

**Republic of the Union of Myanmar**  
**Ministry of Natural Resources and Environmental Conservation**

**Design Phase of Component 2**  
**(Integrated Watershed Management**  
**in the Inle Lake Watershed)**  
**of**  
**The Project for Capacity Building for Sustainable**  
**Natural Resource Management**  
**in**  
**Republic of the Union of Myanmar**  
**Project Completion Report**  
**Volume I: Main Report**

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**Japan International Cooperation Agency (JICA)**

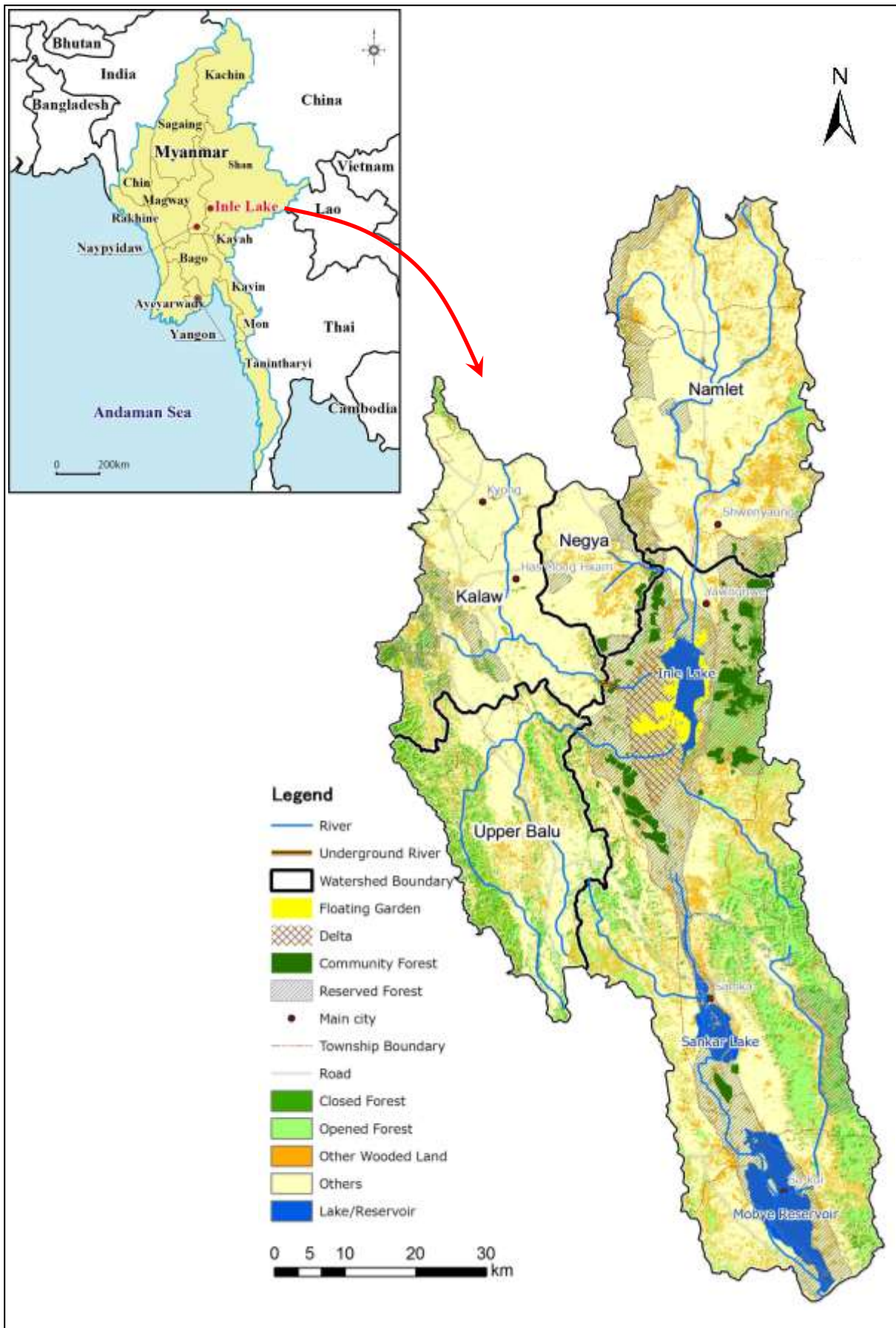
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## Abbreviations

<b>Abbreviation</b>	<b>Term/Organization Name</b>
CF	Community Forest
CFI	Community Forest Instruction
CFUG	CF User Group
CFUGMC	CFUG Management Committee
COVID 19	Coronavirus
CSO	Civil Society Organization
DALMS	Department of Agricultural Land Management and Statistics
DDG	Deputy Director General
DG	Director General
DEM	Digital Elevation Model
DoA	Department of Agriculture
ECD	Environmental Conservation Department
FD	Forest Department
FDSNR	The Project for Capacity Building for Sustainable Natural Resource Management
FMP	Forest Management Plan
FRI	Forestry Research Institute
GAD	General Administration Department
GAP	Good Agricultural Practices
GIS	Geographic Information System
HIS	Household Interview Survey
ICIMOD	International Centre for Integrated Mountain Development
ICT	Information and Communications Technology
IPM	Integrated Pest Management
IWUMD	Irrigation and Water Utilization and Management Department
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
MOALI	Ministry of Agriculture, Livestock and Irrigation
MoECAf	Ministry of Environmental Conservation and Forestry
MONREC	Ministry of Natural Resources and Environmental Conservation
NGO	Non-Government Organization
NIVA	Norwegian Institute for Water Research
ODA	Official Development Assistance
PO	Plan of Operation
PRA	Participatory Rural Appraisal
R/D	Record of Discussion
SALT	Sloping Agriculture Land Techniques
SOPs	Standard Operational Procedures

<b>Abbreviation</b>	<b>Term/Organization Name</b>
Sub-PMU	Sub-Project Management Unit
TSS	Total Suspended Solid
UAV	Unmanned Aerial Vehicle
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USLE	Universal Soil Loss Equation
VMOF	Vision, Mission, Objectives and Functions
WB	World Bank
WMD	Watershed Management Department



Location Map of the Project Area for Component 2 of FDSNR

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## **1. Background of the Project**

### **1.1 Background of the Project for Capacity Building of Sustainable Natural Resource Management**

Myanmar is still endowed with rich forests which covers 43% of the national land (33 million ha), though the country has faced rapid deforestation. It is reported that around 8.9 million ha of forests has been cleared from 1990 to 2015 due to economic development, land use change, mining development, and illegal logging. To prevent deforestation, JICA has assisted the Government of Myanmar, through ODA-funded projects, in building the government officials' capacity in the forestry sector for sustainable forest management, particularly community forestry in terrestrial and mangrove forests in the country.

The New Administration of Myanmar formed in 2016 has paid its attention to environmental conservation along with rural development. The government, particularly Forestry Department (FD) of the Ministry of Natural Resources and Environmental Conservation (MONREC), has undertaken some regulatory measures against logging as well as for sustainable forest management, such as introduction of revised Community Forest Instruction (CFI) since then. In order to reduce the pace of deforestation, further interventions are required especially for capacity enhancement of the related government officials and actual implementation of the revised policies and regulations in the field.

Inle Lake in Shan State is the famous tourist spots in Myanmar, which has attracted about 140,000 tourist per year. However, ecosystem degradation in Inle Lake is one of the serious environmental problems in the country. Land use change, extensive deforestation and forest degradation, extensive soil erosion, discharge of sewer, and unregulated use of agrochemical and chemical fertilizers for production of tomato within the lake are the major causes of environmental degradation in Inle Lake.

Given the rapid population growth in the surrounding areas including its watershed and the increased importance of Inle Lake in terms of regional economy as well as the cultural identity of the nation, conservation of Inle Lake environment balancing with economic development is one of the highest priority issues of the current government.

It is also widely recognized that ecosystem services should be properly evaluated on the basis of the accumulated scientific-based information to fully use their functions for biodiversity conservation and management. The government or FD has had support from international organizations for scientific data collection. Among others, the National Science Museum of Nature & Science and Kochi-Prefecture Makino Botanical Garden in Japan have assisted Forestry Research Institute (FRI) under FD in the collection of basic biodiversity data (e.g., specimen). It is, however, true that more support is needed for strengthening its facilities and human resource capacity for data collection and management for effective biodiversity conservation.

In the face of these issues and challenges, FD and JICA mutually agreed to implement a new technical cooperation project named "The Project for Capacity Building for Sustainable Natural Resource Management (hereinafter referred to as "FDSNR")," which aims to contribute to sustainable natural resource management through development of FD's capacity for i) forest management, ii) Inle Lake integrated watershed management and iii) biodiversity conservation for ecologically balanced rural development. The Record of Discussions: R/D was exchanged by both the parties in December 2017 as shown in **Attachment-1** of this report. The new project, FDSNR, has commenced its operations in June 2018.



## **1.2 Background of the Work (Design Phase of Component 2: Integrated Watershed Management of Inle Lake Watershed)**

As mentioned above, FDSNR comprises three components/outputs: namely Output 1: Improvement of management capacity of forest administration, Output 2: Enhancement of integrated watershed management in Inle Lake watershed, and Output 3: Development of scientific basis for biodiversity conservation.

Each component/output has different purposes and is aimed at different target groups. Output 2 is specifically aimed at strengthening and improvement of integrated watershed management of Inle Lake watershed to reduce the influx of suspended sediment and eventually improve the natural environment of Inle Lake. Although the progress of sedimentation in the Lake is a common concern shared by relevant government organizations and users of Inle Lake, such as private firms and people living in and around the lake, there is no clear or complete data which could be used for clarification of the mechanism of soil runoff in the watershed and sedimentation in the Lake. Hence, there is an urgent need to collect baseline quantitative data which could be used for determination and design of effective measures for integrated watershed management.

In this connection, JICA and FD decided to first undertake the design phase of Component 2, which between the end of March 2019 and the end of August 2020. The design phase mainly aims to: i) form a collaborative platform for integrated watershed management, ii) collect the baseline data on socio-economic and natural conditions of the watershed, iii) design and start the monitoring of suspended sediment flowing in Inle Lake through the major rivers, iv) identify and determine effect measures for soil erosion control and sustainable land management, and v) develop a master plan of control gully erosion in the selected target watershed or sub-/micro-watershed.

## **1.3 Current Conditions of Inle Lake and Necessity of Integrated Watershed Management**

Inle Lake is the second largest lake in Myanmar, which is located in Taunggyi District in Shan State. According to the survey made by the Land Records Department in 2007,<sup>1</sup> the total area of the lake was about 16,300 ha, of which about 6,200 ha is the open water surface. However, another research made in 2008<sup>2</sup> indicated that its water surface was reduced to about 4,350 ha. The total catchment of the lake is 3,682 km<sup>2</sup>, of which 86.6% (or 3,191 km<sup>2</sup>) are occupied by four major river basins (i.e., Namlet, Negya, Kalaw, and Upper Balu) located on the western side of the lake.

