many farmers have alternative crops as black and green gram cultivated area is about half of farm land area in dry season. Selling price is 203000 Kyat per acre. It is higher than rice so it can get more profit about 100,000 Kyat per acre. But it depends on weather, insect and other associated factors.

For rainy season rice productivity is almost the same as village tracts under Bogalae Township. Then, selling price and profit are not much different from other villages.

Detail of farm land area, productivity and profit are shown in Table 2-3.

Table 2-3 Farm land area, average productivity and profit by crops

Crop items	Productivity in terms of volume and value	Village Tract			
		Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
Rice (dry)	Farming area (Acre)	1941.85	3615.27	3306.05	2461.43
	Average productivity (ton/acre)	3.27	3.27	3.27	3.67
	Selling price (Kyat/acre)	320000	400000	320000	150000
	Profit (Kyat/acre)	80000	80000	80000	30000
Rice (rainy)	Farming area	1941.85	3615.27	3306.05	2461.43
	Average productivity (ton/acre)	1.63	1.63	1.63	1.63
	Selling price (Kyat/acre)	160000	160000	280000	380000
	Profit	40000	40000	42000	30000
Black gram/Green gram	Farming area	-	-	-	1407 Gram?
	Average productivity	-	-	-	0.17
	Selling price	-	-	-	203000
	Profit	-	-	-	100000

Source: Survey team

CHAPTER 3
ECONOMIC SITUATION

3.1. MARKET ACCESS

3.1.1. Tha Kan Wa village tract

Most products of paddy about 90% are sold to brokers nearby village tract like Myin Ka Kone village or within village and small volume of rice and animal husbandry are brought to Bogalae market.

3.1.2. Sabal Kone village tract

Most products of paddy about 85% are sold to brokers nearby village tract and within village. These brokers have market access within the village or nearby village tract. Only small volume of rice and animal husbandry products has accessed to market outside the village tract, Bogalae. Farmers who have own boat, they brought their crops to Bogalae market to get higher price.

3.1.3. Hpa Yar Thone Su village tract

Farmers in this village tract have no alternative way to sell brokers within village or village tract. They face tight situation of time and far away from Bogalae, transportation charge by boat also high to carry their crops to Bogalae market which can get high price.

3.1.4. Sit Sali Htone village tract

Main market access for this village tract is Yone Dauk village. Most farmers sold their crops to brokers who collect the crops within market by own transportation. Few of them can access market beyond village tract at Yone Dauk village.

Situation of agricultural products market access is shown in Table 3-1.

Table 3-1 Agricultural market access of village tracts

Agricultural product items	Agricultural market	Village Tract			
		Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
Rice	Broker at village or nearby village Location	Myin Ka Kone Village	Within Village	Hpa Yar Thone Su	Yone Dauk
	Broker at village or nearby village %	90%	85%	100%	80%
	Market Location	Bogalae	Bogalae	-	Yone Dauk
	Market %	10%	15%		20%

3.2. TRANSPORT MEANS TO MARKET

3.2.1. Tha Kan wa village tract

Main agricultural product rice has been collected and brought with motorboat and less amount of rice has been transported by trailor jeep.

3.2.2. Sabal Kone village tract

Similarly most rice is transported by motorboat but small amount has been brought by trailor jeep. Difficulties of transportation by land and predominately is only a significant change every 15 days, due to the wax and wane of lunar month**.** Commodities could be transported only high tide duration for this village.

3.2.3. Hpa Yar Thone Su village tract

All of agricultural products and other domestic goods transportation totally depend on motorboat.

3.2.4. Sit Sali Htone village tract

This village tract, about half of their products has been transported by motorboat and the rest half amount transported by trailor jeep. It depends on village location which is near river or stream, motorboat is more accessible than trailor jeep.

Transportation means in all four village tracts are presented in Table 3-2.

Table 3-2 Transport mean for agricultural products in survey area

Agricultural product item	Transport Means by agricultural market	Village Tract			
		Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
Rice	Vehicle Specific	Trailor Jeep	Trailor Jeep	-	Trailor Jeep
	Vehicle %	10%	15%	-	50%
	Boat Specific	Motorboat	Motorboat	Motorboat	Motorboat
	Boat %	90%	85%	100%	50%

3.3. ACCESS TO FINANCING

All village tracts under Bogalae Township, almost all farm owners got 150,000 kyat per acre as a loan for agricultural financial assistance from Myanmar Agricultural Development Bank (MADB). Although some farmers owned more than 10 acre, they got maximum loan not more than 1,500,000 Kyat with 6 months duration and interest rate was 0.85%.

In Hpa Yar Thone Su village, few people especially female farmers have available loan as microfinance assistance from PACT Myanmar.

In contract, Sit Sali Htone from Mawlamyine Kyun Township financing which is unavailable is needed.

3.4. ACCESS TO AGRICULTURAL MECHANIZATION SERVICE

There is an agricultural mechanization service in all four village tracts. There are many farmers, about half of them own hand tractors for their cultivation. The one who has not possessed the machine, they can borrow from other owners but have to pay for gasoline and daily charges by paddy rice. In addition, for dry season paddy, water pumping machines have been used almost all farmers. Similarly as in rainy season, if farmers who have not machine, they have to borrow and pay by paddy and gasoline whatever they used.

Hpa Yar Thone Su from Bogalae Township and Sit Sali Htone of Mawlamyine Kyun Township have difficult to reach big machines and providing services to their farm land. Therefore, farmers from these village tracts have limited agricultural extension service in using systematically and timely fertilizers for the crops in all village tracts in both townships. Agricultural Mechanization and extension services situations are shown in Table 3-3.

Table 3-3 Agricultural technical services situation in study area

Technical service	Village Tract			
	Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
	AMS			
Availability	Yes	Yes	Yes	Yes
Reason not utilize the service			Transportation is not good	Transportation is not good
	AES			
Availability	Yes	Yes	No	No
Reason not utilize the service			Transportation is not good	Transportation is not good
	NGO			
Availability	Yes	Yes	No	No
Reason not utilize the service			Transportation is not good	Transportation is not good

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CHAPTER 4
POSSIBILITY OF INCOMES INCREASE

According to group discussion with village heads and elders from village tracts, there are possibilities of income increase options for all village tracts in both townships. All of them expected to increase on their agricultural related options such as crop alternation, diversification of agriculture, improvement of distributive for market except extension of agricultural land. All village tracts from both townships have limited agricultural related business like big rice mill and rice based snacks factories. Mechanization, land reclamation, good seed acquisition can produce from 15% to 50% productivity increase along with the other reasons. All village heads, elders and farmers have the same options to increase their income by agricultural sector but in different thinking of increase rate of productivity.

4.1. LAND RECLAMATION AND CROP ALTERNATION

4.1.1. Bogalae village tracts

Farmers have very limited knowledge and practicing in systematically and timely fertilizers for the crops so that they realized that land reclamation is needed but they do know how to develop their land by proper way. Some farmers afraid of cultivate crops alternation like peas and green or black gram for dry season especially farmers from Tha Kan Wa and Sabal Kone village tract. But Hpa Yar Thone Su village tract try to change the crop during dry season like green or black gram instead of dry season paddy rice. Hence their expectation of productivity is from 15% to 30% respectively.

4.1.2. Sit Sali Htone village tract

Different from other village tracts, Sit Sali Htone village tract has cultivated black and green gram in dry season. In addition, if other supports like all mechanization procedures of cultivation system, improvement of distributive system, rural industrialization, productivity rate per increase can be double.

4.2. FINANCIAL ASSISTANCE

According to the survey, all surveyed village tracts under Bogalae Township could increase income if productivity is increased. Other factors that could increase income include mechanization, agricultural product acquisition and distribution system improvement.

Financial loans are available from Myanmar Agricultural Development Bank (MADB) with low interest rate but some limitations like very short term payment and group system. A group has 3 members so if someone from the group could not afford to pay back loan, the rest two also not entitle in next round loan scheme. Under Bogalae Township, both Tha Kan Wa and Sabal Kone have loan available from Government Bank. Exceptional case in Hpa Yar Thone Su village tract female farmers received loan from PACT Myanmar as microfinance assistance.

In contract, Sit Sali Htone from Mawlamyine Kyun Township financing which is unavailable is needed.

4.3. PRODUCTIVITY EXPANSION AND DISTRIBUTIVE SYSTEM IMPROVEMENT

Although all farming households have soil quality problem, small production volume and limitation of financing available, it is possible to further develop agricultural related businesses such as rice mill and other food processing factories in the region to further develop agricultural related businesses and job opportunities for community peoples.

CHAPTER 5
INFRASTRUCTURE

5.1. ROADS AND BRIDGES

5.1.1. Tha Kan Wa village tract

Generally roads condition in Tha Kan Wa village tract is moderate. The roads can be accessd near Bogalae-Phapon highway road, which can used round the year. From highway road to other villages within village tract also can go by earth road during the summer season.

There are eight bridges which are moderate condition in this village tract. Access roads from Tae Pin 1 to the bridge named “Ma Sain” on Bogalae-Pyapon highway road rarely use during wet season since they can use only boat in the stream. Waterway from Tae Pin 1 to Myin Ka Kone village can be used round the year by boat. Villagers go to Myin Ka Kone for market, schools and hospital in the north by boat about half an hour. Some peoples use the road to go Shan Kwin in the east by bicycle or motorcycle about an hour especially for education. Some people go to Sayar Yoe village nearby Tae Pin 2 village by walk about 30 minutes or 15 minutes by motorcycle. Access road between Tae Pin1 and Hin Oh Gyi can be used during rainy season by boat but can walk about 1 mile distance during summer. Road and bridges in the village tract can be seen in Figure 5-1. Existing situation of some roads and bridges in Tha Kan Wa village tract are seen in Figure 5-2.

Summary of road condition in all four village tracts is shown in Table 5-1.

Table 5-1 Summary of road condition in surveyed village tracts

Road condition	Village Tract			
	Tha Kan Wa	Sabal Kone	Hpa Yar Thone Su	Sit Sali Htone
Connecting the villages	Moderate	Not Good	Not Good	Moderate
Difference between the use of roads during dry season and rainy season	Access roads from Tae Pin to Tha Kan Wa and Ma Sane Bridge are not useful in rainy season	Access roads from Sa Bal Kone to Ka Ma Ka Lu are not useful in both seasons	Access roads from Sa Bal Kone to Ka Ma Ka Lu are not useful in both seasons	Yone Dauk - Well Dauk access road is not good in rainy season
Unusable roads connecting the villages	-	-	Access roads from Hpa Yar Thone Su to Ka Ma Ka Lu are not useful in both seasons	
Bridges	8(Moderate)	20(Not good)	23(Not good)	17(Moderate)

Figure 5-1 Roads and bridges condition in Tha Kan Wa village tract

Access road within Tha Kan Wa village tract

Bridge between Sayar Yoe and Tae Pin1 village

Figure 5-2 Existing situation of some roads and bridges in Tha Kan Wa village tract

5.1.2. Sabal Kone village tract

The public roads are easily damaged because of heavy rain during wet season. According to the survey, most people have to use motorcycle to go to other villages and they would like to improve roads within the village tract. It is difficult for villagers to access school, health care services and hospitals as their village situated on road alignment in the centre of Figure 5-3 form Sabal Kone to south of Hpa Yar Thone Su. That road alignment called “Sabal Kone-Kam Ma Kalu”, during survey time it is only walkway with gravel road and difficult to walk in both rainy and dry seasons. Hence, major improvement between Sabal Kone to Hpa Yar Thone Su will be needed according to the village heads, elders and teachers. Villagers have to depend on only motorboat during high tide for human being and commodities transport within village tract and outside village tract like Bogalae.

Most roads connection within village tract in the Map is bad condition in both rainy and summer seasons. Most people go for market and health care service to Bogalae. For education, teachers and students have to go Sa Kar Lon Kone middle school by boat or walking everyday. After rainy season, water level in the rivers and streams is lower. Boats cannot go along water way so villagers including students and teachers have to go on foot everyday within village tract.

There are about 20 bridges in this village tract and most of them are concrete bridges but not good condition. Most people go by walk within village and less people use boat. When villagers and students go to school and health care centre of Sa Kar Lon Kone on foot is about an hour while they go by boat is more than half an hour. When the villagers go to Dar Chaung they have to spend about 30 minutes by walk but by boat is about 20 minutes. Sometimes they go to Taung Tha Lae village and it lasts about an hour by walk and about 45 minutes by boat for their business and education. When villagers go to Bogalae or Pya Pon, they go to junction of Tha Kan Wa and Bogalae- Pya pon highway road by boat then go ahead to Bogalae or Pya pon by motorcycle or by car. It will take time at least one and half hour, if they use only by boat to reach Bogalae or Pya pon will last about two hours.

Figure 5-3 Roads and bridges condition in Sabal Kone village tract

Table 5-2 Existing situation of roads and bridges in Sabal Kone village tract

 Access road Sabal Kone-Kama Kalu	 Bridge access between Sabal Kone-Kama Kalu

5.1.3. Hpa Yar Thone Su village tract

Most roads connection within village tract in the Map, Figure 5-5 Sabal Kone-Kama Kalu road from north to south is bad condition both wet and dry seasons. Although it is shown as a road in the map, actually it is walkway with gravel road and it is impassable during rainy season. Only waterway by boat is practical transport option to go to other villages within village tract and outside of the village tract. Moreover, if the water level is low in streams around village, villagers face difficulty not only to go out but also transportation of their products and goods for domestic consumption.

During discussion with village heads, elders and community peoples, their main issue is bad road condition. They have a keen interest to develop access road “Sabal Kone-Kama Kalu” which proposed alignment passes through this village but they have no budget. In addition, they all agree that because of bad road connection sometimes they feel not secure in the village. When they face police case, police could not reach even within 24 hours to their village Hpa Yar Thone Su. In addition, if they have serious health problem, it is difficult to reach nearest hospital in time. Another reason for better road is for students within village tract attending middle school in Hpa Yar Thone Su. It has more than 400 students and half of students and some teachers pass across the bamboo bridge that is seen in Figure 5-7. Some villagers go to Sabal Kone for their business either on foot about two hours during summer and if waterway by boat about 40 minutes. There are 23 bridges in Hpa Yar Thone Su village tract.

Most people use boat to go within village tract and outside of the village tract within one hour. But if they go to Bogalae or Pya Pon by boat, it takes at least two hours sometimes, more than that. When people go to Pya Pon villagers from this village tract scarcely use bicycle, motorcycle or car. It means transportation totally depends on boat transport.