Inle Lake was registered as the biosphere reserve of UNESCO in 2015 because of its cultural, ecological and economic values. Although ecosystem conservation of the lake is one of the critical issues to be addressed along with economic development in the region, it is not easy to reduce degradation of natural environment in and around the lake. In particular, the shortage of water holding capacity and shrinking of its open water surface have become obvious recently along with the reduction of river discharge due to climate change. Extensive soil erosion in the watershed and the influx of suspended sediment into the lake through the major rivers are considered as main causes of the shortage of water holding capacity of the lake.

In order to maintain the ecological, cultural, and economic values of Inle Lake, it is very crucial to protect and improve the lake environment. Among others, soil erosion control and sustainable land and forest management in the watershed are requisite for reduction of influx of suspended sediment

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<sup>1</sup> A survey of the lake dimensions conducted by the Land Records Department (2007)

<sup>2</sup> A final report submitted to Forest Department, Myanmar, 2008, Takahisa Furuichi

into the lake. Similar interventions have been made by the development partners (e.g., international development institutions and national/international NGOs) in the areas, but the impacts from such interventions were rather limited as they were fragmented. It is, therefore, necessary to introduce a mechanism where stakeholders relevant to management of Inle Lake watershed could take necessary measures and actions for watershed management in a collaborative and coordinated manner.

#### **1.4 Objectives of the Work**

The main objective of the work is to contribute to the smooth and effective implementation of Component 2 of FDSNR through planning and designing of possible measures effective in: i) control of soil erosion/ runoff in the watershed and ii) reduction of the influx of suspended sediment into Inle Lake, which can be further adopted and demonstrated in the watershed in the implementation phase of Component 2. Towards this end, the Project Expert Team for the design phase, in collaboration and coordination with FD as well as Irrigation and Water Utilization and Management Department (IWUMD) and other relevant departments/organizations, aims to:

- Collect the baseline data on the current conditions of the watershed.
- Conduct scientific assessment and analyses of soil erosion/ runoff potentials in the watershed and the influx of suspended sediments into the lake through the major rivers.
- Implement small-scale measures for control of soil erosion and sustainable land management as pilot activities.
- Evaluate the pilot activities and design effective measures for reduction of soil erosion and sustainable land management in the watersheds.
- Establish a collaborative framework for integrated watershed management of Inle Lake watershed.

#### **1.5 Scope of the Work**

In this design phase, the Project Expert Team will undertake: i) collection of baseline data, ii) assessment of soil erosion/ runoff potentials, iii) assessment of the influx of suspended sediment into Inle Lake through the major rivers, iv) trial application of possible countermeasures for watershed management, v) establishment of a collaborative framework for integrated watershed management, and vi) public awareness raising over the course of the works. In the context of the overall project framework of FDSNR, the activities planned in the design phase are placed under the following activities of the revised Plan of Operation (PO), which was confirmed in the 3<sup>rd</sup> JCC meeting held in February 2020.

#### **Activities of the Revised Plan of Operation (PO) of FDSNR**

No.	Description
2.1	Support institutional and financial arrangements for collaborative work among the governmental organizations, Inle Lake Authority, and the other relevant stakeholders
2.1.1	Identify (or form) a platform with related organizations for the component platform
2.2	Carry out a baseline survey on the necessary fields such as land use, population, local livelihoods, household economy, and agriculture etc.
2.2.1	Select areas for the survey
2.2.2	Conduct the survey, and compile and analyze the results
2.2.3	Compile and analyze the results
2.3	Promote fact-based understanding of perceived phenomena
2.3.1	Review history of physical lake boundaries and development of floating gardens
2.3.2	Review impact of river profile changes from Nam Lat River
2.3.4	Review displacement of dredged sediment
2.4	Conduct demonstrative measures against key drivers of sedimentation

No.	Description
2.7	Carry out public relations and advocacy activities such as knowledge sharing workshop(s) with stakeholders such as local governments, NGOs and communities.

Source: Revised Plan of Operation

## **1.6 Duration of the Work**

The activities of this design phase has been carried out between the middle of March 2019 and the end of September 2020.

## **1.7 Implementing Agencies and Organizational Set-up for Implementation**

FD of MONREC is the main implementing agency for the FDSNR as well as this design phase in the Myanmar side. In addition to FD, IWUMD of the Ministry of Agriculture, Livestock and Irrigation (MOALI) is another key player in the implementation of Component 2 as its roles and functions are closely related to watershed management. Moreover, other relevant government departments and offices, namely Department of Agriculture (DoA) of MOALI, the Government of Shan State, and Inle Lake Management Authority, have been involved in the framework for implementation of Component 2 as key stakeholders relevant to the integrated Inle Lake watershed management. As described in this report, the Project Expert Team has organized a project management unit for Component 2 named “Sub-Project Management Unit (Sub-PMU)” in collaboration with FD for smooth information sharing, close communication and collaboration, and coordination of activities among the stakeholders.

## **2. Accomplishments made by the Project**

### **2.1 Overall Project Management**

#### **2.1.1 Submission of the Work Plan**

In March/April 2019, The Project Expert Team prepared and finalized the Work Plan of the Design Phase of Component 2 based on the results of the meetings with the relevant government organizations. The work plan was submitted to FD, FDSNR and the relevant departments and organizations in the same month.

#### **2.1.2 Participation in the Joint Coordination Committee (JCC) Meetings**

The Project Expert Team participated in the 2<sup>nd</sup> and 3<sup>rd</sup> JCC meetings held at Nyaung Shwe on August 2, 2019 and at Taunggyi on February 19, 2020, respectively, and reported the progress of its works as well as the activities planned for the following six months after the respective meetings.

#### **2.1.3 Formation of the Sub-Project Management Unit and Working Groups for Component 2**

With an aim to develop the capacity of the government agencies as well as to build up the basis for collaboration of the integrated watershed management of the Inle Lake, the Project has assisted FD in the establishment of i) Sub-Project Management Unit (Sub-PMU) for project management and ii) working groups for field activities. The sections below introduce the process taken for formation of the organizational set-ups.

##### **(1) Submission of the Proposal for the Establishment of Sub-Project Management Unit and Working Groups for Component 2**

The Project Expert Team had a series of meetings with the relevant government offices, particularly FD technical departments and the relevant offices at state, district, and township levels, to explain the outline of the works in March and April 2019. In the meetings, one of the points emphasized in the meetings was the organizational set-ups for Component 2, namely i) the structure of Sub-PMU for Component 2 and ii) the formation of working groups for the field activities. Based on the results of the discussions in the meetings, the Project Expert Team with assistance from FDSNR finalized and submitted to FD the following proposals for establishment of the organizational set-ups for Component 2.

- Draft Proposal of the Formation of Sub Project Management Unit (Sub-PMU) for the Inle Lake Integrated Watershed Management Component (Component 2) of the Project for Capacity Building for Sustainable Natural Resource Management (FDSNR)
- Draft Proposal for the Formation of Field Working Groups with Appointment of Counterpart Personnel for Component 2 of FDSNR

The draft proposals submitted are presented in **Attachments-2 and -3**.

After the approval of the formation of Sub-PMU in the 2<sup>nd</sup> Joint Coordination Committee meeting on August 2, 2019, FD has prepared and submitted the letter on the formation of Sub-PMU and field working groups to Union Minister of Ministry of Natural Resources and Environmental Conservation (MONREC) for his approval.

##### **(2) Official Set-up of Sub-PMU and Working Groups for Component 2**

As shown in **Attachment-4**, the official letters for i) establishment of Sub-PMU and ii) formation of

field working groups for Component 2 of FDSNR were issued by Union Minister of MONREC on October 9, 2019. The structures of both the set-ups are shown below.

### **Structures of the Working Groups for Component 2**

#### **1) Working Group for River Monitoring and Erosion Control**

<b>Members</b>	<b>Organizations</b>	<b>Position</b>
Group Leader	FD at Nyaung Shwe Township	Staff Officer
Members	FD at Kalaw Township	Staff Officer
	DALS at Taunggyi District	Staff Officer
	IWUMD at Nyaung Shwe Township	Assistant Engineer
	IWUMD at Nyaung Shwe Township	Assistant Engineer
	WMD in FD at National Level	Range Officer
	WMD in FD at National Level	Range Officer

#### **2) Working Group for Community Forestry and Sustainable Land Management**

<b>Members</b>	<b>Organizations</b>	<b>Position</b>
Group Leader	FD at Nyaung Shwe Township	Staff Officer
Members	FD at Kalaw Township	Staff Officer
	GAD at Nyaung Shwe Township	Deputy Township Officer
	DoA at Nyaung Shwe Township	Staff Officer
	DoA at Kalaw Township	Staff Officer
	DALMS at Nyaung Shwe Township	Assistant Staff Officer
	DALMS at Kalaw Township	Assistant Staff Officer

*Source: JICA Project Expert Team (2020)*

### **Structures of the Sub-Project Management Unit**

<b>Members</b>	<b>Organizations</b>	<b>Position</b>
Chair person	Watershed Management Division, FD	Director
Vice Chair person (1)	General Administration Department, Shan State	Director
Vice Chair person (2)	Forest Department of Shan State	Director
Members	Extension Division, FD	Director
	Hydrology Branch, IDUMD	Director
	Land Use Division, DoA	Director
	Forest Department, Taunggyi District	Assistant Director
	IWUMD, Nyaung Shwe Township	Staff Officer
	DoA, Taunggyi District	Assistant Director
	DALMloS, Taunggyi District	Assistant Director
	ECD, Taunggyi District	Assistant Director
FDSNR (Component 1)	Chief Technical Advisor	
Secretariat	FD, Shan State	Assistant Director
	JICA Project Expert Team	Team Leader, etc.

*Source: JICA Project Expert Team (2020)*

### **(3) Meetings with Sub-PMU and Working Groups for Component 2**

#### Meeting of Working Groups for Component 2

The Project Expert Team has held the meetings of Working Group on a monthly basis from November 2019 to February 2020 to share the progress of the project and exchange opinions and ideas on key project activities, namely river monitoring, erosion control, and CF/ agroforestry with members of the working groups. The monthly meeting has been suspended since March 2020 due to the COVID19 pandemic. The memos of the meetings held from November 2019 to February 2020 are shown in **Attachment-5**.

#### Meeting of Sub-PMU

Meanwhile, Sub-PMU had the 1<sup>st</sup> meeting on February 4, 2020 to share the major accomplishments made by Component 2 and discuss its function with a 2020 annual schedule among the members. The minutes of the meeting is shown in **Attachment-6**.

#### 2.1.4 Meetings with Relevant Organizations

Since the commencement of the project activity of Component 2, the Project Expert Team has held a series of meetings with the relevant organizations, such as FD, IWUMD, and other relevant organizations at national, state, district and township levels. In total, 32 meetings have been held in this reporting period as shown in **Table-1**.

In the beginning of the Project, the JICA Project Expert Team focused on the introduction of the work plan of the design phase of Component 2. Once the project activities have started, the JICA Project Expert Team has informed periodically the progress of the activities, e.g., topographic analysis, soil erosion control works, monitoring river flow and suspended sediment, socio economic survey and community forestry, to the relevant organizations to facilitate collaboration in the design phase of Component 2.

The memos of the meetings are shown in **Attachment-7**.

#### 2.1.5 Collection and Review of Existing Documents

In order to overview the forest and environmental sectors in the country and grasp the changes in conditions and environment of Inle Lake and its watershed, the Project Expert Team have collected existing reports, studies, and researches relevant to the sectors and Inle Lake as listed below.

##### Studies, Researches and Plans on Inle Lake

- Contemporary changes in open water surface area of Lake Inle, Myanmar, 2006, Roy C. Sidlt, et al.
- Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar, 2008, Takahisa Furuichi
- Integrated Water Resources Management in Myanmar - Assessing ecological status in Inlay Lake-, 2018, NIVA
- Destination Management Plan for the Inlay Lake Region - Environmental Assessment, 2014, Myanmar Institute of Integrated Development
- Inle Lake Long-term Conservation and Rehabilitation Plan, 2014, MoECAAF
- Inle Lake Conservation and Rehabilitation, 2015, UNDP
- Inle Lake Conservation and Rehabilitation Project, End of Project Evaluation, 2015, UNDP
- A multi-dimensional assessment of ecosystems and ecosystem services at Inle Lake, Myanmar, 2017, ICIMOD
- Impact of land use land cover change on ecosystem services: a comparative analysis on observed data and people's perception in Inle Lake, Myanmar, 2018, Seema Karki, et al.
- Assessment of Soil Erosion Effect on Inle Lake in Mountainous Region (PPT material)
- Monitoring the Thinning of Aged Lakes Using Satellite Remote Sensing, Kyaw Sann Oo, et al.

##### Overviews of the Relevant Sectors

- Community Forestry Instructions, 2016, MoECAAF
- Facts about Environmental Conservation and Forestry in Myanmar, 2013, MoECAAF
- Conservation of Biodiversity and Protected Areas Law, 2018
- Inlay Lake Region Conservation Law (Draft), 2016
- Towards a Sustainable Land Administration and Management System in Myanmar, 2018, WB

In addition, the Project Expert Team collected the 10-year rainfall data (2010-2019) in Kalaw sub-

watershed from IWUMD as tabulated below.

### Rainfall Data of Kalaw Sub-Watershed from 2010 to 2019

(Unit: mm)

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dev	
2010	0.0	0.0	0.0	23.9	53.3	59.4	150.6	246.6	221.2	112.5	4.8	19.8	892.3
2011	0.0	0.0	19.6	110.0	161.5	79.2	152.1	399.0	224.5	188.5	6.9	41.1	1,382.5
2012	0.0	0.0	2.8	31.2	91.7	35.1	150.1	200.7	149.4	60.7	19.3	22.1	763.0
2013	4.3	0.0	6.4	8.9	109.0	93.0	153.2	141.0	203.7	204.0	21.3	2.0	946.7
2014	0.0	0.5	0.0	95.8	91.4	150.1	131.1	135.9	129.3	147.8	13.5	0.0	895.4
2015	26.4	0.0	8.6	44.5	130.8	51.8	150.1	149.6	103.6	98.8	5.1	12.7	782.1
2016	19.8	13.2	1.5	43.7	160.0	173.7	151.6	154.9	102.1	101.3	37.6	0.0	959.6
2017	72.1	0.0	5.8	46.2	182.4	142.0	206.5	215.9	116.6	146.6	72.9	5.1	1,212.1
2018	50.8	0.0	0.0	112.5	135.1	193.8	77.0	121.4	157.2	223.3	9.7	3.0	1,083.8
2019	13.0	1.0	0.5	0.5	42.2	126.5	136.4	305.1	110.0	29.2	70.6	2.5	837.4
<b>Average</b>	<b>18.6</b>	<b>1.5</b>	<b>4.5</b>	<b>51.7</b>	<b>115.7</b>	<b>110.5</b>	<b>145.9</b>	<b>207.0</b>	<b>151.8</b>	<b>131.3</b>	<b>26.2</b>	<b>10.8</b>	<b>975.5</b>

Source: IWUMD

The annual rainfall data collected from IWUMD indicate that the annual rainfalls in the area vary from 782.1 to 1382.5 mm/year with the average of 975.5 mm/year. As suggested by the table above, the rainy season in the sub-watershed starts in April and ends in October/ November.

#### 2.1.6 Selection of the Target Watershed for Component 2

The Project Expert Team made the initial assessment of the four major river basins based on the existing data/reports as well as results of field assessments made in March/ April in 2019 to select the target sub-watershed for Component 2 in terms of i) potential impact of the project interventions and ii) expected demonstration effects of soil erosion control measures proposed by the Project. The results of the assessment are summarized below.

#### Evaluation of the 4 Major Sub-watersheds

Items	Namlet	Negya	Kalaw	Upper Balu
Catchment area <1	1,149 km <sup>2</sup>	250 km <sup>2</sup>	742 km <sup>2</sup>	813 km <sup>2</sup>
Total sediment input <1 (input per unit)	103,600 ton/yr (90 ton/yr/km <sup>2</sup> )	19,000 ton/yr (76 ton/yr/km <sup>2</sup> )	56,500 ton/yr (76 ton/yr/km <sup>2</sup> )	98,300 ton/yr (121 ton/yr/km <sup>2</sup> )
Type of soil erosion <3	Surface: High Gully: Low	Surface: Medium Gully: High	Surface: Medium Gully: High	Surface: High Gully: Low
Sediment trap <4	Exist	Exist	None	None
Deposition in the lake <1	0.85 ton/yr	0.15 ton/yr	0.50 ton/yr	0.03 ton/yr
Outflow at outlet <2	0%	0%	13%	50%

Sources: <1 Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Takahisa Furuichi, 2008

<2 Estimated by the JICA Project Expert Team based on the Dr. Furuichi's report

<3 Initial estimation by the JICA Project Expert Team based on the GIS assessment and interpretation of Google Earth Images

<4 IWUMD Nyaung Shwe

As indicated above, Namlet sub-watershed is considered as the highest contributor to sedimentation in the Lake, which was followed by Kalaw sub-watershed. On the other hand, Kalaw and Negya sub-watersheds were considered suitable for demonstration of gully erosion control and land management/surface soil erosion control measures as both types of soil erosion seemed to prevail in the areas. The Project Expert Team selected Kalaw sub-watershed as the target sub-watershed where demonstration activities would be undertaken under Component 2 considering the potential demonstration effect and contribution to reduced sedimentation in the lake.

#### 2.1.7 Procurement of the Equipment

The Project Expert Team procured and exported the following project equipment to Myanmar during

the project period.

### Equipment Procured under the Project

Items	No. (Unit)	Location of installation/storage
1. Dimension-velocity meter	1	Nyaung Kyo
2. Multi sampler	1	FD Nyaung Shwe office
3. Soil sampler	1	FD Nyaung Shwe office
4. Copy machine	1	FD Nyaung Shwe office
5. Auto sampler	1	Nyaung Kyo
6. Rain gauge	2	Aun bang/Ngoke
7. Water level gauge	5	Namlet/Yepe/Thang Taung/Inntain/Nyaung Kyo
8. Trail camera	4	FD Nyaung Shwe office
9. Velocity meter	1	FD Nyaung Shwe office

Source: JICA Project Expert Team (2020)

As of the end of August 2020, some of the equipment procured have been installed in the field and used for river monitoring activities. All the equipment are under the responsibility and management of JICA as requested by FD so that the equipment could be properly maintained and protected during the project period.

#### 2.1.8 Submission of Bi-monthly Progress Report

The Project Expert Team prepared and submitted bi-monthly progress report every two months to FD and relevant organizations to share the progress of the activities of the Project.

#### 2.1.9 Technical Seminars for FD

The Project Expert Team conducted two technical seminars for FD officers at FD Naypyidaw in collaboration with FDNSR. The outline of the seminars is summarized below. **Attachment-8** shows the reports made by FDSNR on both the seminars.

### Summary of Technical Seminars conducted for FD

Seminar	Date	No. of participants	Topics
Seminar on Soil Conservation	Nov. 20, 2019	35 officials from FD, FRI, IWUMD, Forest School, etc.	<ul style="list-style-type: none"> <li>■ Identification of gullies</li> <li>■ Planning of erosion control with model cases of gully erosion control measures</li> </ul>
Seminar on Sediment Monitoring	Dec. 18, 2019	38 officials from FD, FRI, IWUMD, Forest School, etc.	<ul style="list-style-type: none"> <li>■ Monitoring of river discharge, TSS, and precipitation,</li> <li>■ Core sampling,</li> <li>■ Data analysis</li> </ul>

Source: JICA Project Expert Team (2020)

## 2.2 Field Works

### 2.2.1 Analysis of Soil Erosion Potentials in the Watershed

#### (1) GIS Data Collection

The following data were collected from the relevant organizations to assess soil erosion potentials in the watershed.

### Data Collected for Assessment of Soil Erosion Potentials

Data	Sources of data
Forest cover map	FD, RS&GIS Section
Soil type map <1	DoA, Land Use Division
Geology of Inle lake <2	Taungoo University
DEM data	-
Late satellite image	Google Earth Pro

Note: <1 Need to further collect data from Taunggyi University.



<2 Need to supplement the geological map collected with the data from FAO.  
Source: JICA Project Expert Team (2019)

**(2) Preparation of Thematic Maps**

The Project Expert Team developed the following thematic maps for assessment of soil erosion potentials in the watershed as shown in **Figures 1 to 3**.





- a. Sub-watershed/catchment map
- b. Slope map
- c. Updated forest cover map

**(3) Observation of Gully Erosion in the Field**

The Team conducted a reconnaissance survey on some of the existing gullies in Kalaw and Negar sub-watersheds. The characteristics of existing gullies observed in the field are summarized below.

- Most of the gullies observed have a U-shape cross section (The slope of sidewalls is nearly 90 degree.)
- The depth of gullies ranges from 3 m to 30 m.
- A majority of gullies found in the flat plains near Inle Lake are rectilinear with less branches, while those found in the flat and undulating areas in the upper Kalaw sub-watershed are rather meandering with some branches.
- There are gullies with a limestone layer among those found in the upper Kalaw sub-watershed.
- Many of gullies in the upper Kalaw sub-watershed started in concaved areas between farms (Gully heads are located in concaved areas between farms.)