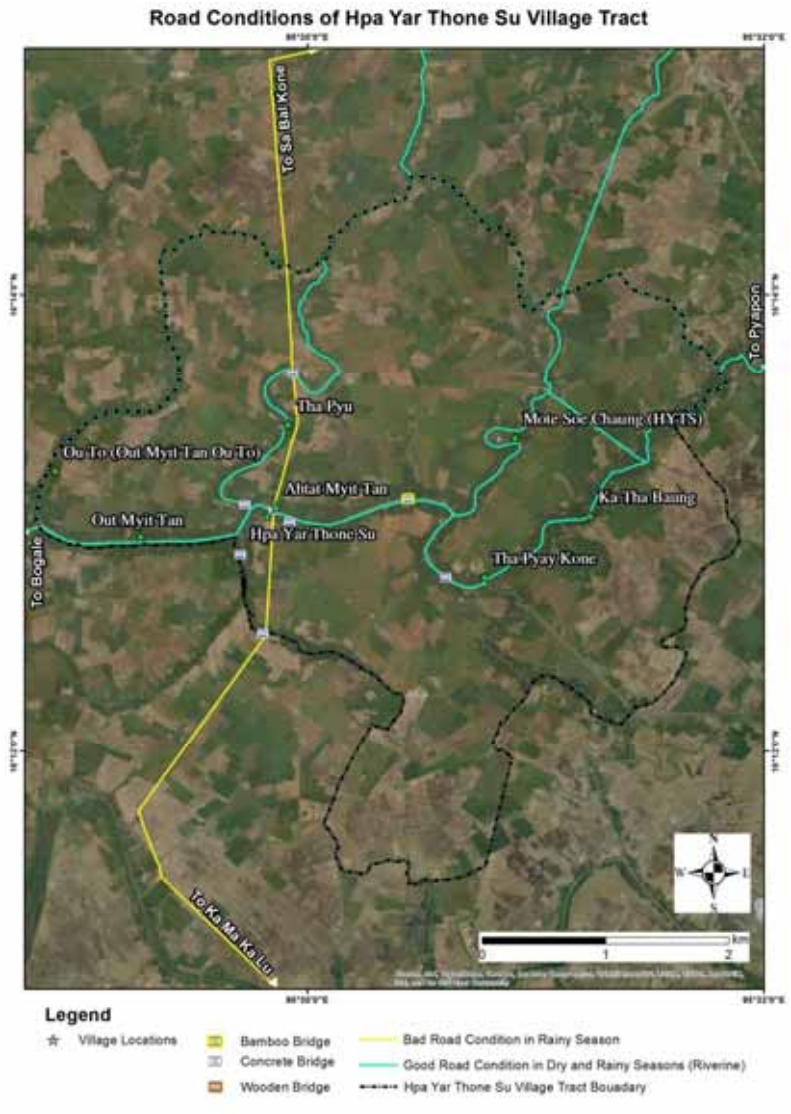


Figure 5-4 Roads and bridges in Hpa Yar Thone Su village tract

	
Access road Sabal Kone-Kama Kalu in Hpa Yar Thone Su village	Connection bridge between Tha Pyay Kone to Mote Soe Chaung
	
Access road between Hpa Yar Thone Su and Out Myit Tan village	Bridge between Hpa Yar Thone Su and Out Myit Tan village

Figure 5-5 Existing road and bridges situation in Hpa Yar Thone Su village tract

5.1.4. **Sit Sali Htone village Tract**

According to village heads, the villages of Sit Sali Htone villagers use gravel roads within village. Earth roads to get to main market Yone Daunt which is outside village tract are usable. However, during wet season access roads to Yone Daunk and Wea Daunt are not good condition with full of mud. During dry season rivers and streams water level is very low so transportation is also difficult. It is presented in Figure 5-6. Streams and creeks nearby village tract get narrower day by day especially during summer. These streams are no longer used for transportation. On the other hand, transportation for commodity is impossible by boats. Most villagers within this village tract use motorbike for transportation mean. In Sit Sali Htone village tract, diversity of transportation means are motorbike, car and boat but scarcely use bicycle.

There are 17 bridges in Sit Sali Htone village tract. Access road connected from Sit Sali Htone to Pat Taw is not good condition and roads to go Yone Dauk and Tha Khut Kone is also usable condition so many people have used these ways by walk for more than an hour, mostly use by motorbike for about 45 minutes and by boat for 15-20 minutes for main market, school and health care service. When villagers go outside village tract such as Wea Daunt which is near junction of Mawlamyine Kyun highway road, it takes time about an hour by car. Access roads condition can be seen as Figure 5-7.

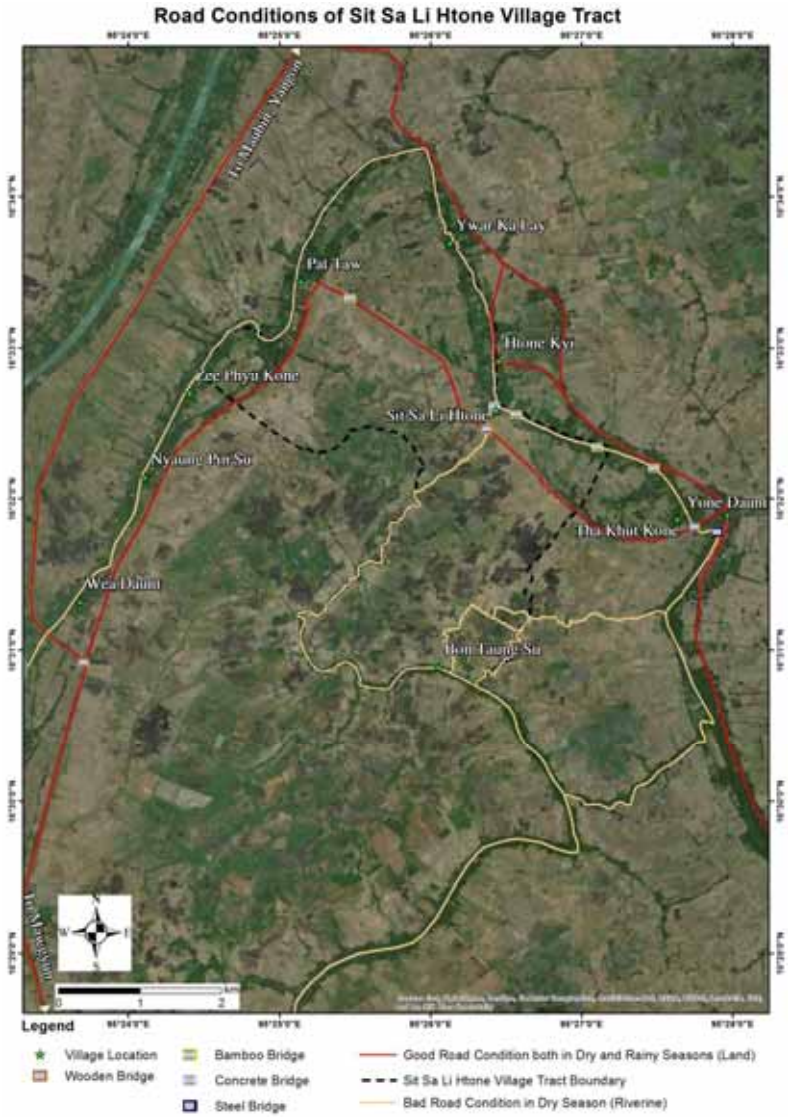


Figure 5-6 Map of existing road condition in Sit Sali Htone village tract

	
Access road between Sit Sali Htone and Pat Taw village	Bridge between Sit Sali Htone and Yone Dauk
	
Access road between Sit Sali Htone and Pat Taw village	Access road between Sit Sali Htone and Yone Dauk

Figure 5-7 Existing road and bridges condition in Sit Sali Htone village tract

5.2. SCHOOLS AND HEALTH CARE SERVICES

5.2.1. Tha Kan Wa village tract

Students of Tha Kan Wa village tract have access to high school education in Myin Ka Kone village that is far away about 1.5 mile from Tha Kan Wa village tract. Most children go to school by walking. Some students attend in sub-middle school in Sayar Yoe village. Some students attend in Shan Kwin high school. There are 8 schools including kindergarten school in this village tract.

Station Hospital in Myin Ka Kone provides healthcare for most of Tha Kan Wa village tract villagers when the Kyone Pha village rural health center cannot provide sufficient healthcare. Some goes further to Bogalae township hospital for better health service. Schools and health care services locations are as seen in Figure 5-8.

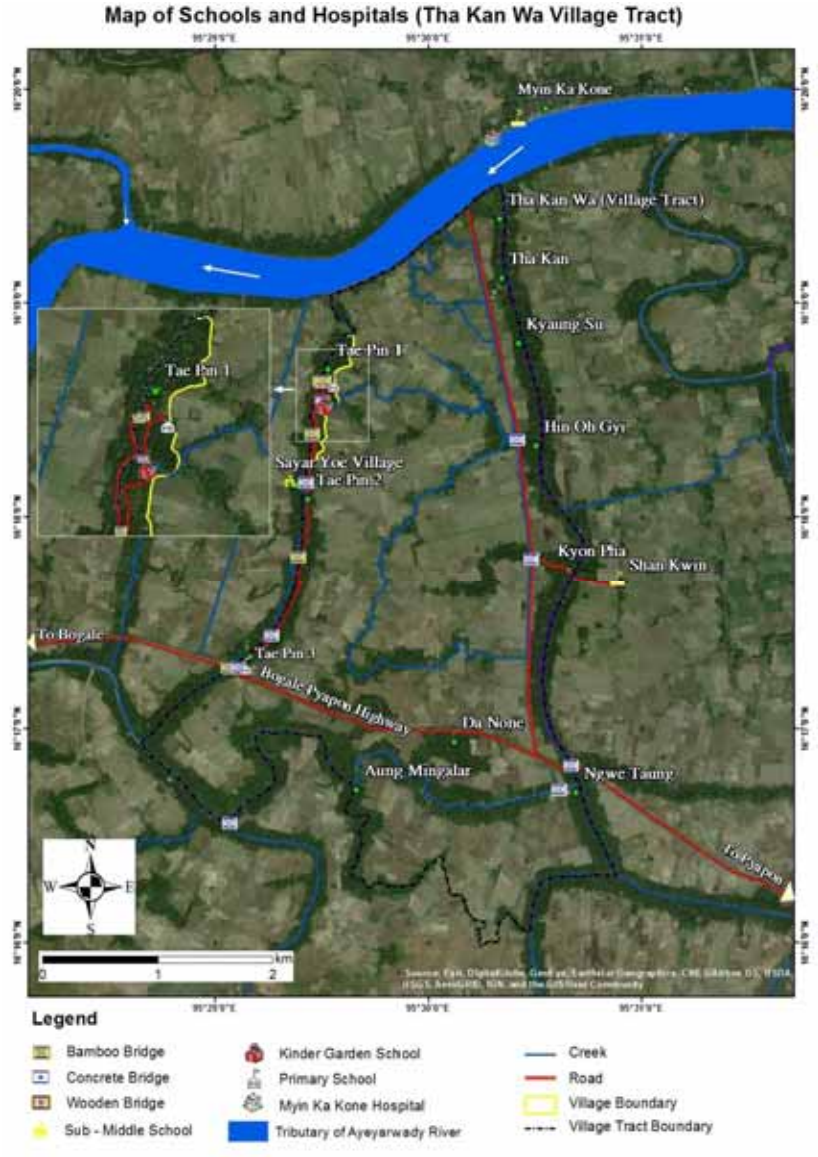


Figure 5-8 Location of Schools and health care services in Tha Kan Wa village tract

5.2.2. **Sabal Kone village tract**

Students from Sabal Kone village tract have access to primary education within the village. However middle school students have attended in Sakar Lone Kone village about 1.5 miles far from village tract and have to go 4 miles away Shan Kwin for high school education outside village tract. Some students can also go to Ngapi Chaung for Middle school education on foot more than an hour everyday. Few students attend in Sub-middle school especially in boarding school in Taung Tha Lae outside of the village tract. Less students go to Shan Kwin high school outside the village tract. There are six schools including middle school and sub-middle school in Sabal Kone village tract.

Similarly like students, villagers solve their general health problems in rural health centre at Sakar Lone Kone village within village tract. But most people go to Bogalae township hospital for better medication service.

Location of schools and health care service in Sabal Kone village tract is presented in Figure 5-9.

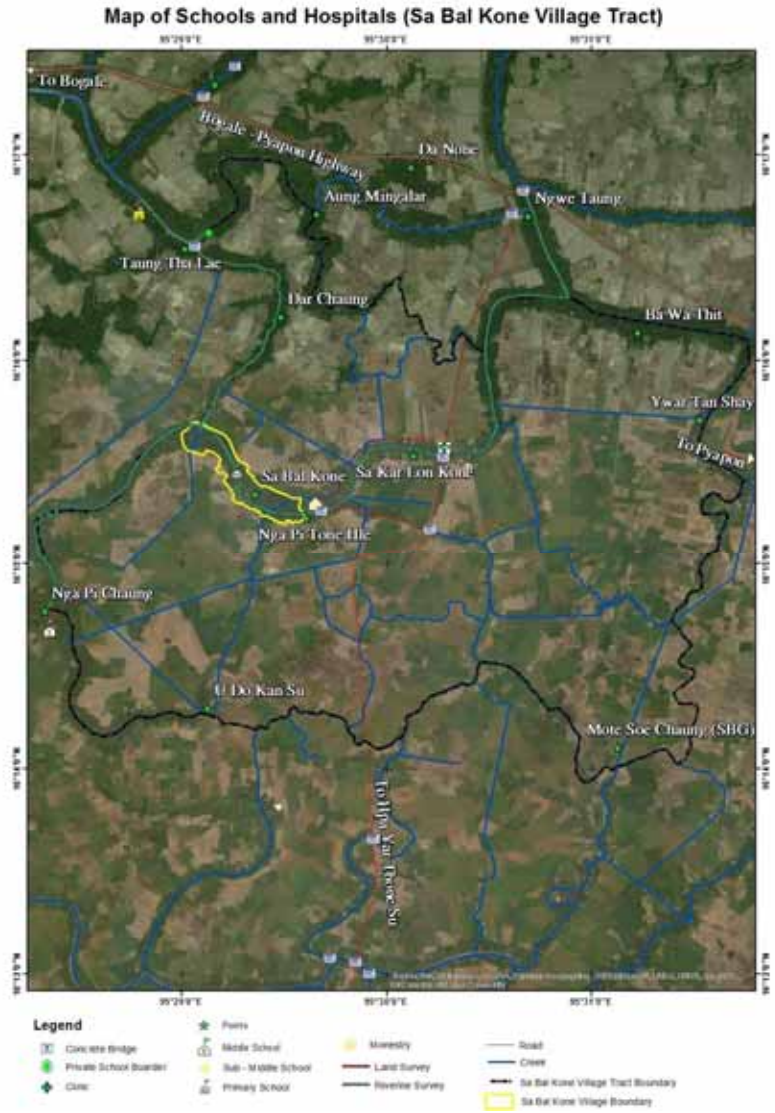


Figure 5-9 Map of schools and health care service in Sabal Kone village tract

5.2.3. **Hpa Yar Thone Su village tract**

There are total six schools in this village tract including sub-middle school in Hpa Yar Thone Su, post-primary schools in Mot Soe Chaung, Ka Tha Baung village and Tha Pyay Kone villages. Students have to go Kama Kalu high school about 6 miles away since village tract lack high school. It takes time about an hour everyday. Primary and middle school education can access within village tract.

Sub rural health center is located near sub-middle school so that most villagers can access health care within village by walking. But for better healthcare, they have to go Bogalae and Pya Pon hospitals by both boats and car. Education and health care access locations are shown in Figure 5-10.

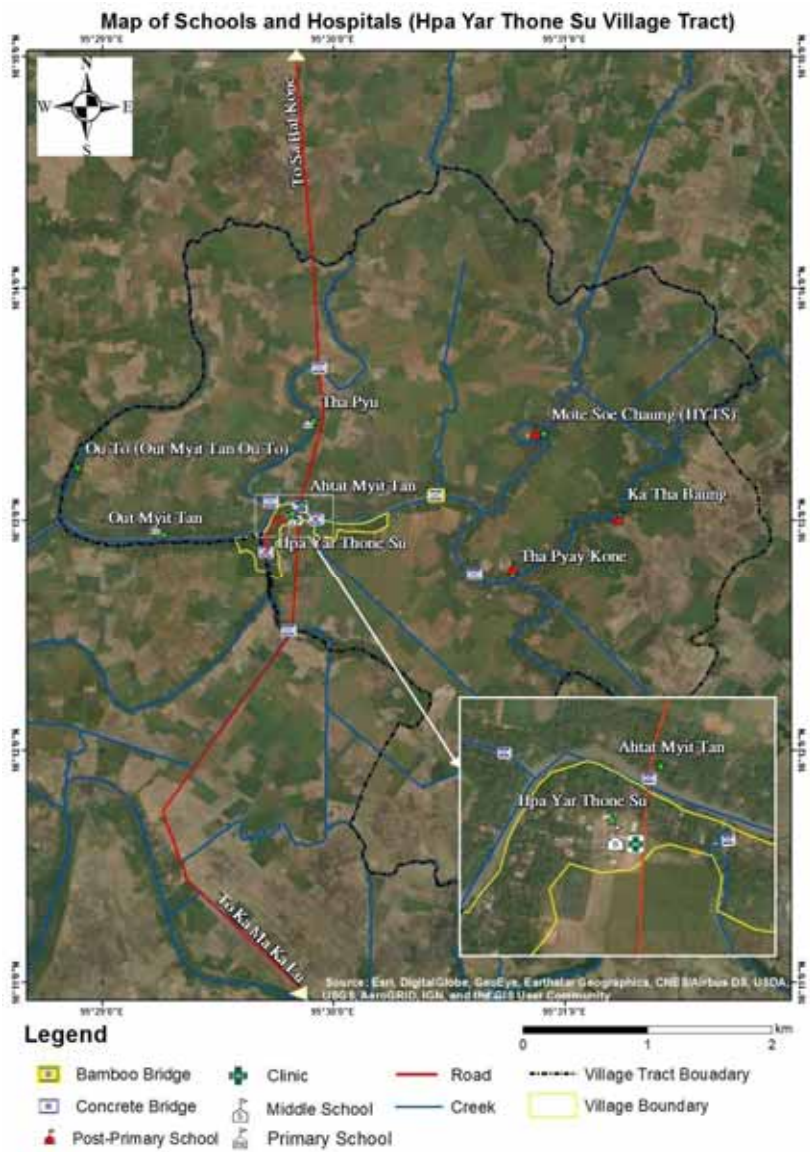


Figure 5-10 Map of Schools and hospitals in Hpa yar Thone Su village tract

5.2.4. **Sit Sali Htone village tract**

Students of Sit Sali Htone village tract can access high school education except matriculation exam within village tract. When high school students have examination, they have to go and sit at Yone Daunt high school. Some students attend in private school at Yone Daunt for better education for high school. There is no primary school in Ywar Kalay village under Sit Sali Htone village tract.