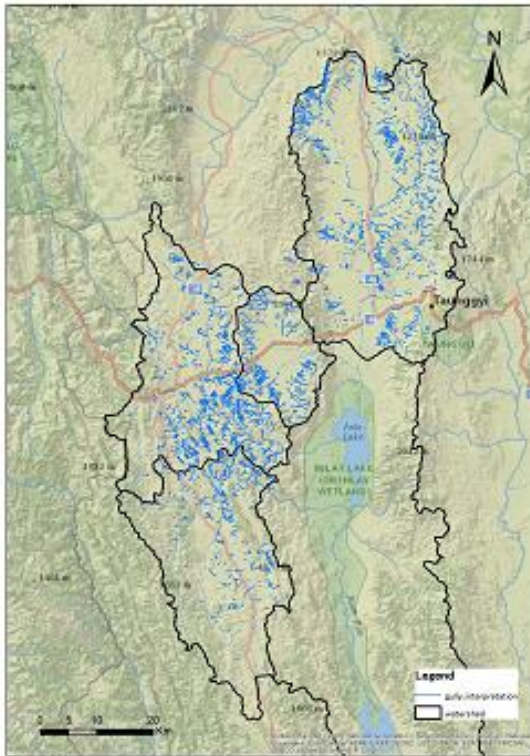
**Photos of Existing Gullies**

	
Cross section of gullies	Branches of gully
	
Gully with limestone layer	Gully head located in concaved areas between farms.

Source: JICA Project Expert Team (2019)

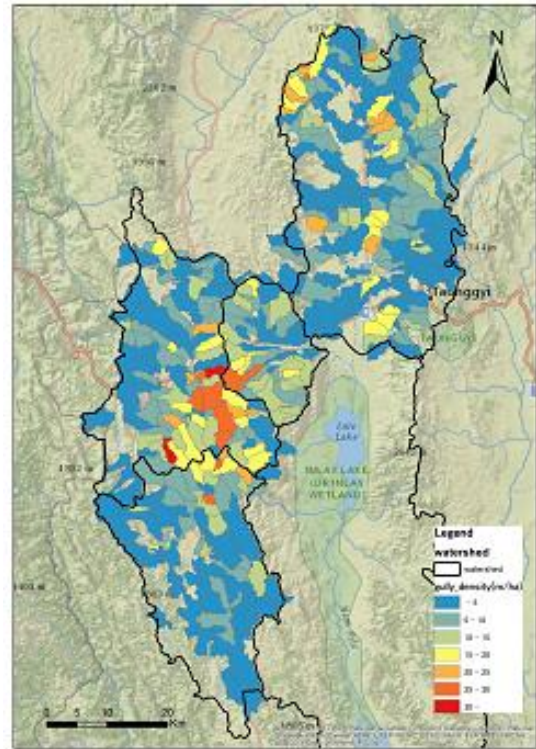
**(4) Analysis on Distribution of Gully Erosion**

The Project Expert Team also analyzed the distribution and density of existing gullies in the four sub-watersheds through visual interpretation of Google Earth Image and field observation as shown below.



**Distribution of Gully Erosion**

Source: JICA Project Expert Team (2019)

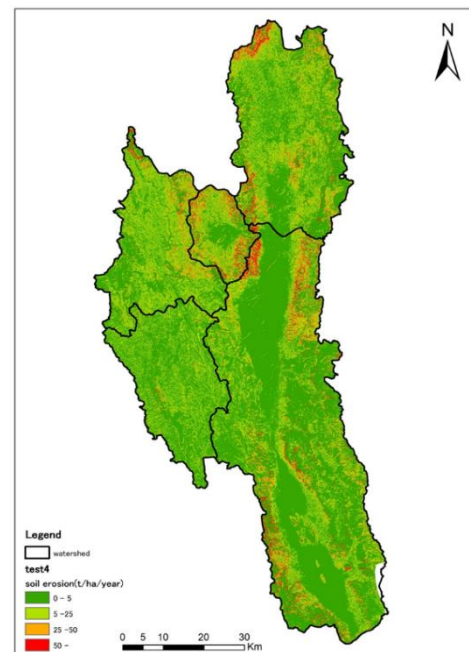


**Density of Gully Erosion**

As shown above, existing gullies are concentrated in Kalaw and Negya sub-watersheds. In particular, the eastern part of Kala sub-watershed shows the highest density of existing gullies.

#### (5) Analysis on the Potential Surface Erosion by USLE

In order to grasp the potential of surface erosion in the watershed, the Project Expert Team calculated the potential of soil loss in the 4 sub-watersheds using Universal Soil Loss Equation (USLE) and compared the results among the sub-watersheds. Necessary data for USLE was collected including precipitation, soil erodibility index, slope factor and crop management factor. Although USLE requires the erosion control factor which represents status of introduction of soil conservation measures, such as terracing and planting along the contour lines, the erosion control factor was not considered due to the difficulty of the data acquisition. The results of the analysis are shown below.



**Potential of Soil Surface Erosion**

Source: JICA Project Expert Team (2019)

### Results of USLE by Sub-watershed

Sub-watershed	Area(km <sup>2</sup> )	Estimated quantity of soil flow (1000 t)	Estimated quantity of soil flow per km <sup>2</sup> (t/km <sup>2</sup> )
Namlet	1,170	1,069.6	914
Negya	261	388.4	1,488
Kalaw	754	667.1	885
Upper Balu	716	303.8	424
Total	2,508	1,818.3	725

*Source: JICA Project Expert Team (2019)*

In the USLE analysis above, the slope and vegetation data were influencing factors for the estimation since the resolution of precipitation and soil data was low. Hence the potential of surface soil erosion in Negya sub-watershed is higher since the area encompasses steep sloping hills of the left bank of Inle Lake and extensive agricultural farms.

#### (6) Classification of Gully Erosion

The Project Expert Team classified the existing gullies into six types in terms of their shapes, size, and vegetation based on the results of the analysis. The table below shows the types of gullies found in the watershed.

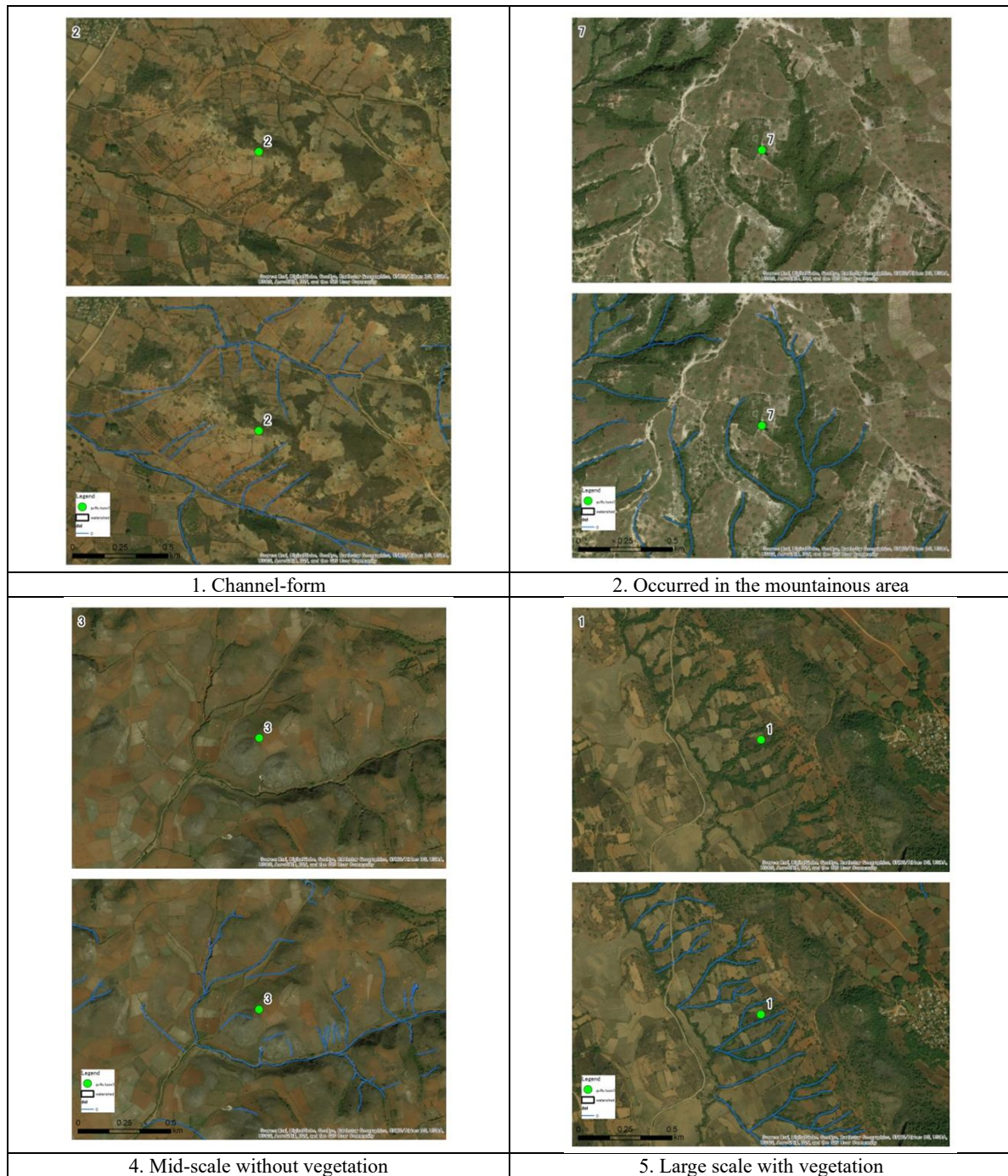
#### Type of Gullies in the Watershed

Type of Gully	Location of Occurrence	Width	Vegetation	Remarks
1.Channel-form	Flat area	Around 2m	Grassland, shrub, bare land	
2.Mountainous area	Mountainous area	—		Including the site which surrounding area is eroded heavily
3.Mid-scale with vegetation	Hillside	5~15m	Grassland, shrub, bare land	The depth of the erosion could be estimated easier than gully type 1 and 2.
4.Mid-scale without vegetation	Hillside	5~15m	Grassland, shrub, bare land	
5.Large scale with vegetation	Hillside	>15m	Grassland, shrub, forest	
6.Large scale without vegetation	Hillside	>15m		

*Source: JICA Project Expert Team (2019)*

The following figures show the typical image of some types of gully erosion.





Source: JICA Project Expert Team (2020)

### Typical Images of the Existing Gullies

The total length of existing gullies by gully type in the four sub-watersheds are tabulated below.