Yone Daunt station hospital is also the health care service for Sit Sali Htone villagers as there is no health care centre within village tract. Villagers can get access to market, education and healthcare at Yone Daunt. Location of schools and hospital in Sit Sali Htone village tract is illustrated in Figure 5-11.

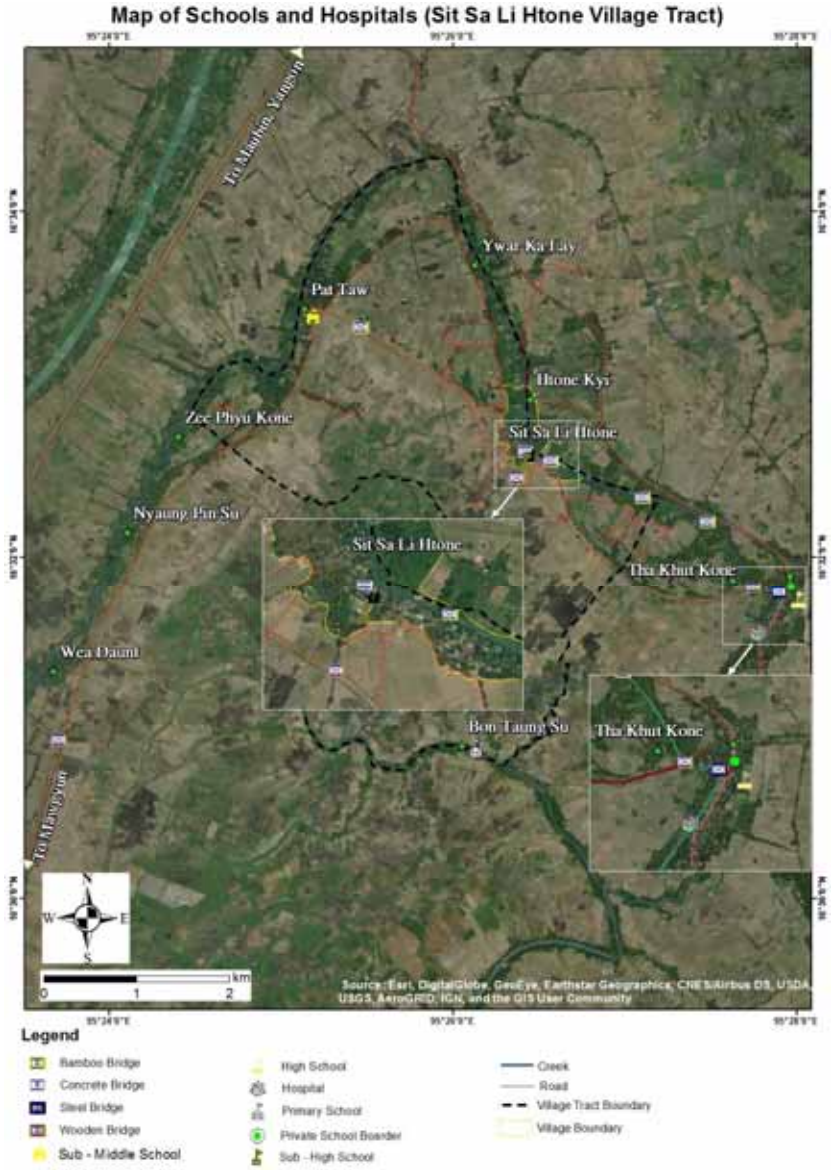


Figure 5-11 Schools and health care locations in Sit Sali Htone village tract

5.3. IRRIGATION SYSTEM

5.3.1. Tha Kan Wa village tract

Tha Kan Wa rice paddies use river and stream water that is streaming from west to east and north to south streams. As seen in the Figure 5-12, there are many paddy fields can get water nearby streams and rivers but the stream which is connected from west to east cannot provide water during dry season.

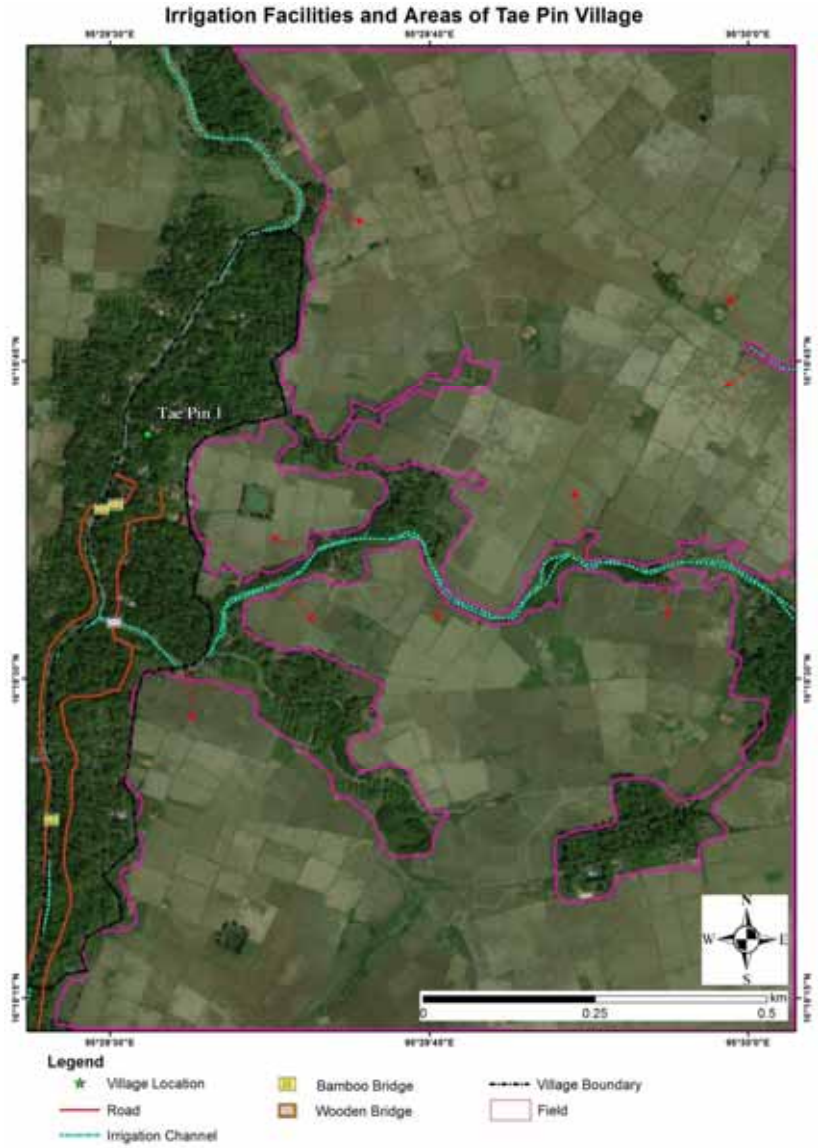


Figure 5-12 Irrigation system of Tha kan Wa village tract

5.3.2. **Sabal Kone village tract**

Sabal Kone village tract Irrigation area has been shown in Figure 5-13. During rainy season all paddy fields connect to the irrigation facilities which are scattered of streams and rivulets nearby the fields from north to south, some from northwest to southeast direction respectively.

Figure 5-13 Irrigation system of Sabal Kone village tract

5.3.3. Hpa Yar Thone Su village tract

This village tract is surrounding by rivers and streams so water for irrigation system easily to get anywhere nearby paddy fields. As shown in Figure 5-14, big area of rice paddy fields connected with rivers from north to south and passing across the stream within village tract.

Figure 5-14 Irrigation facilities in Hpa Yar Thone Su village tract

5.3.4. **Sit Sali Htone village tract**

In the past the main stream was a big river passing across the village. It is no longer river and very low water level during summer. According to village head and elders from Sit Sali Htone village tract, it has a stream from north to south and small canals from the stream going to southwest. The irrigation facility to the farmlands surrounding the village can be seen in Figure 5-15.

Around Pat Taw village under Sit Sali Htone village tract irrigation system is not regular in some fields even in rainy season because of different ground level. During summer these cultivated lands have difficult to reach water from proper irrigation system.

However Bone Taung Su village fields are over flow of waterlogged during rainy season called “Yay Net Kwin”. Therefore these paddy fields also hard to cultivate.

Figure 5-15 Irrigation facility in Sit Sali Htone village tract

5.4. WATER SUPPLY

5.4.1. Tha Kan Wa village tract

The village gets domestic and drinking water supply from rivers and streams nearby villages during rainy season. There is no pubic water well or any tap water in the village tract. However the villagers have no difficulty for the water during rainy season; during dry season they face water shortage about 2 weeks. Some villager can store water with ground tank. In a household, mostly adult male and female take responsibility of water fetching. In most cases, it takes less than 10 minutes to fetch water (76.7%).

5.4.2. Sabal Kone village tract

Similarly in this village main water supply system is rivulets and streams near villages and if it is rainy season, there is no problem for domestic and drinking water. However they have faced about a month with water storage problem especially for drinking water. Most of them cannot store water for dry season. Water fetching takes less than 10 minutes for 98% of household. This responsibility is shared between adult male and female, but female (63.6%) takes more responsibility.

5.4.3. Hpa Yar Thone Su village tract

This village has a big pond for drinking water so it can provide some other nearby villages within village tract during dry season. Due to delta region village, there are many houses have water from the river and stream around villages. Adult male and female equally shares the responsibility of fetching water in a household. So there is no difficulty for rainy season both domestic and drinking water. But sometimes during summer, villagers within village tract and surrounding area face water shortage problem about 2 weeks. Therefore all village heads discussed and distribute water by quota system for every household.

5.4.4. Sit Sali Htone village tract

Few part of this village faces water shortage issue not only for drinking but also for domestic in this village. Shortage duration also lasts about 1-2 months. Villagers bring water from Htone Gyi which is near Sit Sali Htone village. But some villagers have to fetch water by trailer jeep from some other village under Kyaik Latt township. These peoples spend more than 2 hours for fetching water for their households from stream and river. This responsibility is shared between adult male (63%) and female (23%) in a household.

CHAPTER 6
PRIORITY OF INFRASTRUCTURE

6.1. MAIN ISSUES

Ministry of Construction (MOC) in Bogalae and Mawlamyine Kyun Townships does not own any heavy construction machines. During the time of need, the ministry needs to get approval from other Ministries of Roads and Bridges Department to get construction machines.

Due to rain and many rivers, streams and creeks, most of the roads are not good in surveyed village tracts. On the other hand, all of community villagers depend on only motorboats and other small boats for transportation in the region. Some sections of the road situation are impassable during wet season as seen in below Figure 6-1.

Access road between Wea Daunt and Maubin-Yangon Highway Road

Access road near Hpa Yar Thone Su village

Figure 6-1 Bad condition access roads within surveyed village tracts

Some bridges across the streams and creeks are also damaged during heavy rain and most bridges are made of one or two long bamboo or betelnut tree trunk. They are very dangerous and difficult to pass especially for young students. Some bamboo bridges can be seen in Figure 6-2.

Bamboo bridge	Bamboo bridge

Figure 6-2 Bamboo bridges within surveyed village tracts

The surveyed villages also have difficulties in transportation of their products rice paddy and obtaining goods in big cities such as Bogalae, Pya Pon and Kyaik Latt due to bad road conditions. Although it has been ten years since Nagis cyclone, the effect of the disaster is a reminder why infrastructure investment is badly needed in the area.

Moreover, some village tracts cannot go by boat during dry season since low level of water in rivulets, streams and creeks around their villages. Then, peoples carrying heavy loads have to wait high tide water level due to waxed and waned of lunar calendar. It means that transportation by water is not reliable in some village tracts especially Sabal Kone village tract.

For Sit Sali Htone village tract, some villages have no primary school so primary students difficult to access even primary education in Ywar Kalay village. In Sit Sali Htone village experienced water shortage in some parts. The time it takes for fetching water is a daily problem.

6.2. PRIORITY OF INFRASTRUCTURE DEMAND

Due to their main issue, all surveyed village tracts demand in priority in roads and bridges in terms of their situation and location as following priority;

6.2.1. Tha Kan Wa village tract

In this village tract, village heads and elders demanding in first priority is roads within their village tract. Second priority of infrastructure that they need is schools for children. Last but not least, third priority is health facility within village tract since Myin Ka Kone is the place they go by foot and boats.

6.2.2. Sabal Kone village tract

Sabal Kone village tract lists first priority as access roads connecting Kama Kalu village tract. It needs better roads and at the same time bridges are also not negligible for improvement. Then, most farmers have keen interest to promote their agricultural machines and method for more productivity and market standard. They have limited knowledge and practice of fertilizer, pesticides and suitable alternative crops in their fields. In addition, there is no school in their village when their hope rest on their children education. In order to fill up their gap, they need school for village children. Lastly, water supply system within village tract is also required especially during dry season.

6.2.3. Hpa Yar Thone Su village tract

Access road “sabal Kone-Kama Kalu is an essential need as first priority for Hpa Yar Thone Su villagers. Then, the bamboo bridge between Out Myit Tan village and Hpa Yar Thone Su village is major requirement for improvement. It is for passing across more than two hundred students and teachers from other villages each and everyday to attend Sub-middle school in Hpa Yar Thone Su village. Due to far away from cities and spend

more time by boats, they are eager to upgrade sub-middle school to high school for young generation. Similarly like Sabal Kone villagers, their main livelihood rest on agricultural production methods and machines. Following agricultural sector, health facility should be improved for villagers. As next priority, water supply need improvement, particularly drinking water to provide whole village during summer. Lastly, students use cyclone shelter as class rooms in sub-middle school building in Hpa Yar Thone Su sub-middle school. They are in need for construction materials for the school.

6.2.4. Sit Sali Htone village tract

Access road from Young Daunt to Sit Sali Htone is needed as first priority for the village tract. Access roads within village tract are required as well. Similarly roads and bridges within village tract need improvement according to survey. Next priority for improvement is systematic irrigation for the paddy fields since some paddy fields ground level is different. Because of improper irrigation system, some shallow fields will be flooded and waterlogged all the time during rainy season. At the same time, villager heads, elders and farmers seek to improve technology in agricultural mechanization, systematic and timely fertilizer practice in their village tract as they have no financial assistance scheme. Following is construction materials for new sub-middle school as it has been fifty years already and classrooms are too small.

CHAPTER 7
RECOMMENDATION

Recommendations are different in all four surveyed village tracts of Bogalae and Mawlamyine Kyun in line with their needs and demands as follows:

- Roads and bridges are essentially needed to improve not only for infrastructure but also for transportation of products in all surveyed village tracts
- Proper technology for agricultural machines and services are necessarily needed in all village tracts
- Agricultural related business and food processing factories should be develop within Ayeyarwaddy region
- Access roads connected to villages within village tract and access road from Tae Pin 1 to Ma Sane bridge are priority for Tha Kan Wa village tract
- Sabal Kone –Kama Kalu access road and the main bridge near sub rural health care centre are prioritized requirement of Sabal Kone village tract
- Access roads and bridges within village tract and upgrading of school are necessarily needed for Hpa Yar Thone Su village tract
- Access roads and bridges within village tract are first priority, water supply facility and systematic irrigation system for cultivated lands and construction materials to renovate sub-high school are needed for Sit Sali Htone village tract

In conclusion, infrastructure, education and technology investments are needed for long-term improvement in productivity. The agricultural related businesses along with other industries and small businesses could flourish if invested in those sectors effectively.

７－６　ミャンマー免税情報シート

別紙１

ミャンマー国免税情報シート

更新日：2017 年 9 月 27 日

（１）企業の所得に課される税金（法人税など）

【税の基礎情報（名称、税率、計算方法、根拠法）】

- 名称：法人税
- 税率：居住法人・非居住法人とも 25%。但し、キャピタルゲインは、別申告にて 10%。
- 計算方法：課税所得に課税されるが、この所得が企業会計上の利益をベースとするのか、具体的な規定はないとみられる。このため、減価償却費以外は、会計上の利益と所得との関係が税法上明確となっていない。経費の損金算入基準についても、抽象的な基準が 3 つあるのみ。
- 根拠法：INCOME TAX LAW

【免税に必要な情報（手順、申請先、所要期間）】

免税には、ミャンマーの所得税法による免税と他国との条約による免税とがある。
ミャンマーの所得税法に基づく免税に関しては、所得税法自体ではその手続き等に関する規定はない。
交換公文等による免税に関しては、別途の合意がない限り、案件ごとに課税当局に照会・協議する必要があると考えられる。

【備考】

備考：一般的には施設建設案件において法人税の免税手続きが必要となる。

（２）企業の従業員の所得に課される税金（個人所得税など）

【税の基礎情報（名称、税率、計算方法、根拠法）】

- 名称：個人所得税
- 税率：原則、ミャンマー人及び外国人とも 0%～25%の累進税率。但し、キャピタルゲインは、ミャンマー人及び外国人とも一律 10%で別申告。
- 計算方法：給与、賞与、諸手当に課税。交通費等は非課税。
- 根拠法：INCOME TAX LAW

【免税に必要な情報（手順、申請先、所要期間）】

免税には、ミャンマーの所得税法による免税と他国との条約による免税とがある。
ミャンマーの所得税法に基づく免税に関しては、所得税法自体ではその手続き等に関する規定はない、
交換公文等による免税に関しては、別途の合意がない限り、案件ごとに課税当局に照会・協議する必要があると考えられる。

【備考】

備考：一般的には施設建設案件において個人所得税の免税手続きが必要となる。

（３）付加価値税（VAT)

【税の基礎情報（名称、税率、計算方法、根拠法）】

- 名称：商業税
- 税率：原則 5%。
- 計算方法：ミャンマー国内における財貨の販売、役務提供、及び財貨の輸入が課税対象。日本と異なり、輸出免税は財貨の輸出に限定され、サービスの輸出は非課税サービスに該当しない限り課税、また一部の物品輸出も課税。仕入れ控除には制限され、または取扱いが不明な点が多い。
- 根拠法：COMMERCIAL TAX LAW

【免税に必要な情報（手順、申請先、所要期間）】

免税には、ミャンマーの商業税法による免税と他国との条約による免税とがある。ミャンマーの商業税法に基づく免税に関しては、商業税法自体ではその手続き等に関する規定はない。

交換公文等による免税に関しては、別途の合意がない限り、案件ごとに課税当局に照会・協議する必要があると考えられる。

【備考】

①ミャンマーにおける商業税の免税に関して、事前免税方式と事後還付方式の区分として、少なくとも商業税法上は、免税を二つの形態には区分した規定はないとみられる。したがって、両者の区分があるとすれば、それは交換公文等の解釈又は両国間の合意によるもの、あるいは単なる事実上の慣行によるものと考えられる。

②ミャンマーの有償・無償資金協力事業において、例えば本体工事代金部分は日本側負担で外貨支払い、一方、商業税部分はミャンマー政府負担でチャット払いといった契約事例もあるとのこと。その場合、工事本体は外貨支払い、商業税はチャット払いとなり、しかも工事本体部分の支払者と商業税の支払者とが異なることとなる。この結果として、工事請負業者は本来、工事本体の売上げ時レートによってミャンマー政府にチャット建て商業税を請求しているにも関わらず、ミャンマー政府は、商業税を業者への支払日レートで行なってしまう可能性もある。懸念事項として、場合によっては事後に、工事請負業者が追加納税、修正申告等を強いられる事態にもなりかねず、注意が必要と考えられる。

③商業税が免税扱いとなる場合は、単に売上げが免税扱いとなるだけか、あるいは仕入れ控除も取れるのかを明確にしておく必要があると考えられる。日本の消費税で免税扱いとなる場合、同時に仕入れ控除も取れる（すなわち輸出免税）との見解が有力であり、そのような日本の法制度を前提として締結される交換公文等については、その解釈にも影響してくる可能性があると考えられる。

備考：事前免税方式か事後還付方式かについて正確に記載すること。VAT の免税／還付申請のために、当該国で法人登録や税務監査の受入れなどが必要になり、追加コストが必要となる場合もあるため、これら手続きやコストについても記載する。

（４）資機材の輸入及び再輸出の際に課される税金や手数料

【税の基礎情報（名称、税率、計算方法、根拠法）】

- 名称： 関税
- 税率： 輸入品により異なる
- 計算方法：-

根拠法：Control of Imports and Exports Act

【免税に必要な情報（手順、申請先、所要期間）】
申請先：実施機関, Directorate of Investment and Company Administration (DICA) Office
手順：
① 調達業者より実施機関に、輸入許可取得のための Profoma Invoice を提出。
② Profoma Invoice に基づき、実施機関より経済･通産省に、Import License（輸入許可）を申請。
③ 経済･通産省より、実施機関に対して Import License 発行。
④ 実施機関より、計画･財務省に免税申請を提出。
⑤ 計画･財務省より、実施機関に対して免税承認。
時間：約２ヶ月

- 名称：輸出入前払法人税
- 税率：2%
- 計算方法：原則すべての貨物が対象とされ、輸出の際は、輸出貨物の課税価格の 2%を通関時に納税し、輸入の場合は、輸入貨物の課税価格の 2%を通関時に関税と一緒に納税する。納税義務者はミャンマーの輸出入業者であり、源泉税でなく自ら税として納税する。
- 根拠法：計画･財務省令 17/2016(2016 年 2 月 4 日付)

【免税に必要な情報（手順、申請先、所要期間）】
原則 2%の税金が課せられることから、免税手続き等の情報はなし。

【備考】
上記の通り課税が原則であるが、有償・無償資金協力事業において、事前に免税証明書等が発行される実績があるとの情報を得ている。本件は引き続き「免税に必要な情報」等について情報収集を行う。

備考：事前に免税証明書等が発行され、通関時に免税が確保される方式と、通関後の事後申請により還付される方式とがありえるため明確に記載すること。

以下、JICA 内部情報（非公開）
在外事務所の担当者（部署、名前、連絡先）：
更新履歴：（更新日、更新者、更新内容）

７－７　小型膜ろ過浄水システムの視察結果報告

エーヤワディー地域 Pathein 市（Magyi Kone VT, Chaungwa Village）
小型膜ろ過浄水システムの視察結果報告

2018 年 12 月 14 日

1. 背景

ミャンマー国地方部農村インフラ準備調査の給水施設の対象地域であるエーヤワディー地域は、2016 年度「貧困削減小規模インフラ情報収集・確認調査」の実施以降、ミャンマー実施機関関係者との協議を通じ、農村開発やベーシック・ヒューマン・ニーズの観点に基づき、複合セクター（道路・橋梁、灌漑、給水）支援により事業効果が高いと考えられる地域を選定している。当該エーヤワディー地域は、乾季に水源である雨水の水量が減少し、渇水状態に陥る。既存施設としては、雨水を原水とした飲料水用の雨水貯留池や雨水貯留タンクであるが、水処理施設が付帯されていないため、安全な水へのアクセスが実現出来ておらず、乾季における安全な水の確保が喫緊の課題である。

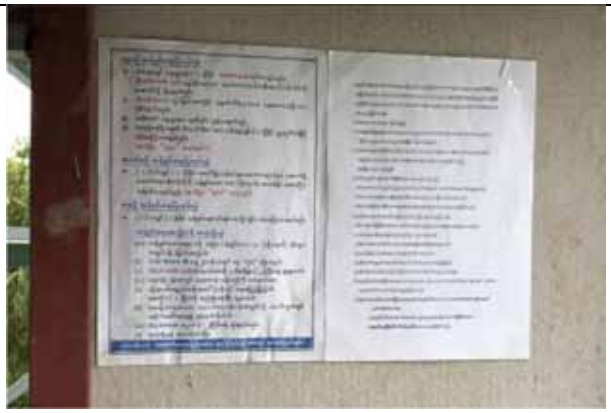
かかる状況下、ミャンマー政府は、2030 年までに飲料水 1.0 ガロン（4.5L）/人/日、生活用水 9.0 ガロン（40.5L）/人/日、給水アクセス率 100%を上位目標としている。一方、本計画の協力対象としている 3 村落においては、水源量や施設建設用地の確保の問題から、上位目標の全給水量を計画施設により達成することは困難である。そのため、喫緊の課題である乾季の渇水対策に重点を置き、乾季に安全な飲料水 1.0 ガロン（4.5L）/人/日を確保することを計画目標とした給水施設を計画した。

一方、2018 年 12 月 10 日に実施した概略設計説明において、給水セクターの実施機関である農業畜産灌漑省地方開発局（以下、「DRD」という）より、先方が自前予算（中央政府予算）で地方展開を検討している村落給水のための簡易施設（スイス製 小型膜ろ過浄水システム）について技術的相談を受けた。調査団は上記相談を受け、DRD エーヤワディー地域職員同行のもと、2018 年 12 月 13 日に簡易施設のパイロット地区である Pathein 市近郊 Chaungwa Village を現場視察した。以下に、現地視察結果を報告する。

2. 現場状況

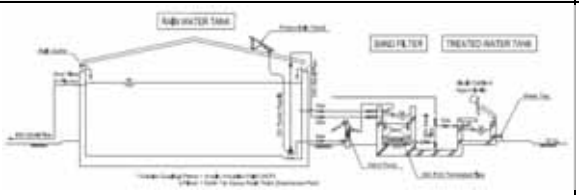
視察結果は、以下の写真のとおりである。

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>【竣工日】
2018 年 8 月 6 日に施工が開始され、2018 年 9 月 7 日より施設の運用が開始された。現在までの実運用期間は約 3 ヶ月である。</td><td>【全体施設外観】
右上貯留タンクに河川水をポンプアップし、自然流下により中央部の小屋に設置された膜ろ過浄水器で浄水し、下部にある配水タンクの水栓より給水する。施設建設用地は、村人からの寄贈によるものである。総建設費は 1,350 万 kyat であり、うち、DRD が 1,000 万 kyat 負担し村民が建設した。</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>【取水場】
施設から数 m 離れた河川から、揚水ポンプにより揚水し、高さ 6m の上部タンクに原水を貯水する。以前は、この河川水の煮沸や雨水を飲料水として利用していた。パイロット地域は海岸線から離れているため、満潮時でも河川には、海水が混入しない。</td><td>【揚水ポンプ】
最大揚程 8m、容量 60L/分のポンプにより、管理者が揚水する。電源は商用電源であり、9-11 月の電気代は 3,000kyat/月である。乾季は稼働が多くなるため、負担が大きくなることが予想される。</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>【揚水ポンプのオペレーション】
管理者により、ポンプのオペレーションを手動で実施する。管理者（水利組合）は他のオペレーションも含め、7 名体制で実施している。</td><td>【小型膜ろ過浄水器】
小型膜ろ過浄水器に原水を自然流下で流入させ、12L/時間のろ過能力で浄水する。本施設は、95 世帯（約 400 人）の給水人口であるため、10 基連結して 120L/時間までろ過能力を高めている。</td></tr>
</table>

<table>
<tr><td>  </td><td> 
</td></tr>
<tr><td>【浄水器の内部】
原水が浄水器上部に貯留され、浄水器中部に設置されたフィルターにより、ろ過する。ろ過速度は、12L/時間、フィルターの寿命は、4-5NTU の濁度で最大100,000L である。(メーカーホームページよる) フィルターの調達は DRD Pathein 事務所がサポートしているが、調達に係る費用は村民達が維持管理費として捻出する。また、フィルターの予備は購入時に付帯されていない。現在まで、3 ヶ月の運用期間中は、フィルターの交換は実施していない。</td><td>【フィルターの洗浄剤】
メーカー指導により、フィルターを毎月 1 回洗浄剤（塩素）にて消毒を実施する。消毒には 1 日要するため、その間のオペレーションは停止する。停止中は、事前に配水タンクに十分な処理水を貯留して給水準備する。</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>【ろ過後の浄水】
目視では透明度も高く感じられる。また臭気も感じられない。
DRD Pathein 事務所の水質試験では、ミャンマーの水質基準を満たしており、浄水前の河川水の濁度は 70NTU に対し、2NTU まで除去されている（WHO 基準では 5NTU 以下)。</td><td>【運用ルール】
・ 飲料水および料理用を使途とし、1.0 ガロン(4.5L)/人/日の給水量とする事。
・ 生活用水は河川や雨水を利用する事。
・ 水道料金は 1 世帯当たり 1,000kyat/月を徴収する。
・ 徴収料金より維持管理費を捻出する。</td></tr>
</table>

3. 本計画給水施設と小型膜ろ過浄水システムの概要比較

以下に、各施設の概要を示す。

項目	本計画給水施設	小型膜ろ過浄水システム
概略図		
施設位置	エーヤワディー地域、Bogale/Sit Sali Htone/ Takanwa Village Tract	エーヤワディー地域、Chaungwa Village
給水人口	3 村落（23 村）：合計 9,992 人	1 村落（1 村）：合計約 400 人
給水原単位	1.0 ガロン（4.5L）/人/日	1.0 ガロン（4.5L）/人/日
給水システム	原水を雨水とし、砂ろ過による夾雑物の除去および塩素処理を実施	・河川を原水とし、中空糸膜により、濁度や細菌類を除去 ・塩素処理は行っていない。
原水	雨水	河川
施設構成	・雨水貯留槽 ・砂ろ過池 ・浄水タンク	・河川水貯留槽 ・膜ろ過浄水器 ・配水タンク
必要機材	ソーラーポンプユニット/ハンドポンプ	・膜ろ過浄水器（メーカー： Vestergaard 社（スイス）、商品名：Life Straw@community） ・揚水ポンプ（電源：商用電源）
浄水方法	砂ろ過/塩素注入	フィルターろ過（中空糸膜）
ろ過能力	最大 1,600L/時間	12L/時間
ろ過材寿命	最大 585m^3 （585,000L） 目詰まりした場合には、表層の砂の掻き取りにより、性能は回復する。（定期的な砂の補充が必要）	4-5NTU の濁度を有した原水の通水で最大 100m^3（100,000L） * メーカーホームページより 膜寿命に達した場合には、フィルターを交換する。（交換用フィルター：80,000kyat）
水質	ミャンマー国の飲料水の基準を満たし、かつ、大腸菌の検出なし。	ミャンマー国の飲料水の基準を満たす。 （ただし、ミャンマーでは大腸菌検査を義務付けていない）