#### Total Length of Gully Erosion by Gully Type

(Unit:m)

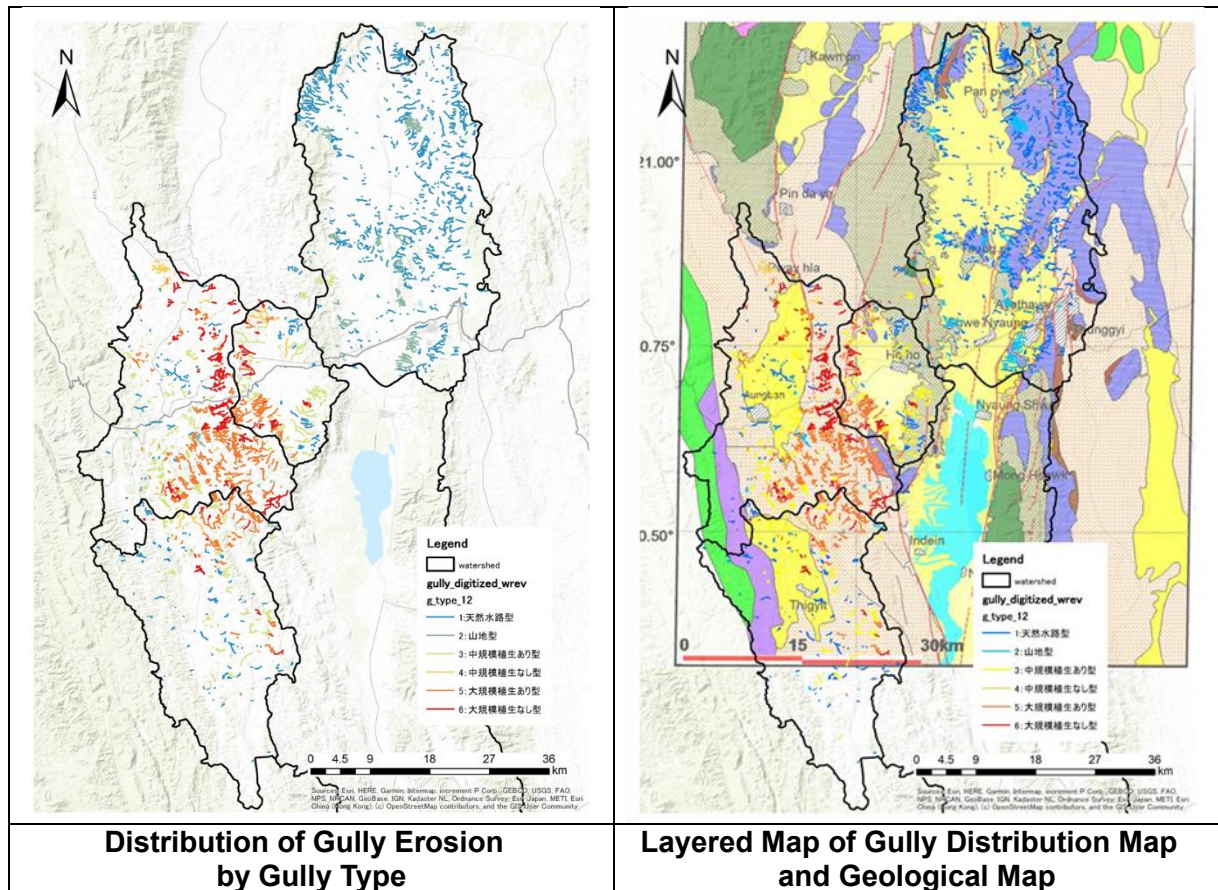
Gully Type	Namlet	Negya	Kalaw	Upper Balu	Total Length
1.Channel-form	494,896	28,054	32,162	53,928	610,071
2.Mountainous area	142,074	69	11,347	4,998	158,754
3.Mid-scale with vegetation	13,815	74,417	83,872	64,658	236,762
4.Mid-scale without vegetation	0	16,637	21,633	9,989	48,259
5.Large scale with vegetation	0	80,316	262,922	87,144	430,382

Gully Type	Namlet	Negya	Kalaw	Upper Balu	Total Length
6.Large scale without vegetation	0	36,404	154,186	21,762	214,763
Total	650,786	235,897	566,122	242,480	1,698,992

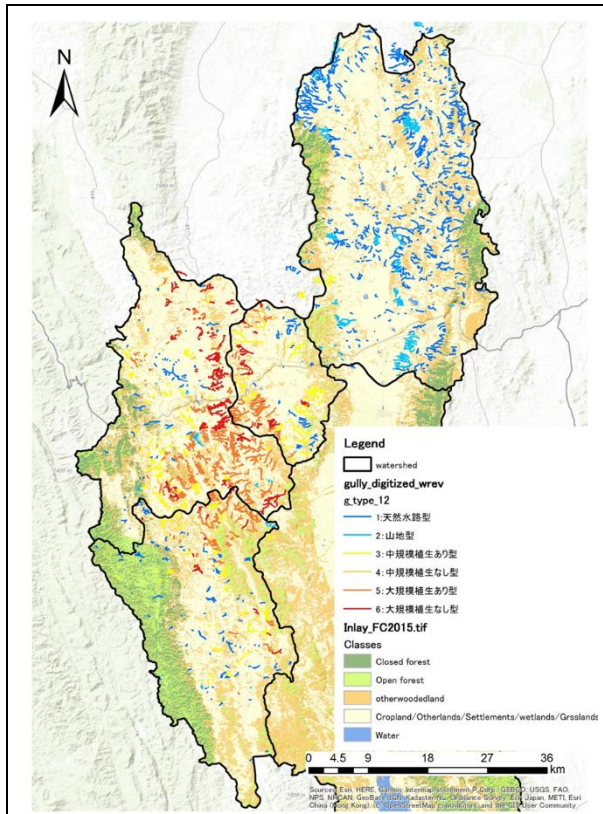
Source: JICA Project Expert Team (2020)

As shown above, Type 1: Channel-form gullies are mostly found in Namlet sub-watershed, while Mid-scale and Large-scale gullies (Types 3 to 6) predominantly exist in the other sub-watersheds. Particularly, those types of gullies concentrate in the eastern part of Kalaw sub-watershed as shown in the map named “Distribution of Gully Erosion by Gully Type.”

Occurrence of gully erosion seems to be highly related to geological features and vegetation covers. As shown in the map named “Layered Map of Gully Distribution Map and Geological Map” and “Layered Map of Gully Distribution Map and Vegetation Cover Map,” the majority of Types 3 to 6 are found in the areas which have the same geological feature (i.e., limestone highland formed in the Triassic period) and vegetation covers (i.e., non-forest lands or woodlots). In contrast, Upper Balu sub-watershed, where the major part of the areas are still covered with forests, has less gully erosion as compared to the other sub-watersheds, although the watershed has the same geological formation as Kalaw sub-watershed has.







**Layered Map of Gully Distribution Map and Vegetation Cover Map**

Source: JICA Project Expert Team (2020)

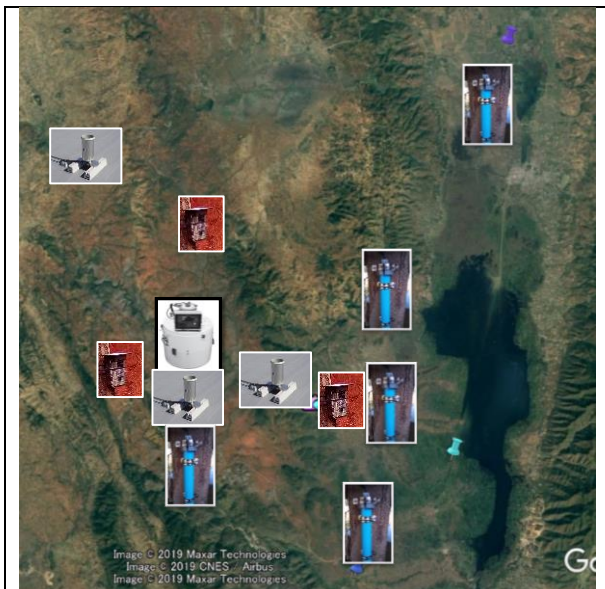
## 2.2.2 Analysis of the Influx of Suspended Sediment and Sedimentation in Inle Lake

### (1) Installation of Monitoring Equipment/ Devices

As described in Section 2.1.8, the Project Expert Team procured the following equipment/ devices for estimation of the volume of suspended sediment flown into Inle Lake through the major rivers.

- Five units of water level gauge
- One unit of Auto water sampler
- Three units of rain gauge

All the equipment/ devices have been placed in the field as of the end of August 2020. The location map of the equipment/ devices installed in the field is shown right. The georeferenced data of the respective locations are shown below.



**Location Map of River Monitoring Equipment**

Source: JICA Project Expert Team (2020)

**Locations for River Monitoring Equipment and Devices Installed**

Equipment	No. of equipment	Location	GPS data
Water Level Gauge	No. 1	Mid-stream of Kalaw river where auto sampler is placed	N 20° 34' 43" E 96° 44' 25"
	No. 2	Downstream of Namlet river	N 20° 43' 17" E 96° 55' 20"
	No. 3	Downstream of Kalaw river (Bridge on the ring road over the river)	N 20° 32' 37" E 96° 50' 25"
	No. 4	Downstream of Neyga river (Wooden bridge near the ring road)	N 20° 42' 05" E 96° 53' 21"
	No. 5	Downstream of Upper Balu river (Bridge on the ring road over the river)	N 20° 27' 36" E 96° 50' 32"
Auto Sampler	No. 1	Mid-stream of Kalaw river (the same place where No. 1 water level gauge is placed)	N 20° 34' 43" E 96° 44' 25"
Rain gauge	No. 1	Aung Bang	N 20° 39' 23" E 96° 38' 01"
	No. 2	Ngoke Village	N 20° 38' 08" E 96° 47' 29"

Source: JICA Project Expert Team (2020)



Water Level Gauge at the Bridge over Upper Balu



Water Level Gauge at the Bridge over Namlet



Water Level Gauge at the Bridge over Neyga



Water Level Gauge at the Bridge over Kalaw



Auto sample installed in the mid-stream of Kalaw

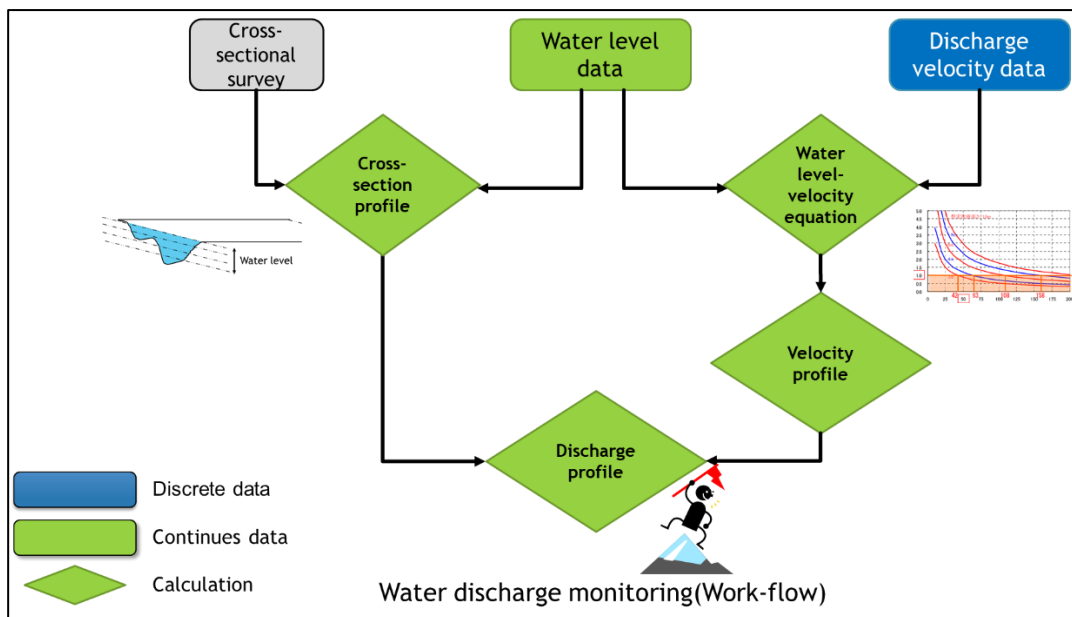
Source: JICA Project Expert Team (2019)

### Site Views of the Locations where River Monitoring Equipment and Devices are placed

Out of five units of water level gauge, the ones for Kalaw and Upper Balu rivers have been just installed and re-installed in August 2020, respectively, due to the replacement of the bridges over the rivers where the gauges were placed. Hence, there is no monitoring data available of Kalaw river, while the data collected at Upper Balu are limited to the months when the equipment had been placed on the river.