4. 本計画給水施設と小型膜ろ過システムの比較検証

以下に、本計画給水施設と小型膜ろ過システムを比較した際の評価結果を示す。

項目	雨水貯留タンク（計画給水施設）	小型膜ろ過システムを本施設に適用した場合
給水システム	原水を雨水とし、砂ろ過による夾雑物の除去、および大腸菌の死滅と、一時貯留時の雑菌の繁殖を抑えるため、さらし粉による処理を実施	河川を原水とし、中空糸膜により、濁度や細菌類を除去
耐用年数	50 年（RC 製） 【◎】	約 10 年（硬質プラスチック製） 【△】
施工期間	約 2.5 ヶ月 【○】	約 2 週間 【◎】
施工性	小型の重機を必要とし、現地の施工業者で施工 【△】	人力施工が可能で、現地の施工業者および水利組合で施工 （ろ過装置本体の組立てや場内配管などは、現地の水利組合で施工可能） 【◎】
設置条件	・小型重機が搬入可能である事 ・雨水の集水が十分に可能である事 ・計画給水量を満たすために必要な容量に対して十分な用地面積がある事	・河川沿いである事 ・乾季に河川の水量が十分にある事 ・広大な用地面積は不要
設計条件	・対象地域の風荷重を考慮 ・軟弱地盤対策を考慮 【○】	－ < *風荷重や軟弱地盤対策を検討する必要がある。>
維持管理	・給水量管理（4.5L/人/日） ・雨水貯留槽、ろ過池、浄水タンクの点検、修繕が必要 ・塩素の注入/日および塩素の調達/年が必要 ・残留塩素の定期モニタリングおよびモニタリング用試薬の調達/年が必要	・給水量管理（4.5L/人/日） ・膜ろ過機材、貯留タンク、揚水ポンプの点検、修繕が必要 ・フィルター交換（70,000L～100,000L 毎）、毎月のフィルター洗浄が必要 <*河川は濁度が高いため、フィルター交換頻度は増加する事が懸念される。>
水質	ミャンマー国の飲料水の基準を満たす。 <*さらし粉による殺菌と残留塩素効果の持続を前提として計画しており、大腸菌の検出を生じることは無い。> 【◎】	ミャンマー国の飲料水の基準を満たす。 <*ただし、ミャンマーでは大腸菌検査を義務付けていない。但し、WHO ガイドラインに基づく、殺菌と残留塩素効果の持続が必要とされる。> 【◎】
建設費[注 1)]	約 5 億円（50 千円/人） 【△】	約 2,500 万円（2.5 千円/人） <*風荷重を考慮した施工費や場所によっては地盤改良費が追加で必要になる。> 【◎】
維持管理コスト[注 1)]	約 200kyat/人/年（940kyat/世帯/年、0.25kyat/L） 【◎】	約 1,500kyat/人/年（6,000kyat/世帯/年、1.85kyat/L）[注 2)] <*ソーラーポンプを使用した場合、約 1,550kyat/人/年> 【△】

注 1) 建設費と維持管理コストについては、本計画施設の条件（給水人口約 10,000 人に対して、年間当たり乾季の 6 か月間で 4.5L/人/日の飲料水を供給）で算出した。

注 2) 小型膜ろ過システムは雨季も稼働しているが、計画給水施設と同等の乾季のみの稼働としてコスト計算して比較している。雨季は稼働時間が短いが、雨季の稼働期間も含めると、さらなるコスト増になることが想定される。

5. 小型膜ろ過システムを本計画給水施設に適用した場合の課題

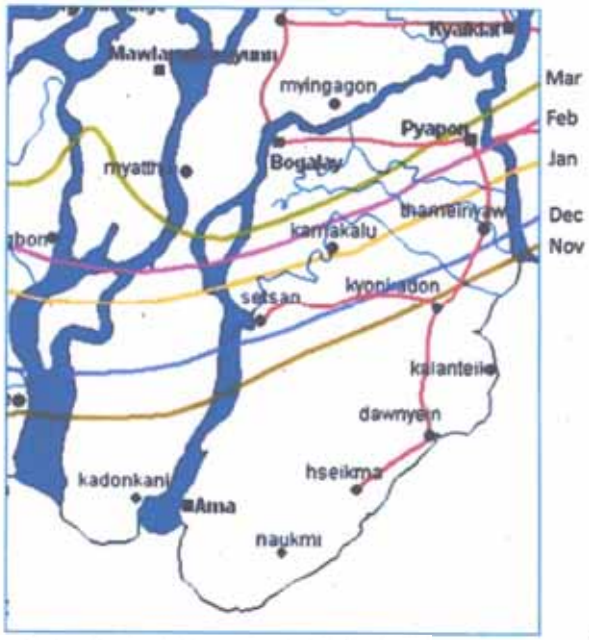
今回の現場視察ならびに DRD Phatein 事務所職員への聞取り調査により、施設を計画する上で以下の課題が挙げられる。

1) パイロット地区は、河川沿いの設置状況が良好かつ、商用電力の供給されている地域を対象としている。そのため、河川から遠方にある地域、また商用電力の整備されていない地域に施設を計画する際は、原水を揚水する手段を検討する必要がある。

2) 小型膜ろ過システムは、試験開始してからまだ 3 ヶ月しか経過していない。これから本格的な乾季となるため、河川水量の減少も含め、乾季における施設運用状況のモニタリングが必要である。

3) 家庭用浄水器等で一般に使用される精密ろ過中空糸膜では、農薬や洗剤の除去、イオン除去は対象としておらず、このことは本装置にも該当すると判断（推測）される。そのため、河川に上記の不純物が混入した場合、安全な水の供給が危ぶまれる。施設を展開するには、原水の水質についても定期検査やモニタリングが必要である。また、図 1 に示す通り、エーヤワディー地域の南部は塩水が遡上する傾向にあるので、施設の展開には注意が必要である[1]。

4) DRD Pathein 事務所の水質試験結果によると、河川の濁度は 70NTU と非常に高い。小型膜ろ過浄水器のメーカー発表では、ラボ環境の 4-5NTU で試験した結果、70,000L～100,000L 毎でのフィルター交換とされている。そのため、濁度が高い状態で使用し続けた場合、フィルター交換頻度が高くなり、さらに維持管理費が高くなると想定される。



出所：灌漑・水利用局ボガレ事務所

図 1　本計画対象地域周辺の塩水遡上マップ（参考資料）

5) パイロット地区は電力の供給されているため、商用電源によるポンプ揚水が可能となっている。今後、電力の供給されていない村落に展開する際には、太陽光発電やディーゼル発電機などの代替電源が必要と考えられるが、太陽光発電は発電力が小さく、また直流ポンプは揚程が制約される。揚程に合わせた施設設計を検討する必要がある。ディーゼル発電機の場合は、燃料代が嵩むため、維持監理費の負荷が増える。

6) 膜は万能ではないので、膜処理水を一時貯留する場合には、WHO 基準からも、塩素殺菌と残留塩素の義務化が必要である。

[1]塩分を除去するためには、ナノろ過や逆浸透膜による処理が求められるが、逆浸透圧を確保するためのポンプ施設が不可欠であり、維持管理コストの増加を招く。

6. 今後の考察

小型膜ろ過浄化システムは、建設費が安価で処理水の水質も良い。そのため、十分な水量を有する河川が近傍にある等の条件を満たせば、エーヤワディー地域の村落給水を展開するうえで非常に有効なシステムであると考える。

一方、今回視察したパイロット地区では、試験運用開始から 3 ヶ月しか経過していないことから、今後、乾季の運用状況をモニタリングし、試験実績を蓄積する必要がある。

最後に、今後の村落給水においては、河川条件や電力事情等の地域特性に応じて、従来方式を併用して展開することで、国家計画とする給水量および給水アクセス率の向上を目指すことが推奨される。

以上

７－８　環境社会配慮に関するスクリーニングフォーマット

Appendix 4. Screening Format

Name of Proposed Project: Project for Rural Infrastructure Development in Local Areas

Project Executing Organization, Project Proponent or Investment Company:

Department of Rural Road Development (DRRD), Ministry of Construction (MOC)

Name, Address, Organization, and Contact Point of a Responsible Officer:

Name: U Wunna Zaw (Deputy Director General)

Signature:_____

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site (See Attachiment-1)

≪Zarthwlor village tract in Falam Township in Chin State≫

PA(U)

- Route PA(U)(L=0.4km)／Upgrading
- PA(U) –BR (L=80m) ／Modification

PA(D)

- Route PA(D)(L=0.3km) ／Upgrading
- PA(D) –BR 1 (L=10m) ／New
- PA(D) –BR 2 (L=30m) ／New

State / Region	Village Tract	Village	Name of Route	coordinate		Name of Bridge	coordinate
				Origin	Destination		
Chin	Zarthwlor	Pa Mun Chang	Route PA(U)	22°58'49.95"N 93°58'15.07"E	22°58'48.08"N 93°58'1.88"E	PA(U)-BR1	22°58'48.60"N 93°58'12.99"E
			Route PA(D)	22°58'31.47"N 93°58'54.62"E	22°58'27.37"N 93°58'54.98"E	PA(D)-BR1	22°58'30.36"N 93°58'54.23"E
						PA(D)-BR2	22°58'28.71"N 93°58'53.86"E

≪Dolluang village tract in Tedim Township in Chin State≫

Route ZZ

- Route ZZ (L=4.1km)
- Route ZZ –BR 1 (L=160m)

Route TZ

- Route TZ (L=2.2km)
- Route TZ –BR 1 (L=20m)
- Route TZ –BR2(L=10m)
- Route TZ –BR3(L=20m)

Route ZN

- Route ZN (L=3.7km)
- Route ZN –BR 1 (L=20m)

State / Region	Village Tract	Village	Name of Route	coordinate		Name of Bridge	coordinate
				Origin	Destination		
Chin	Dolluang	Zo Zang	Route ZZ	23°19'35.91"N 94° 1'5.11"E	23°20'43.08"N 93°59'10.50"E	ZZ-BR1	23°20'8.73"N 94° 0'19.23"E
		Tan Zan	Route TZ	23°20'34.24"N 93°59'46.18"E	23°19'33.49"N 93°59'51.57"E	TZ-BR1	23°20'5.24"N 93°59'44.94"E
						TZ-BR2	23°20'2.71"N 93°59'48.55"E
						TZ-BR3	23°19'36.35"N 93°59'52.37"E
		Zo Nun Zang	Route ZN	23°20'20.98"N 94° 1'50.42"E	23°21'57.30"N 93°59'58.56"E	ZN-BR1	23°21'56.31"N 94° 0'0.74"E

≪Sit Sa Li Htone village tract in Mawlamyaing Kyun Township in Ayarwaddy Region≫

Route SS

- Route SS (L=11.8km)
- Route SS –BR 1 (L=15m)
- Route SS –BR2(L=10m)
- Route SS –BR3(L=15m)

State / Region	Village Tract	Village	Name of Route	coordinate		Name of Bridge	coordinate
				Origin	Destination		
Ayarwaddy	Sit Sa Li		Route SS	16°30'55.11"N 95°23'41.91"E	16°31'56.40"N 95°27'57.17"E	SS-BR1	16°30'55.36"N 95°23'42.42"E
						SS-BR2	16°32'27.47"N 95°26'22.22"E
						SS-BR3	16°31'48.71"N 95°27'44.86"E

≪Sa Bai Kone village tract in Bogale Township in Ayarwaddy Region≫

Route SB

- Route SB (L=4.2km)
- Route SB –BR 1 (L=60m)
- Route SB –BR2(L=20m)
- Route SB –BR3(L=20m)

State / Region	Village Tract	Village	Name of Route	coordinate		Name of Bridge	coordinate
				Origin	Destination		
Ayarwaddy	Sa Bai Kone		Route SB	16°16'50.05"N 95°30'34.33"E	16°15'16.85"N 95°29'47.12"E	SB-BR1	16°16'42.57"N 95°30'36.62"E
						SB-BR2	16°15'31.82"N 95°30'16.43"E
						SB-BR3	16°15'10.93"N 95°30'12.50"E

≪Tha Kan Wa village tract in Bogale Township in Ayarwaddy Region≫

Route TK

- Route TK (L=4.8km)
- Route TK –BR 1 (L=30m)
- Route TK –BR2(L=15m)

State / Region	Village Tract	Village	Name of Route	coordinate		Name of Bridge	coordinate
				Origin	Destination		
Ayarwaddy	Tha Kan Wa		Route TK	16°16'52.18"N 95°30'30.18"E	16°19'26.28"N 95°30'10.83"E	TK-BR1	16°17'48.15"N 95°30'29.01"E
						TK-BR2	16°18'21.60"N 95°30'25.16"E

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (contents)

- Road Improvement
- Bridge construction and renovation
- Box Culvert construction

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

☑YES: Please describe the higher program/policy.

(National Strategy for Rural Road and Access)

☐NO

2-3. Did the proponent consider alternatives before this request?

☑YES: Please describe outline of the alternatives

(Zero option (no project) and project implementation have compared as the alternatives. The proposed project has been judged as the most appropriate from the point of view of cost and technical performance.)

☐NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

☑Implemented ☐Not implemented

If implemented, please mark the following stakeholders.

☑Administrative body

☑Local residents

☐NGO

☐Others ( )

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

☑New ☐Ongoing (with complaints) ☐Ongoing (without complaints)

☐Other [ ]

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) Is, required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☐Necessity (☐Implemented ☐Ongoing/planning)

☑Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐Approved without a supplementary condition	☐Approved with a supplementary condition	☐Under appraisal

(Date of approval: Competent authority:)

☐Under implementation

☐Appraisal process not yet started

☑Other (N/A)

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

☑Not required

☐Other [ ]

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes ☑No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

☑Yes ☐No

If yes, please mark the appropriate items.

☑Involuntary resettlement (scale:140 ㎡ / 4 households around Route TK –BR2)

☐Groundwater pumping (scale: m3/year)

☐Land reclamation, land development, and/or land-clearing (scale: hectors)

☐Logging (scale: hectors)

Aside from above impact, with this project, some agricultural lands are occupied. Total areas are about 2500 ㎡ (0.6 a). Until starting the projects, It needs to get the agreement from affected owner.

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

☑Yes ☐No

☑Air pollution	☑Water pollution	☐Soil pollution
☑Waste	☑Noise and vibrations	☐Ground subsidence
☐Offensive odors	☐Geographical features	☐Bottom sediment
☑Biota and ecosystems	☐Water usage	☑Accidents
☐Global warming		
☑Involuntary resettlement	☐Local economies, such as employment, livelihood	
☑Land use and utilization of local resources		
☑Social institutions such as social infrastructure and local decision-making institutions		
☐Existing social infrastructures and services		☐Poor, indigenous, or ethnic people
☐Misdistribution of benefits and damages		☐Local conflicts of interest
☐Gender	☐Children's rights	☐Cultural heritage
☐Infectious diseases such as HIV/AIDS	☐Other ( )	

Outline of related impact:

There is a negative impact about the above checked items during the construction. However, the impact is temporary and not enormous.