#### (2) Monitoring of River Discharge

River discharge can be calculated and estimated from water level data, river velocity data, and river cross section profile. The following diagram shows how the monitoring data are used for estimation of river discharge.

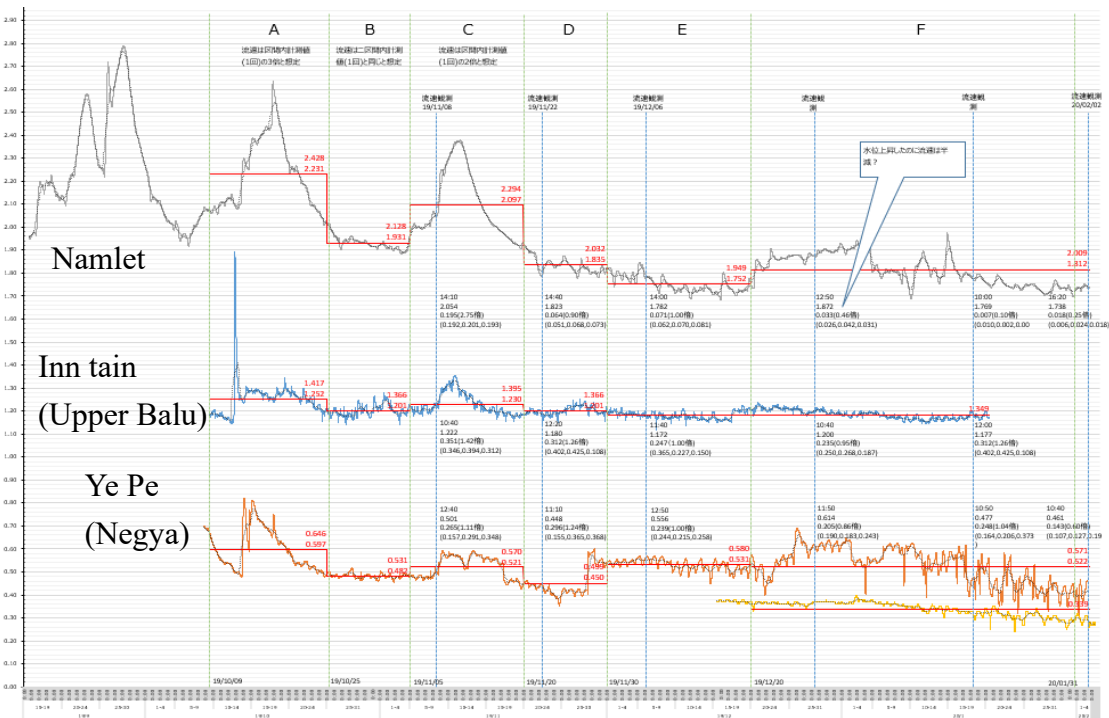


The sections below describe the data collected and analyses made for estimation of river discharge of Namlet, Negya and Upper Balu rivers. The details are also shown also in **Attachment-9**.



a. Monitoring of Water Level and results

The data collected from the water level gauges set at Namlet, Negya and Upper Balu rivers from October 2019 to January 2020 are illustrated below.



Source: JICA Project Expert Team (2020)

**Result of Monitoring of Water Level in Upper Balu, Namlet and Negya rivers**

Although the observation period is limited only to the dry season, the results indicate that Nam Lat River has the deepest water depth, followed by Negya and Upper Balu rivers. In Namlet and Negya rivers, fluctuation in water level in the same day are observed. It is presumed that the water level of Namlet and Negya might be affected by i) backwater from the irrigation canal connected to the river below the water level gauge and ii) water intake by local farmers for flower cultivation in the upstream area, respectively.

b. Measurement of Water Velocity and results

The Project Evaluation Team manually measured the flow velocity of the rivers at the locations where the water level gauges were placed. The current in the center and both sides of the rivers were measured at a depth of 50 cm from the surface. The results of river velocity monitoring are shown below.

**Results of water flow velocity in three monitoring points (Units : m/s)**

Date	Place	Time	Depth (cm)	Left	Middle	Right	
8/Nov/2019	INNTAIN (Upper Balu)	10:43	50	0.346	0.394	0.312	
22/Nov/2019	INNTAIN	12:22	50	0.402	0.425	0.108	
6/Dec/2019	INNTAIN	11:45	50	0.365	0.227	0.150	
28/Dec/2019	INNTAIN	10:44	50	0.250	0.268	0.187	
18/Jan/2020	INNTAIN	12:00	50	0.402	0.425	0.108	
2/Feb/2020	INNTAIN	Uninstalled on 20 January, 2020					
8/Nov/2019	TAIYO (Namlet)	14:10	50	0.192	0.201	0.193	
22/Nov/2019	TAIYO	14:42	50	0.051	0.068	0.073	
6/Dec/2019	TAIYO	14:05	50	0.062	0.070	0.081	
28/Dec/2019	TAIYO	12:52	50	0.026	0.042	0.031	
18/Jan/2020	TAIYO	10:00	50	0.010	0.002	0.008	

Date	Place	Time	Depth (cm)	Left	Middle	Right
2/Feb/2020	TAIYO	16:20	50	0.006	0.024	0.024
8/Nov/2019	YEPE (Negya)	12:40	50	0.157	0.291	0.348
22/Nov/2019	YEPE	11:15	50	0.155	0.365	0.368
6/Dec/2019	YEPE	12:55	50	0.244	0.215	0.258
28/Dec/2019	YEPE	11:53	50	0.190	0.183	0.243
18/Jan/2020	YEPE	10:56	50	0.164	0.206	0.373
2/Feb/2020	YEPE	10:39	50	0.107	0.127	0.194

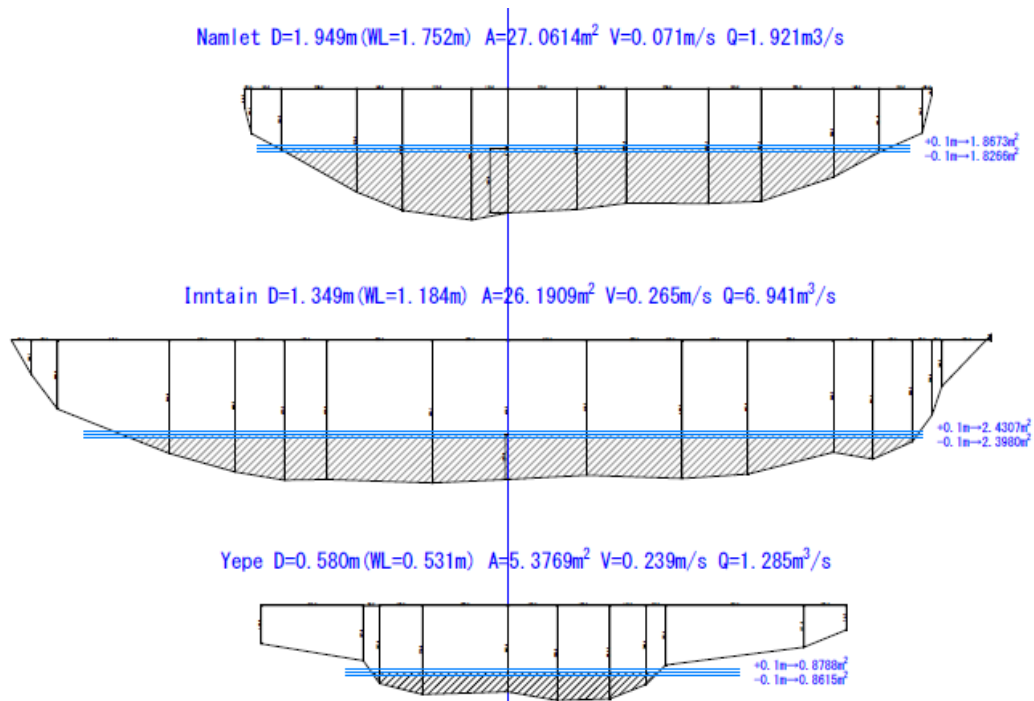
Source: JICA Project Expert Team (2020)

As indicated above, Upper Balu river (Inntain) has the highest flow velocity among three rivers, followed by Nager river (Yepe) and Namlet river (Taiyo). The fastest flow velocity was recorded in the different points in the respective rivers, which suggested that the shape of the rivers might affect the river flow velocity.

One of the reasons why the flow velocity of Namlet river was the lowest among the three rivers though it has the highest water level is possibly the effect of backwater from the irrigation canal connected to the river below the point where the water level gauge is installed. In general, a positive correlation is observed between the increase in water level and the increase in flow velocity. This suggests that the water level gauge on Namlet river be relocated to avoid the effect of backwater.

c. Measurement of Discharge Profile and results

The Project Expert Team conducted the cross section profile survey with auto-level at the points where the water level gauges were placed on Namlet (Tay Yo), Negya (Yepe), and Upper Balu (Inn Tain) rivers in September 2019 and February 2020. The cross section profiles of the respective rivers based on the results of the survey are shown below.



\*Note: WL : Water level, A : Area, V : Velocity, Q : Water discharge

Source: JICA Project Expert Team (2020)

**Result of Measurement of Water Discharge Profile for 3 rivers**

d. Estimation of River Discharge

The Team estimated river discharge of Namlet, Negya, and Upper Balu using the results of the analyses described in the previous sections, namely water level, flow velocity, and cross section profiles. As the flow velocity was not measured continuously, the period from October to December was divided into six time scales, so that the respective monitoring data could represent the certain periods which have the same tendency in river flow. The results of the estimation of river discharge in the three rivers are tabulated below.

**Estimation of Water Discharge for 3 rivers**

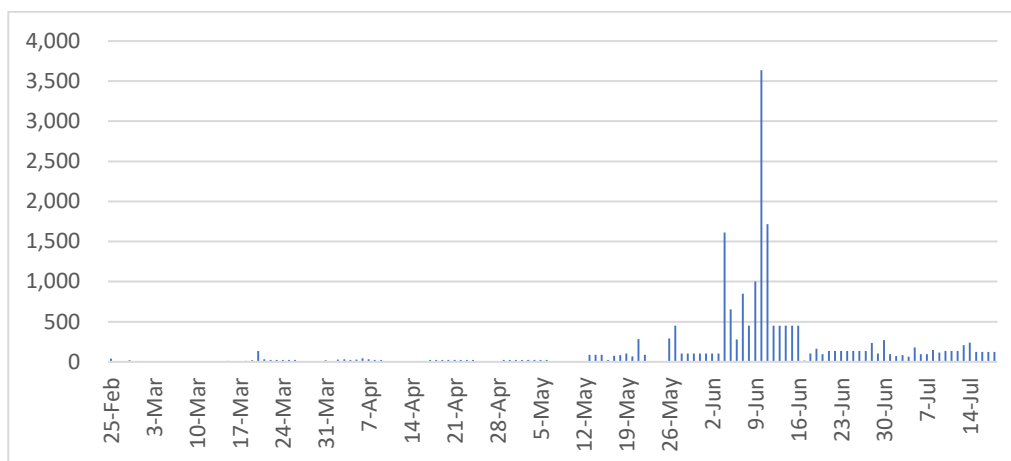
River	Period			Water level (m)	Cross section area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Days	Total discharge (m <sup>3</sup> )
	No	Start	End						
Namlet	1	19/10/9	19/10/24	2.428	36.7384	0.585	21.281	16	29,418,854
	2	19/10/25	19/11/4	2.128	30.4330	0.195	5.934	11	5,639,674
	3	19/11/5	19/11/19	2.294	33.7151	0.390	13.149	15	17,041,104
	4	19/11/20	19/11/30	2.032	28.6084	0.064	1.831	11	1,740,182
	5	19/12/1	19/12/19	1.949	27.0614	0.071	1.921	19	3,151,514
	6	19/12/20	20/2/1	2.009	28.1769	0.019	0.535	44	2,033,856
	Total								
Upper Balu	1	19/10/9	19/10/24	1.417	27.8402	1.503	29.316	16	40,526,438
	2	19/10/25	19/11/4	1.201	26.1909	0.351	9.193	11	8,737,027
	3	19/11/5	19/11/19	1.395	27.3050	0.702	19.168	15	24,841,728
	4	19/11/20	19/11/30	1.366	26.6018	0.312	8.300	11	7,888,320
	5	19/12/1	19/12/19	1.349	26.1909	0.247	6.469	19	10,619,510
	6	19/12/20	20/2/1	1.349	26.1909	0.265	6.941	44	26,386,906
	Total								
Negya	1	19/10/9	19/10/24	0.646	5.9550	0.795	4.734	16	6,544,282
	2	19/10/25	19/11/4	0.331	4.9508	0.265	1.312	11	1,246,925
	3	19/11/5	19/11/19	0.570	5.2900	0.530	2.804	15	3,633,984
	4	19/11/20	19/11/30	0.499	4.6777	0.296	1.358	11	1,316,304
	5	19/12/1	19/12/19	0.580	5.3769	0.239	1.285	19	2,109,456
	6	19/12/20	20/2/1	0.571	5.2987	0.199	1.054	44	4,006,886
	Total								

Source: JICA Project Expert Team (2020)

(3) Monitoring of Influx of Suspended Sediment

a. Monitoring of Suspended Sediment in Kalaw

The volume of suspended sediment flown into Inle Lake is estimated by multiplying the estimated water discharge with the discharging Total Suspended Solid (TSS) per unit volume of river water. To this end, the Project Expert Team installed one unit of Auto Water Sampler in the middle stream of Kalaw river to collect water samples for TSS analysis from February to date. The volume of Suspended Sediment in Kalaw ranges around from 4 to 3,600 mg/l per day as illustrated in the following figure during the monitoring period from February to July 2020.



b. Estimation of TSS in Namlet, Negya and Upper Balu

Since Auto Water Sampler has been set only on Kalaw river as stated above, the following results of TSS analysis made by Chief Advisor of FDSNR in 2018 were fully used to supplement the data to estimate TSS in Namlet, Upper Balu (Inn Tain) and Negya (Ye Pe).

**TSS data applied**

(Unit: mg/l)

Period	Start	End	NamLat	Inntain	YePe
Period-1	9 October 2019	24 October 2019	100	120	200
Period-2	25 October 2019	4 November 2019	100	120	200
Period-3	5 November 2019	19 November 2019	7	28	59
Period-4	20 November 2019	30 November 2019	7	28	59
Period-5	1 December 2019	19 December 2019	7	28	59
Period-6	20 December 2019	1 February 2020	7	28	59

Source: Yuzuru Kimura (Chief Technical Advisor for FDSNR)

The Team estimated the daily volume of suspended sediment flown in the rivers using the results of TSS analysis as shown below.

**Discharged Amount of TSS from October 9, 2019 to February 1, 2020**

Site	Period	Days	TSS (mg/L)	Total	Site	Period
Namlet	Period-1	16	100	29,418,854	2,942	183.9
	Period-2	11	100	5,639,674	564	51.3
	Period-3	15	100	17,041,104	1,704	113.6
	Period-4	11	100	1,740,182	174	15.8
	Period-5	44	7	2,033,856	14	0.3
	Period-6	19	7	3,153,514	22	1.2
Upper Balu (Inn Tain)	Period-1	16	120	40,526,438	4,863	303.9
	Period-2	11	120	8,737,027	1,048	95.3
	Period-3	15	120	24,841,728	2,981	198.7
	Period-4	11	120	7,888,320	947	86.1
	Period-5	44	28	26,386,906	739	16.8
	Period-6	19	28	10,619,510	297	15.6
Negya (Ye Pe)	Period-1	16	200	6,544,282	1,309	81.8
	Period-2	11	200	1,246,925	249	22.7
	Period-3	15	200	3,633,984	727	48.5
	Period-4	11	200	1,316,304	263	23.9
	Period-5	44	59	4,006,886	236	5.4
	Period-6	19	59	2,109,456	124	6.6

Source: JICA Project Expert Team (2020)

The results of the estimation given above suggest that the total amounts of suspended sediment flown through Upper Balu (Inn Tain), Namlet ( and Negya (Ye Pe) during the period from October 9, 2019 to February 1, 2020 were estimated at 10,875 tons, 5,420 tons and 2,909 tons, respectively.



#### (4) Analysis on the Process of Sedimentation in Inle Lake

##### a. Aerial Observation with Drone and Water Sampling in Floating Garden and Lake

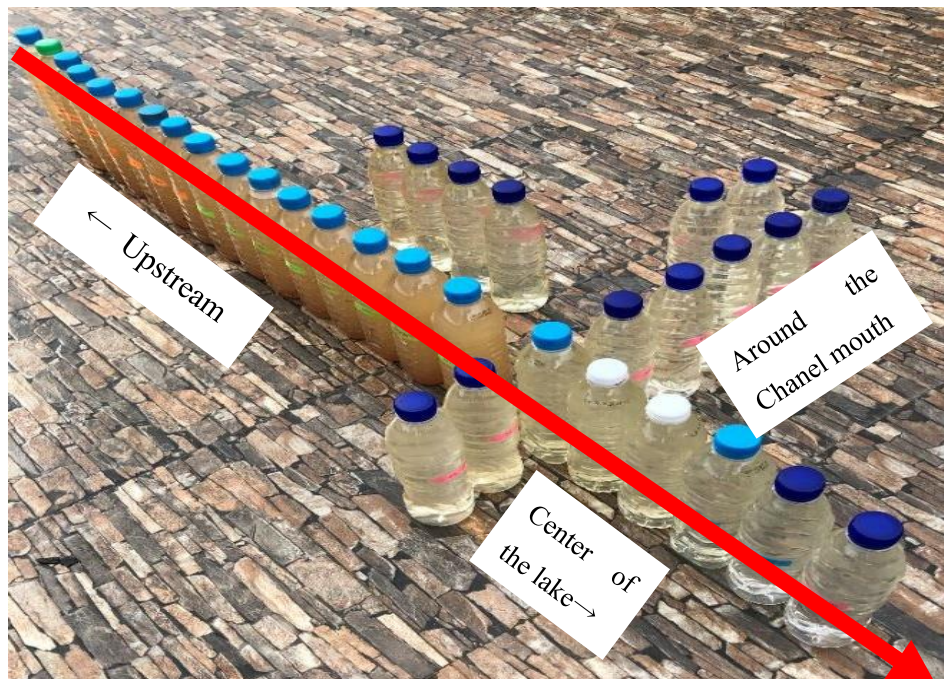
In the middle of August 2019, the Project Expert Team took a visible light image using drone along the water channel passing through floating gardens in Inle Lake to assess the turbidity of water flowing to Inle Lake. The Team simultaneously took samples of surface water in the same channel to analyze TSS in the surface water. The channel where the visual image was taken and sampling points are shown below.



Source: JICA Project Expert Team (2019)

#### Location of Points where Surface Water Samples were taken

As shown in the photo above and the one below (the photo of the water samples taken), the visibility of the samples becomes clear as the sampling points are away from the channel mouth.



Source: JICA Project Expert Team (2019)

#### Water Samples taken by the Project Expert Team

The results of TSS analysis of surface water is shown below.

<b>Results of TSS Analysis of Surface Water</b>		
<b>Location</b>	<b>Sampling Point ID</b>	<b>TSS (mg/lit)</b>
Canal running in river delta	W00	277
	W01	274
	W02	300
	W03	298
	W04	319
	W05	282
	W06	282
	W07	293
	W08	275
	W09	263
	W10	304
	W11	299
	W12	289
	W13	296
	W14	307
W15	292	
Lake shore to the center of the lake from the canal mouth	E01	22
	E02	22
	E03	13
	E04	5
	E05	3
	E06	6
Water channel in floating garden	Wa	4
	Wb	10
	Wc	9
	Wd	5
Southern side lake shore from the canal	S01	23
	S02	18
Northern side lake shore from the canal	N01	9
	N02	4
	N03	4
	N04	1
	N05	11
	N06	2
	N07	4

*Source: JICA Project Expert Team (2020)*

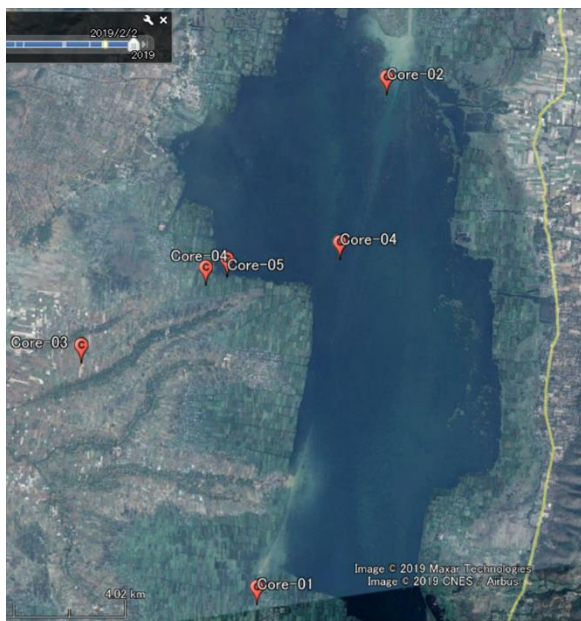
As the water in the canal comes from Kalaw river and directly flows into Inle Lake, data of TSS in surface water in the canal are more or less 300 mg/lit at any locations. On the other hand, those in the water channel in floating garden near lakeshore are less than one tenth of the ones in the canal. TSS in surface water in the middle of Inle Lake is less than 10 mg/lit.