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ☑No

Question 11:

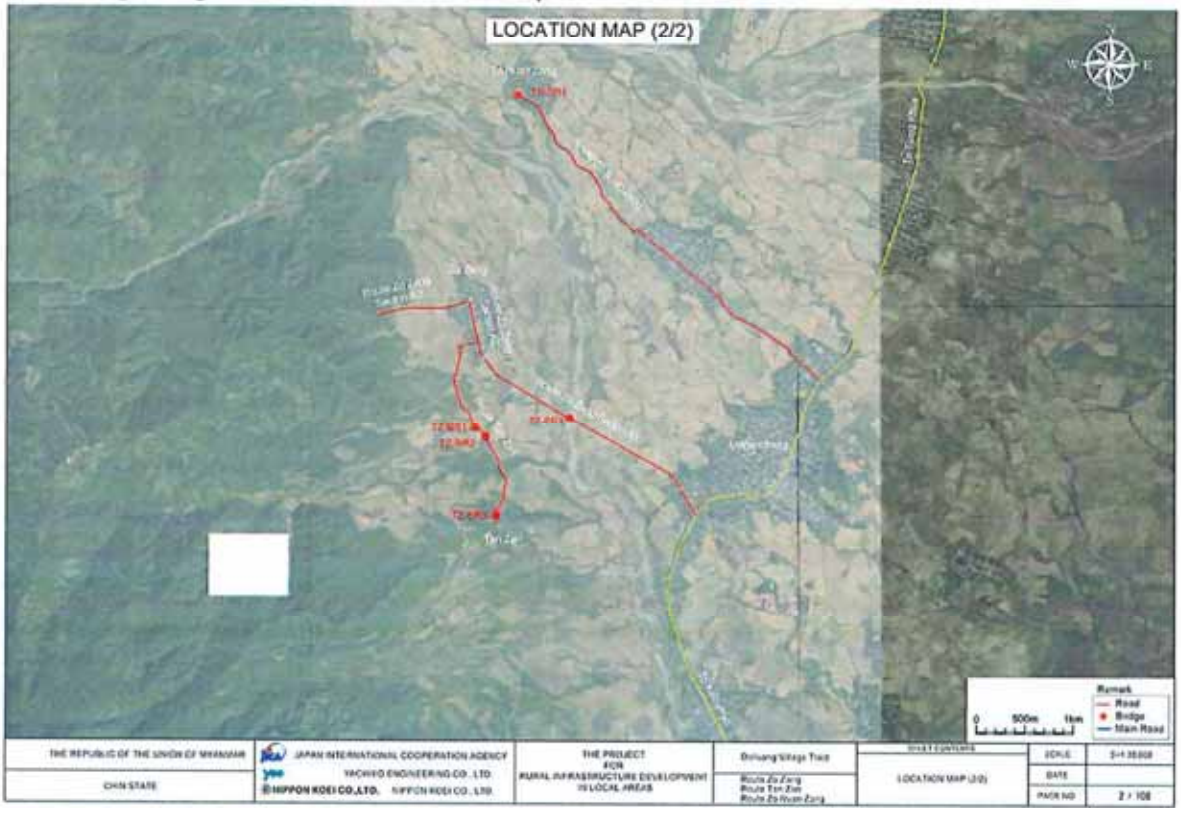
Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

☑Yes ☐No

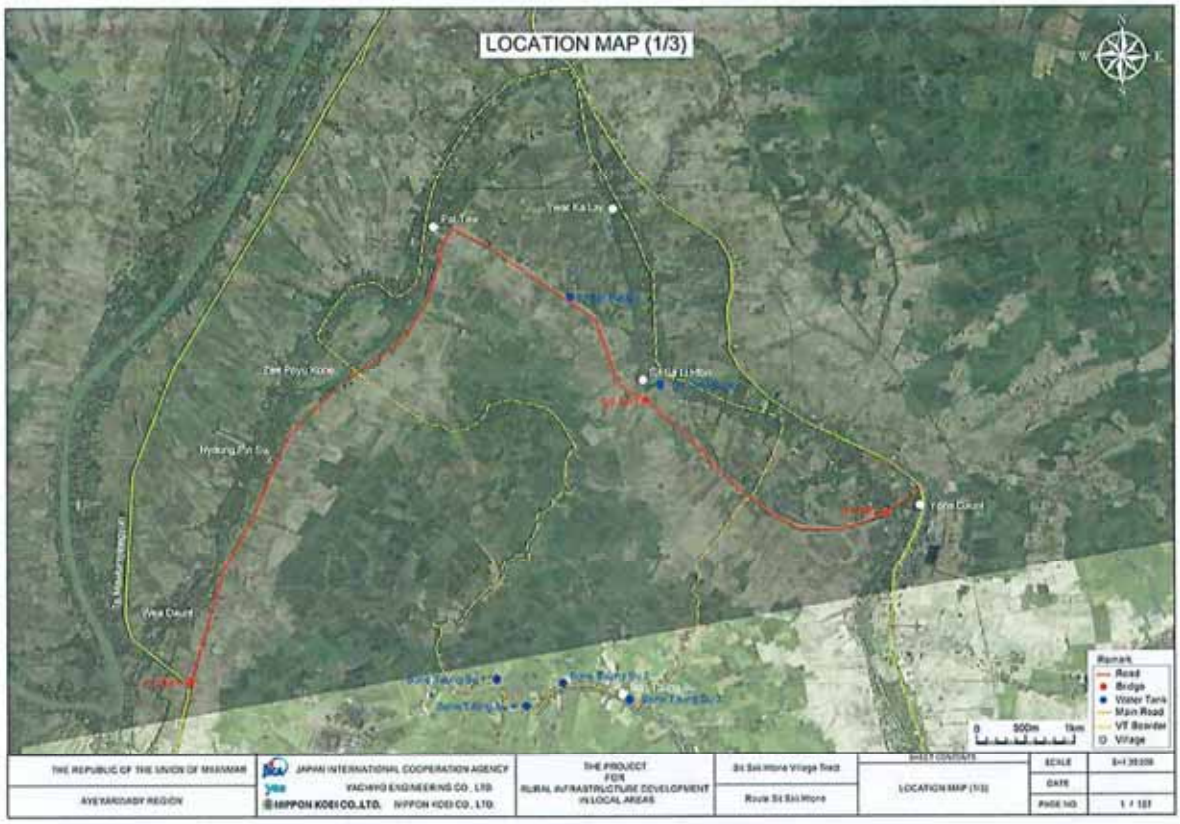
Attachiment-1 Project Site

≪Zarthwlor village tract in Falam Township in Chin State≫

≪Dolluang village tract in Tedim Township in Chin State≫

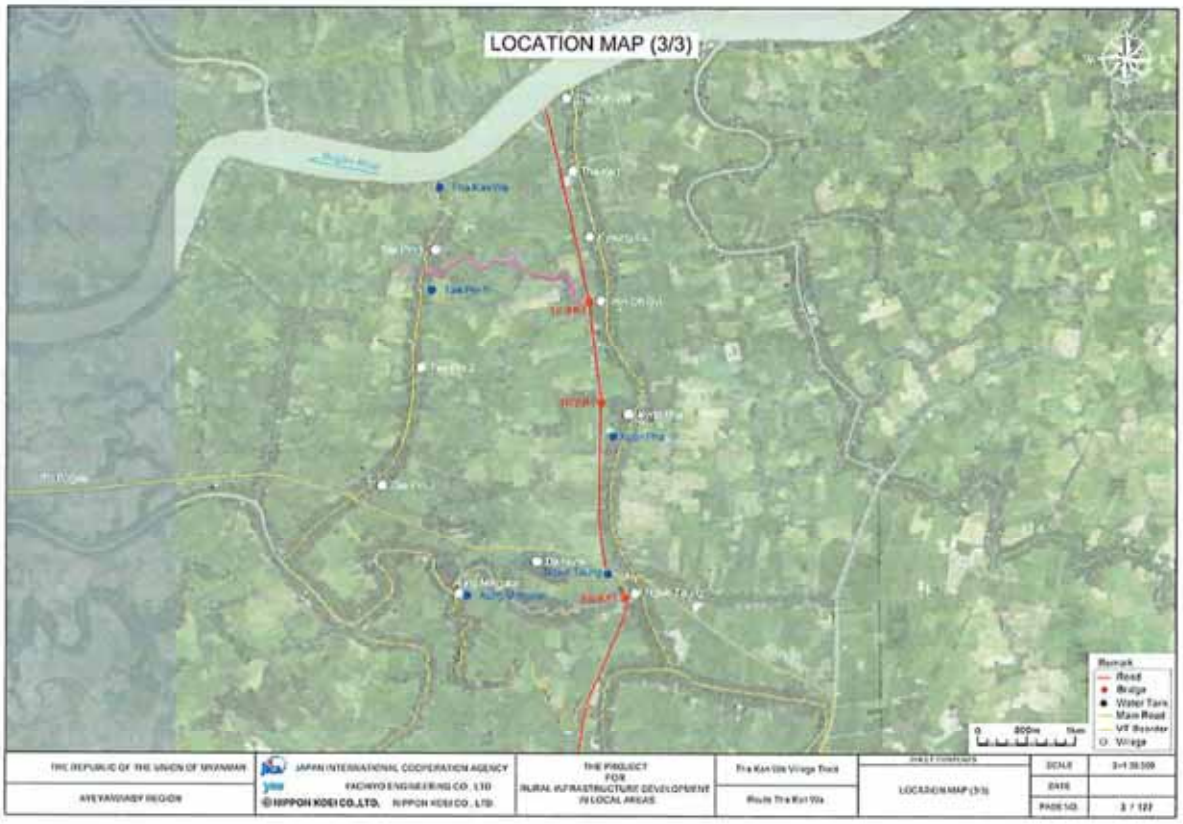


≪Sit Sa Li Htone village tract in Mawlamyaing Kyun Township in Ayarwaddy Region≫



≪Sa Bai Kone village tract in Bogale Township in Ayarwaddy Region≫

≪Tha Kan Wa village tract in Bogale Township in Ayarwaddy Region≫



Appendix 4. Screening Format

Name of Proposed Project: Project for Rural Infrastructure Development in Local Areas

Project Executing Organization, Project Proponent or Investment Company:

Irrigation and Water Utilization Management Department (IWUMD), Ministry of Agriculture, Livestock and Irrigation (MOALI)

Name, Address, Organization, and Contact Point of a Responsible Officer:

Name: U Zaw Lwin Tun (Deputy Director General)

Signature:

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site (See Attachiment-1)

≪Zarthwlor village tract in Falam Township in Chin State (See Attachiment-1) ≫

- Head Works 1 (Width 13.5 m , height 1.9 m) /Modification/93.937318°, 22.993261°
- Head Works 2 (Width 30 m , height 2.2 m) /Modification/93.960449°, 22.984806°

≪Tha Kan Wa village tract in Bogale Township in Ayarwaddy Region≫

- Gate 1 (Width 2.0 m , height 2.2 m) /New/95.492658°, 16.309176°
- Gate 2 (Width 2.0 m , height 1.5m) /New/95.499449°, 16.309945°

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (contents)

- Irrigation system renovation
- Water gate construction

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

☑YES: Please describe the higher program/policy.

(20 year plan for Agriculture sector (2011/12-2030/31) , 5 year plan)

☐NO

2-3. Did the proponent consider alternatives before this request?

☑YES: Please describe outline of the alternatives

(Zero option (no project), ODA project and larger scale of irrigation project were have compared as the alternatives. The proposed project has been judged as the most appropriate from the point of view of cost and technical performance.)

☐NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

☑Implemented ☐Not implemented

If implemented, please mark the following stakeholders.

☑Administrative body

☑Local residents

☐NGO

☐Others (　　)

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

☑New ☐Ongoing (with complaints) ☐Ongoing (without complaints)

☐Other [　　]

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) Is, required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☐Necessity (☐Implemented ☐Ongoing/planning)

☑Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐Approved without a supplementary condition	☐Approved with a supplementary condition	☐Under appraisal

(Date of approval: Competent authority:)

☐Under implementation

☐Appraisal process not yet started

☑Other (N/A)

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

☑Not required

☐Other ( )

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes ☑No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

☐Yes ☑No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale: households persons)

☐Groundwater pumping (scale: m3/year)

☐Land reclamation, land development, and/or land-clearing (scale: hectors)

☐Logging (scale: hectors)

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

☑Yes ☐No

☑Air pollution	☐Water pollution	☐Soil pollution
☑Waste	☑Noise and vibrations	☐Ground subsidence

☐Offensive odors ☐Geographical features ☐Bottom sediment
☐Biota and ecosystems ☐Water usage ☑Accidents
☐Global warming
☐Involuntary resettlement ☐Local economies, such as employment, livelihood
☑Land use and utilization of local resources
☐Social institutions such as social infrastructure and local decision-making institutions
☐Existing social infrastructures and services ☐Poor, indigenous, or ethnic people
☐Misdistribution of benefits and damages ☐Local conflicts of interest
☐Gender ☐Children's rights ☐Cultural heritage
☐Infectious diseases such as HIV/AIDS ☐Other ( )
Outline of related impact:

There is a negative impact about the above checked items during the construction. However, the impact is temporary and not enormous.

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ☑No

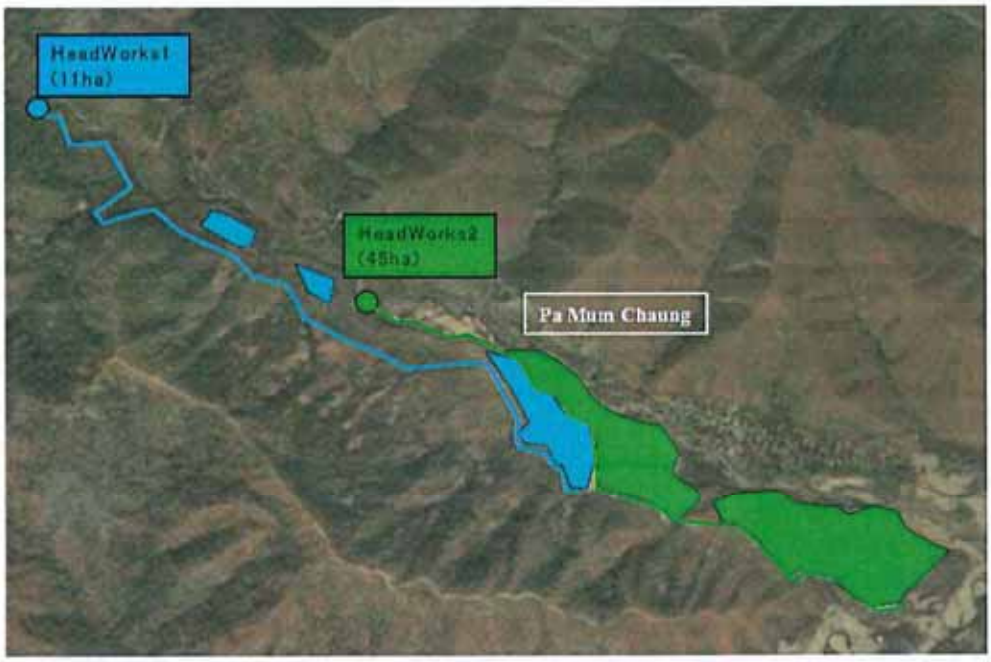
Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

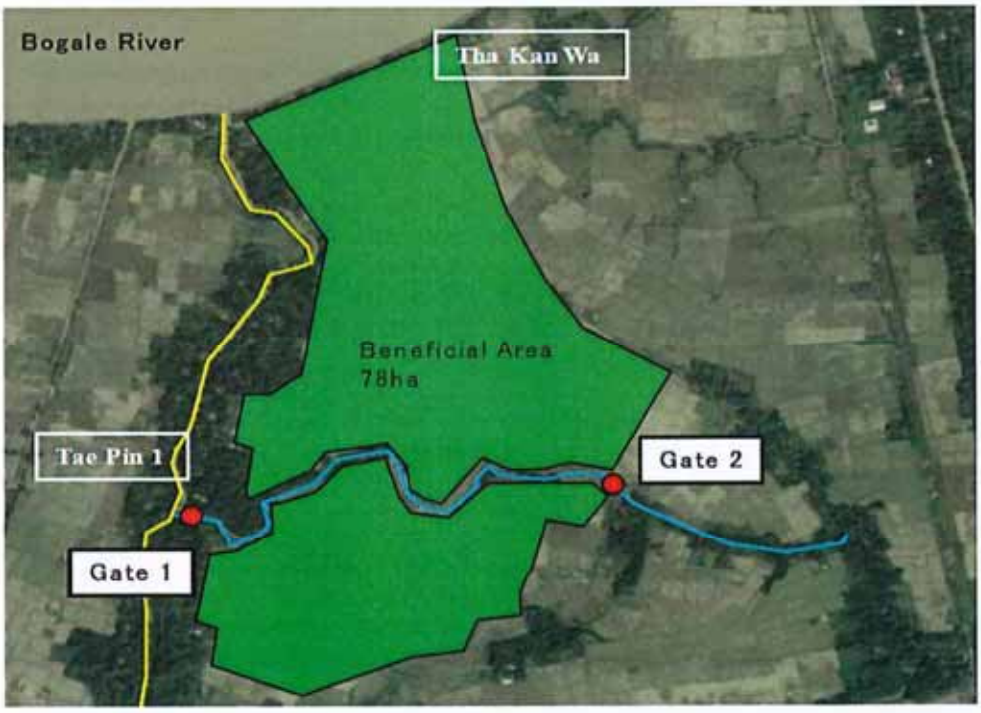
☑Yes ☐No

Attachiment-1 Project Site

≪Zarthwlor village tract in Falam Township in Chin State≫



≪Tha Kan Wa village tract in Bogale Township in Ayarwaddy Region≫



Appendix 4. Screening Format

Name of Proposed Project: Project for Rural Infrastructure Development in Local Areas

Project Executing Organization, Project Proponent or Investment Company:

Department of Rural Development (DRD), Ministry of Agriculture, Livestock and Irrigation (MOALI)

Name, Address, Organization, and Contact Point of a Responsible Officer:

Name: U Khant Zaw (Director General)

Signature:_____

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site (See Attachiment-1)

≪Sit Sa Li Htone village tract in Mawlamyaing Kyun Township in Ayarwaddy Region≫

- SST-1 (130,000Gallon)／New／16°33'2.50"N, 95°25'56.40"E
- SST-2 (130,000Gallon) ／New／16°32'32.58"N, 95°26'27.29"E
- SST-3 (130,000Gallon) ／New／16°30'55.33"N, 95°25'28.77"E
- SST-4 (40,000Gallon) ／New／16°30'53.70"N, 95°25'51.93"E
- SST-5 (100,000Gallon) ／New／16°30'48.01"N, 95°26'15.03"E
- SST-6 (100,000Gallon) ／New／16°30'46.26"N, 95°25'38.95"E

≪Sa Bai Kone village tract in Bogale Township in Ayarwaddy Region≫

- SBK-1 (100,000Gallon) ／New／16°16'35.52"N, 95°29'36.72"E
- SBK-2 (100,000Gallon) ／New／16°15'46.80"N, 95°30'33.58"E
- SBK-3 (40,000Gallon) ／New／16°15'30.21"N, 95°30'23.72"E
- SBK-4 (100,000Gallon) ／New／16°15'19.74"N, 95°29'38.37"E
- SBK-5 (100,000Gallon) ／New／16°15'3.51"N, 95°29'24.02"E
- SBK-6 (100,000Gallon) ／New／16°15'30.81"N, 95°31'31.22"E
- SBK-7 (100,000Gallon) ／New／16°14'15.49"N, 95°29'6.31"E

≪Tha Kan Wa village tract in Bogale Township in Ayarwaddy Region≫

- TKW-1 (130,000Gallon) ／New／16°19'0.23"N, 95°29'33.93"E
- TKW-2 (130,000Gallon) ／New／16°18'26.00"N, 95°29'31.17"E
- TKW-3 (100,000Gallon) ／New／16°16'43.87"N, 95°29'42.17"E
- TKW-4 (100,000Gallon) ／New／16°17'36.57"N, 95°30'33.39"E
- TKW-5(130,000Gallon) ／New／16°16'50.51"N, 95°30'30.97"E

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (contents)

- Rain Water Tank
- Sand Filter
- Treated Water Tank

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

☑YES: Please describe the higher program/policy.

(National Strategy for Rural Water, Sanitation and Hygiene (WASH), WASH in School and WASH in Health Facilities (2016))

☐NO

2-3. Did the proponent consider alternatives before this request?

☑YES: Please describe outline of the alternatives

(Zero option (no project) and a project of water purification facilities installation have compared as the alternatives. The proposed project was judged as the most appropriate from the point of view of cost and technical performance.)

☐NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

☑Implemented ☐Not implemented

If implemented, please mark the following stakeholders.

☑Administrative body

☑Local residents

☐NGO

☐Others (　　)

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

☑New ☐Ongoing (with complaints) ☐Ongoing (without complaints)

☐Other [　　]

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) Is, required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☐Necessity (☐Implemented ☐Ongoing/planning)

☑Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐Approved without a supplementary condition	☐Approved with a supplementary condition	☐Under appraisal

(Date of approval: Competent authority:)

☐Under implementation

☐Appraisal process not yet started

☑Other (N/A)

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

☑Not required

☐Other [ ]

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes ☑No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

☐Yes ☑No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale:)

☐Groundwater pumping (scale: m3/year)

☐Land reclamation, land development, and/or land-clearing (scale: hectors)

☐Logging (scale: hectors)

With this project, the private garden yard of the project is occupied. However, all affected people have been agreed on this project. Therefore, the owners of the sub-project site indicates a willingness to donate the land.

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

☑Yes ☐No

☑Air pollution ☐Water pollution ☐Soil pollution

☑Waste ☑Noise and vibrations ☐Ground subsidence

☐Offensive odors ☐Geographical features ☐Bottom sediment

☐Biota and ecosystems ☐Water usage ☑Accidents

☐Global warming

☐Involuntary resettlement ☐Local economies, such as employment, livelihood

☑Land use and utilization of local resources

☑Social institutions such as social infrastructure and local decision-making institutions

☐Existing social infrastructures and services ☐Poor, indigenous, or ethnic people

☐Misdistribution of benefits and damages ☐Local conflicts of interest

☐Gender ☐Children's rights ☐Cultural heritage

☐Infectious diseases such as HIV/AIDS ☐Other ( )

Outline of related impact:

There is a negative impact about the above checked items during the construction. However, the impact is temporary and not enormous.

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ☑No

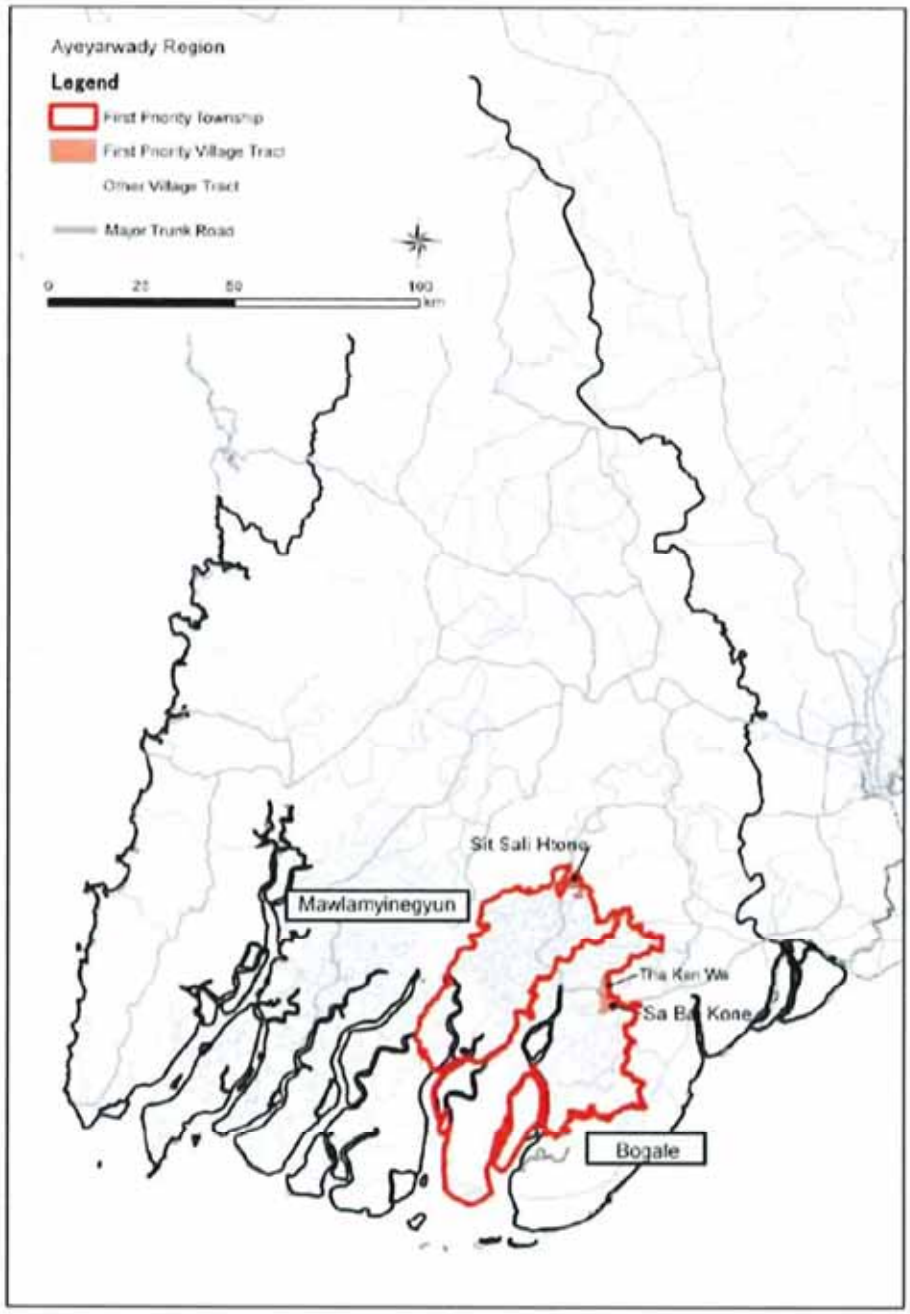
Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with

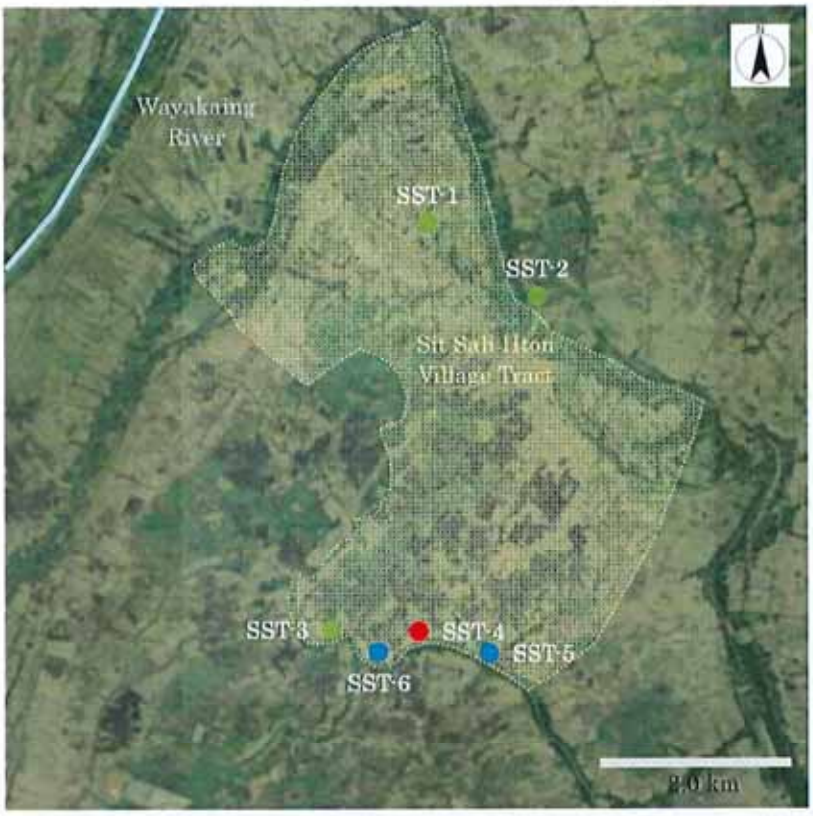
stakeholders through these guidelines?

☑Yes ☐No

Attachiment-1 Project Site



≪Sit Sa Li Htone village tract in Mawlamyaing Kyun Township in Ayarwaddy Region≫

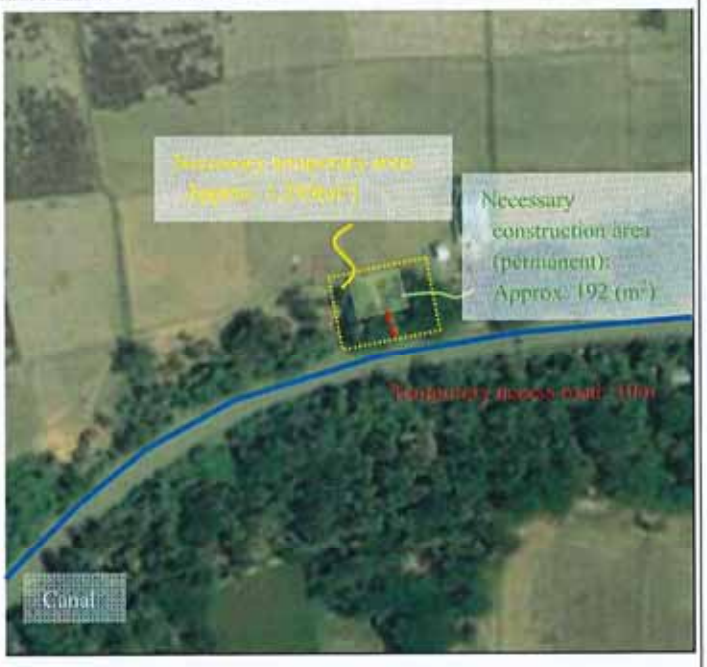


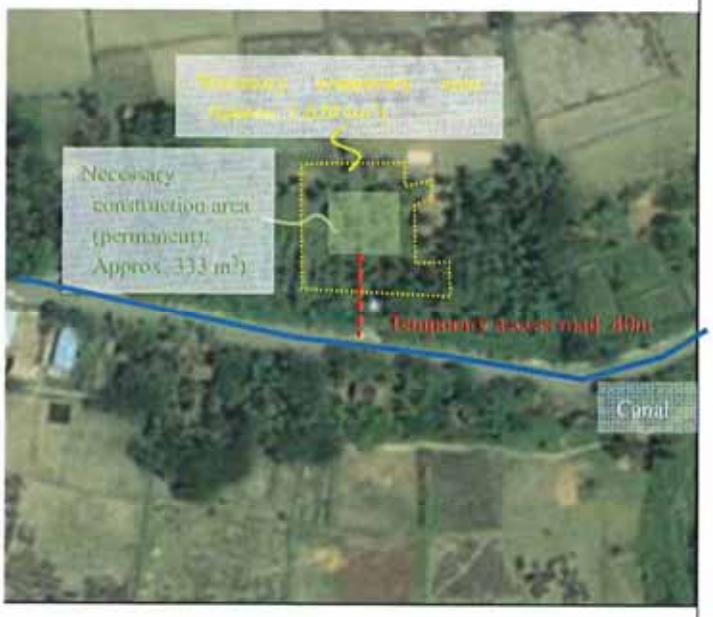
Legend

Type of rain water tank
- 40,000 gallon tank: (Type-1)
- 100,000 gallon tank: (Type-2)
- 100,000 gallon tank: (Type-3)
- 130,000 gallon tank: (Type-4)

* As for difference between Type-2 and Type-3, it is due to difference of detention of water supply facility.

No.	Site No.	Village Name	Detailed location of proposed construction site
No. 1	SST-1	Ywar Kalay	GPS: 16°33'2.50"N, 95°25'56.40"E
			Owner name: U Saw Kwal Htoo
			Tank Type: Type-4
			Area of proposed construction site: Approx. 1,764(m^2) (Temporary access road is not needed)
			Detailed Map: 
No.2	SST-2	Sit Sali Htone	GPS: 16°32'32.58"N, 95°26'27.29"E
			Owner name: U Saw Hto Be Boe
			Tank Type: Type-4
			Area of proposed construction site: Approx. 1,764(m^2) (Temporary access road is not needed)
			Detailed Map: 
No.3	SST-3	Bon Taung Su	GPS: 16°30'55.33"N, 95°25'28.77"E
			Owner name: U Saw Ba Gae
			Tank Type: Type-4
			Area of proposed construction site: Approx. 1,764(m^2) (Distance of Temporary access road is 15m)

			Detailed Map: 
No.4	SST-4	Bon Taung Su	GPS: 16°30'53.70"N, 95°25'51.93"E
			Owner name: U Gale Crack
			Tank Type: Type-1
			Area of proposed construction site: Approx. 1,285 (m²) (Distance of Temporary access road is 10m)
			Detailed Map 
No.5	SST-5	Bon Taung Su	GPS: 16°30'48.01"N, 95°26'15.03"E
			Owner name: U Moe Kyaw
			Tank Type: Type-3
			Area of proposed construction site: Approx. 1,620 (m²) (Temporary access road is not needed)

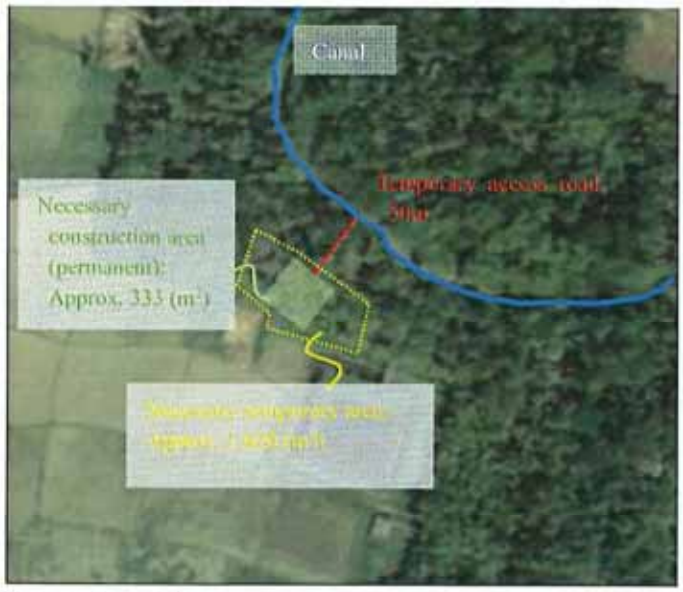
			Detailed Map 
No.6	SST-6	Bon Taung Su	GPS: 16°30'46.26"N, 95°25'38.95"E
			Owner name: U Myat Phaw
			Tank Type: Type-3
			Area of proposed construction site: Approx. 1,620 (m^2) (Distance of Temporary access road is 40m)
			Detailed Map 

≪Sa Bai Kone village tract in Bogale Township in Ayarwaddy Region≫

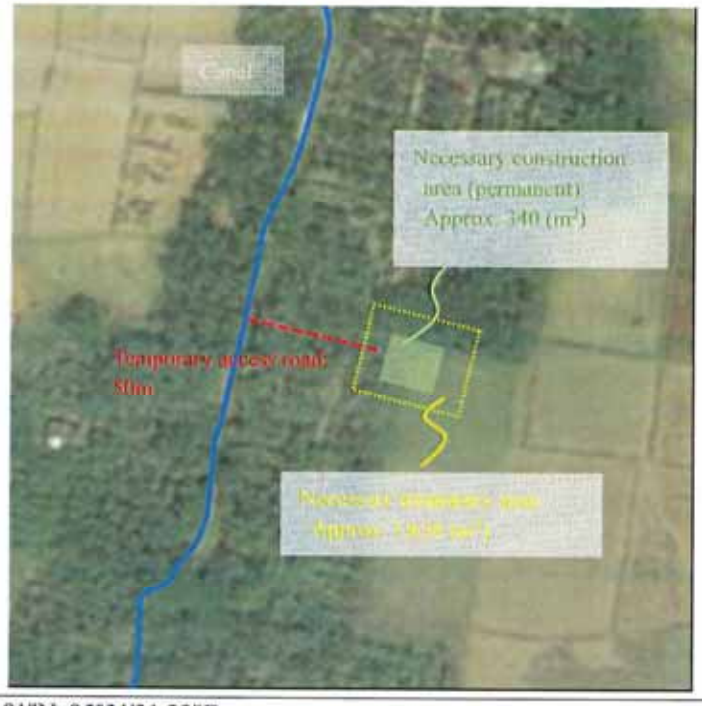
Legend

Type of rain water tank
- 40,000 gallon tank: (Type-1)
- 100,000 gallon tank: (Type-2)
- 100,000 gallon tank: (Type-3)
- 130,000 gallon tank: (Type-4)

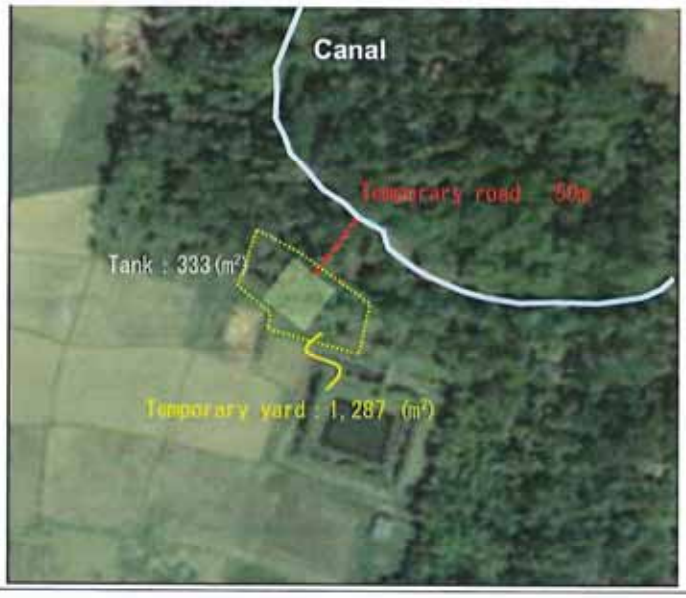
* As for difference between Type-2 and Type-3, it is due to difference of detention of water supply facility.

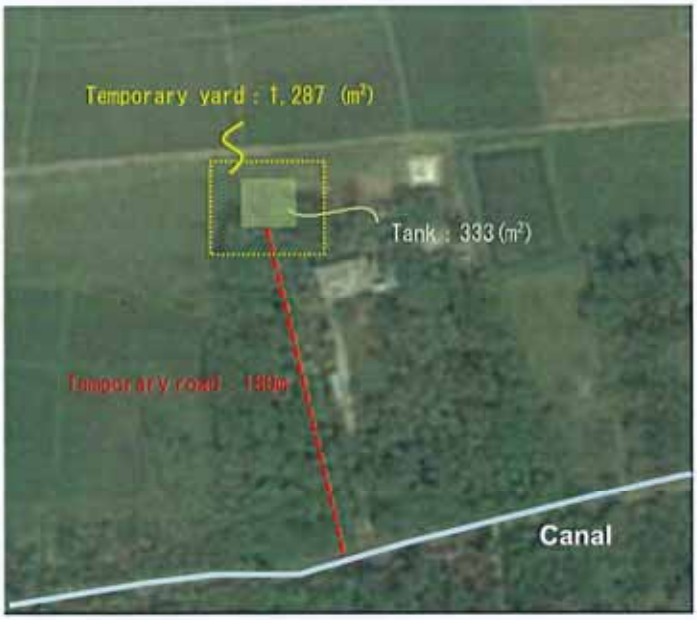
No.12	Site No.	Village Name	Detailed location of proposed construction site
	SBK-1	Dar Chaung	GPS: 16°16'35.52"N, 95°29'36.72"E
			Owner name: U Thant Zin
			Tank Type: Type-3
			Area of proposed construction site: Approx. 1,620 (m^2) (Distance of Temporary access road is 50m)
			Detailed Map 
No.13	SBK-2	Sa Kar Lon Kone	GPS: 16°15'46.80"N, 95°30'33.58"E
			Owner name: Daw Tin Myint
			Tank Type: Type-2
			Area of proposed construction site: Approx. 1,636 (m^2) (Temporary access road is not needed)
			Detailed Map 
No.14	SBK-3	Sa Kar Lon Kone	GPS: 16°15'30.21"N, 95°30'23.72"E
			Owner name: U Kyaw Zin Oo
			Tank Type: Type-1

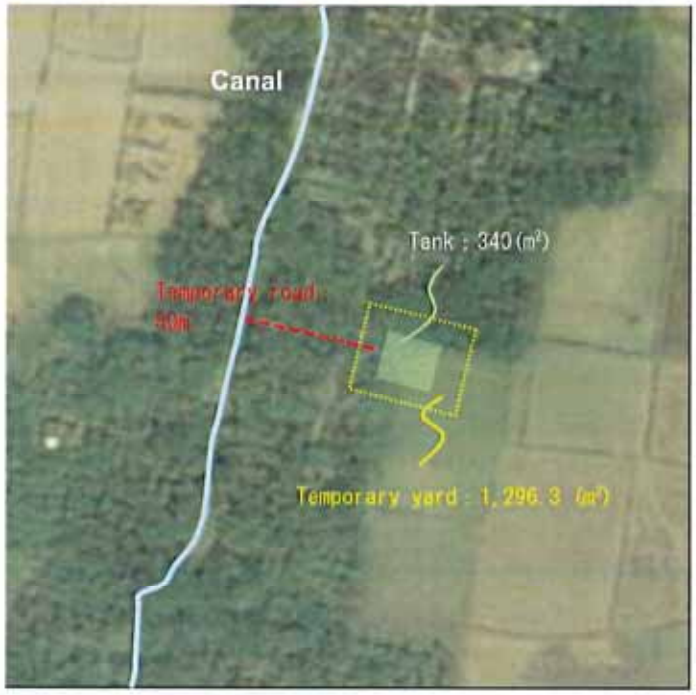
			Area of proposed construction site: Approx. 1,285 (m^2) (Distance of Temporary access road is 100m)
			Detailed Map 
No.15	SBK-4	Sa Bai Kone	GPS: 16°15'19.74"N, 95°29'38.37"E
			Owner name: U Kyaw Zin Oo
			Tank Type: Type-3
			Area of proposed construction site: Approx. 1,620 (m^2) (Distance of Temporary access road is 180m)
			Detailed Map 
No.16	SBK-5	Nga Pi Tone Hle	GPS: 16°15'3.51"N, 95°29'24.02"E
			Owner name: Daw Aye Kyi
			Tank Type: Type-2
			Area of proposed construction site: Approx. 1,636 (m^2) (Distance of Temporary access road is 50m)

			Detailed Map 
No.17	SBK-6	Ywar Tan Shay	GPS: 16°15'30.81"N, 95°31'31.22"E Owner name: U Kyaw Zin Oo Tank Type: Type-3 Area of proposed construction site: Approx. 1,620 (m²) (Distance of Temporary access road is 40m) Detailed Map 
No.18	SBK-7	U Do Kan Su	GPS: 16°14'15.49"N, 95°29'6.31"E Owner name: U Kyaw Zin Oo Tank Type: Type-2 Area of proposed construction site: Approx. 1,636 (m²) (Temporary access road is not needed) Detailed Map

			 Necessary temporary area: Approx. 1,430 (m²) Necessary construction area (permanent): Approx. 340 (m²) Canal

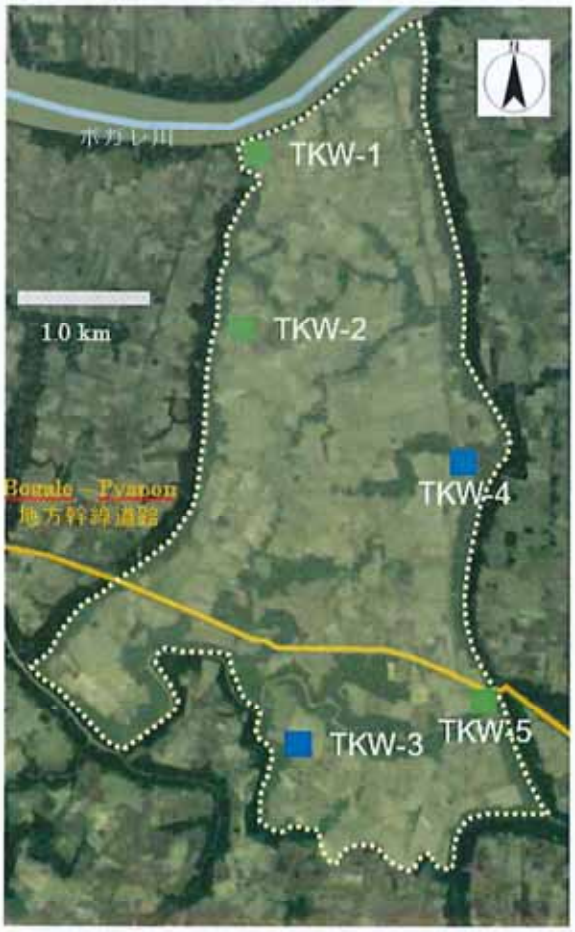
Dar Chaung	SBK-1		
Sa Kar Lon Kone	SBK-2		

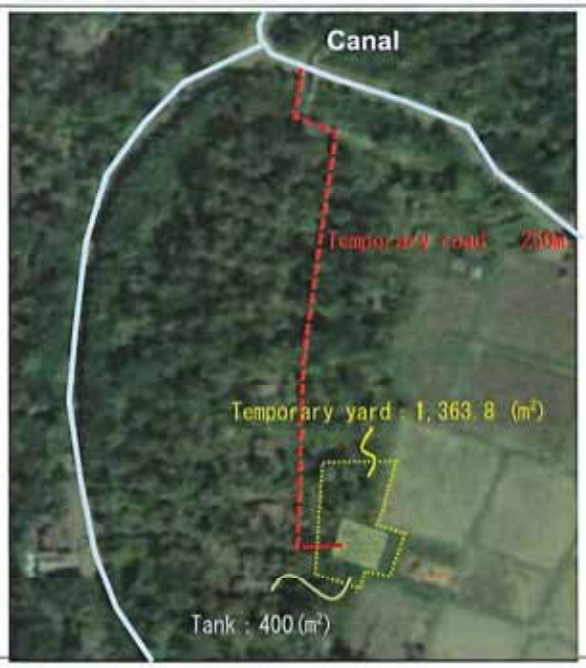
Sa Kar Lon Kone	SBK-3		
Sa Bai Kone	SBK-4		

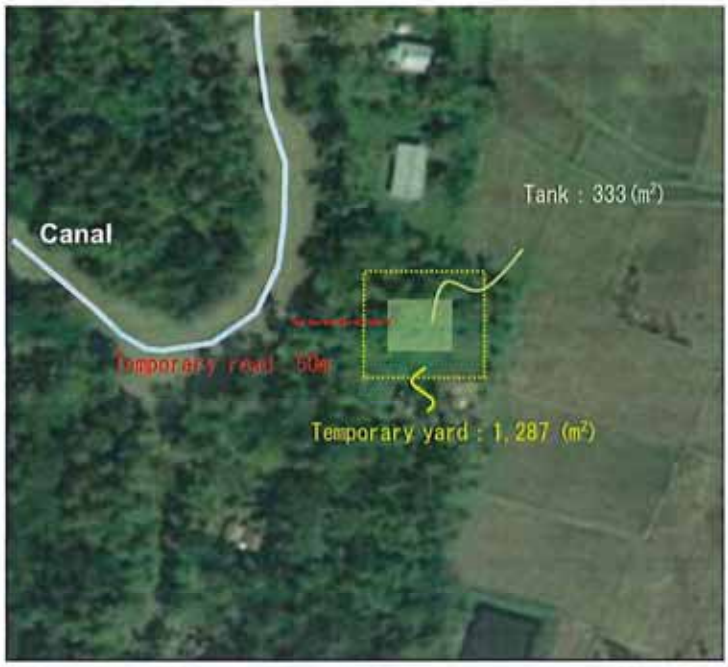
Nga Pi Tone Hle	SBK-5		
Ywar Tan Shay	SBK-6		

U Do Kan Su	SBK-7		

≪Tha Kan Wa village tract in Bogale Township in Ayarwaddy Region≫



Tha Kan Wa	TKW-1		
Tae Pin 1	TKW-2		

Aung Mingalar	TKW-3		
Kyon Pha	TKW-4		

Ngwe Taung	TKW-5