The results suggest that the major part of suspended sediment flown in Kalaw river might be trapped by floating garden sand deposited underneath the same areas. The results of TSS in surface water at the lakeshore and within the lake also show the low density of TSS, which also indicate the possibility that most of the suspended sediment might be deposited in floating garden, at the mouth of the canal, or near lakeshore.

- b. Collection of the Soil Samples from Lake Bottom and Alluvial Fun for Analyses of Soil Particle Size and Radio Carbon Dating (C-14)

The Project Team conducted the core sampling survey at six (6) strategic points in Inle Lake

and alluvial fan to collect soil samples from their profiles, so that the Team could grasp the parent materials of sediment and history of deposition in the lake. The locations of the sampling points are shown below.



Source: JICA Project Expert Team (2020)

### Location of Core Sampling

The results of the C14 analysis are also summarized below.

#### Results of C14 Analysis of the Soil Samples

ID	20 cm (year)	60 cm (year)	Deposition rate in 20 cm (mm/year)
C-01	240±20	960±20	0.77
C-02	310±20	860±20	0.61
C-03	50±20	910±20	2.86
C-04	670±20	NA*	0.29
C-05	1,270±20	2,590±20	0.16
C-06	990±20	1,610±20	0.18

\*Data not available

Source: JICA Project Expert Team (2020)

The results indicate that soil deposition may occur at C-03, which is the middle of floating gardens, at a fast pace. C-01 and 02, which are the downstream or mouths of canals running through floating gardens, the second highest pace of deposition, while C-04, 05 and 06 in the lakeshore or within the lake are lower than others. Hence, it can be said that the deposition rate is the highest in floating gardens, and it decreases as it goes down to the lake.

This suggests that the sedimentation rate decreases as the water velocity decreases proportionally, and that the sedimentation does not significantly occur at the outer edge of the floating garden. At the estuary of Namlet, sedimentation rate may be relatively higher than other locations, as the water velocity in Namlet river, even at the mouth of the river, is kept high due to its straightened concrete lining channel.

#### (5) Camera Trap Monitoring

The Project Expert Team placed camera traps at i) the outlet of Kalaw river from the cave to monitor the flow of Kalaw river, ii) the existing gully erosion at Ein Yar village and ii) existing gully where erosion control measures were piloted at Kone Ni village to observe the progress of gully erosion.

Like as the other equipment, the installation of the camera trap was made in November 2019, which was far behind the original schedule due to time-consuming process of importing the equipment in Myanmar. Hence, there has been no significant events recorded by the cameras, as they started the recording in the beginning of dry season.

#### (6) Capacity Building of Government Personnel for River Monitoring

The government officials of the relevant departments, namely FD and IWMUD, which are the members of Working Group for Component 2 have been involved in the processes of installation of river monitoring equipment, particularly water level gauges, auto water sampler and rain gauge, and collection of monitoring data of the water level gauges.

#### (7) Conditions of Existing Check Dams and Sediment Ponds

##### a. Inventory of Existing Check Dams

The Project Expert Team requested FD and IWUMD township offices (Nyaung Shwe , Kalaw FD and Nyaung Shwe IWUMD) to provide the inventory of existing check dams constructed by both departments in the watershed. **Attachment-10** shows the report on the inventory survey of existing check dams built by Nyaung Shwe and Kalaw FD offices and Nyaung Shwe IWUMD as summarized below.

#### Data (Average Dimension) of Check Dams Installed by FD and IWUMD

##### Nyaung Shwe FD

Year	No. of dams	Length (m)	Height (m)	Volume (m3)
2014	14	3.7	1.9	168.5
2015	17	4.4	1.8	196.0
2016	10	4.9	1.5	219.5
2017	17	4.1	1.5	183.9
2018	19	4.3	1.5	192.0
Total	77	4.2	1.6	190.4

Source: Nyaung Shwe FD, Arranged by the JICA Project Team (2020)

##### Kalaw FD

Year	No. of dams	Length (m)	Height (m)	Volume (m3)
2014	10	4.5	1.3	61.8
2015	10	4.9	1.3	66.7
2016	10	4.1	1.3	62.0
2017	11	4.4	1.3	62.5
2018	13	4.4	1.3	59.4
Total	54	4.5	1.3	62.3

Source: Kalaw FD, Arranged by the JICA Project Team (2020)

##### Nyaung Shwe IWUMD

Year	No. of dams	Length (m)	Height (m)	Volume (m3)
2014	22	11.0	1.2	N/A
2015	18	11.8	1.2	N/A
2016	25	10.4	1.4	N/A
2017	3	15.2	1.5	N/A
2018	2	10.7	1.2	N/A
Total	70	11.2	1.3	N/A

N/A: Data not available

Source: Nyaung Shwe IWUMD, Arranged by the JICA Project Team (2020)

Both Nyaung Shwe and Kalaw FDs have constructed more than 10 check dams per year constantly, while the number of check dams constructed by IWUMD has decreased drastically since 2017 mainly due to budget limitation accordingly. On the other hand, the size of check





dams built by IWUMD is generally larger than those built by FD as shown in the tables above.

b. Field Observation of Check Dams

To confirm the conditions of existing check dams, the Project Expert Team conducted field observation of some existing check dams constructed by FD and IWUMD in the watershed. Some findings of the field observation are summarized below.



**Summary of Field Observation of Existing Check Dams (1)**

Items	FD	IWUMD
Types of Check dam	Masonry with wooden frame Masonry with concrete	Masonry with wooden frame Masonry
Size	L:3~5m、H : 1.5~2m、 W:0.5~0.8m	L:5~10m、 H : 1.5~2.5m、 W : 0.8~1m
Issues to be addressed	In general, a single unit of check dam is put in a gully due to financial constraints as well as the limited capacity for the planning, particularly layout planning. The structure of check dam is standardized without consideration of site conditions.	A series of check dams are constructed in a gully with a layout plan to protect the downstream apron from erosion. However, the structure and layout of check dam are rather standardized without consideration of site conditions. Many weep holes are put in check dam to drain water, but the holes likely weaken the structural strength.
Photos		

Source: JICA Project Expert Team (2019)

In addition to masonry check dams shown above, other types of gully erosion control measures, namely i) gully plug with wooden fence and sandbags and ii) sandbag check dam, shown below, were observed as shown below.

**Summary of Field Observation of Existing Check Dams (2)**

	Gully plug with wooden fence and sand bag at gully head		Sand bag check dam on the lower side of the gully plug shown left
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Source: JICA Project Expert Team (2019)

It was concluded by the expert of the JICA Project Expert Team that i) the facilities or measures developed by FD and IWUMD were simple and needed to be further improved, but ii) they have potentials to reduce the progress of gully erosion with some improvements by using materials locally available.

c. Location of Sedimentation Ponds

There are three sedimentation ponds in the watersheds, i.e., two in Namlet and one in Negya.

### 2.2.3 Collection of Socio-economic Baseline Data

#### (1) Collection of Secondary Data

The Project Expert Team collected the following socio-economic data relating to either village tracts or villages located in the watershed.

- Name and location
- No. of households and Population
- Ethnicity
- Agricultural statistics

The data collected were used for selection of the target villages for the socio-economic survey. It was difficult to collect household economic data, such as household income or poverty level, due to the lack of data.

#### (2) Preparation of Questionnaires for the Socio-economic Survey

Prior to the interview survey, the Project Expert Team together with the NGO selected for the socio-economic survey finalized a set of questionnaires after a pre-test in the field. The final version of the questionnaires used for the survey is presented in **Attachment-11**.

#### (3) Selection of the Target Villages

The Project Expert Team together with Kalaw and Nyaung Shwe FD offices decided to select the target villages from those located in Kalaw township as the majority of village tracts in Kalaw sub-watershed (65% or 22 village tracts out of 34) are located in the same township<sup>3</sup>. Out of 22 village tracts in Kalaw Township, the Project Expert Team, in consultation with Kalaw FD, selected six village tracts, which have i) existing gullies, ii) steep sloping lands, and iii) existing CF communities or potential CF communities within the respective jurisdictional areas. As it was difficult to clearly differentiate village tracts in terms of ethnicity due to the mixture of ethnic groups in some village tracts, such a criterion was not considered in this step. The following table shows the characteristics of 22 village tracts including the six tracts selected.

**Evaluation of 22 Village Tracts in Kalaw Township**

Name of VT	No. of villages	Slope avg	Slope max	No. of gullies	Number of CF
1. Baw Nin	1	13.0	47.7	14	0
2. Kan Bar Ni	4	7.6	35.2	43	3
3. La Mong	8	11.9	43.2	4	0
4. Lel Kyar	6	10.7	43.4	25	0 <1
5. Loi An	1	14.7	46.8	0	6
6. Loi Maw	5	11.5	43.6	0	6
7. Myin Ma Hti	17	12.3	54.6	17	1
8. Nang Naing	6	16.1	54.2	0	0
9. Nang Taing	4	8.9	37.1	0	0
10. Nawng Ye	2	9.9	46.4	0	0
11. Ngoke	9	11.8	53.0	25	2
12. Ngone Thon	6	8.8	41.2	68	0
13. Pe Yin Taung	2	9.6	41.7	3	13
14. Pin Hmi	15	11.0	56.6	47	3
15. Shwe Min Hpone	NA	16.4	49.3	0	5
16. Taung Kwe	4	17.5	50.0	0	0

<sup>3</sup> Other nine village tracts are located in Pindaya township, while 3 are in Ywangan township.

Name of VT	No. of villages	Slope avg	Slope max	No. of gullies	Number of CF
17. Taung Lar	7	15.0	57.7	0	2
18. Thar Mong Hkam	6	7.0	29.8	36	4
19. Thu Ye	7	9.9	38.6	2	3
20. Urban	1	11.0	35.7	0	0
21. Wet Hpyu Yae	NA	16.3	47.0	0	12
22. Yae Cho	5	8.8	41.9	20	4

Note: <1 There are at least two villages where FD plans to introduce CF existing in the area.

Source: JICA Project Expert Team (2019)

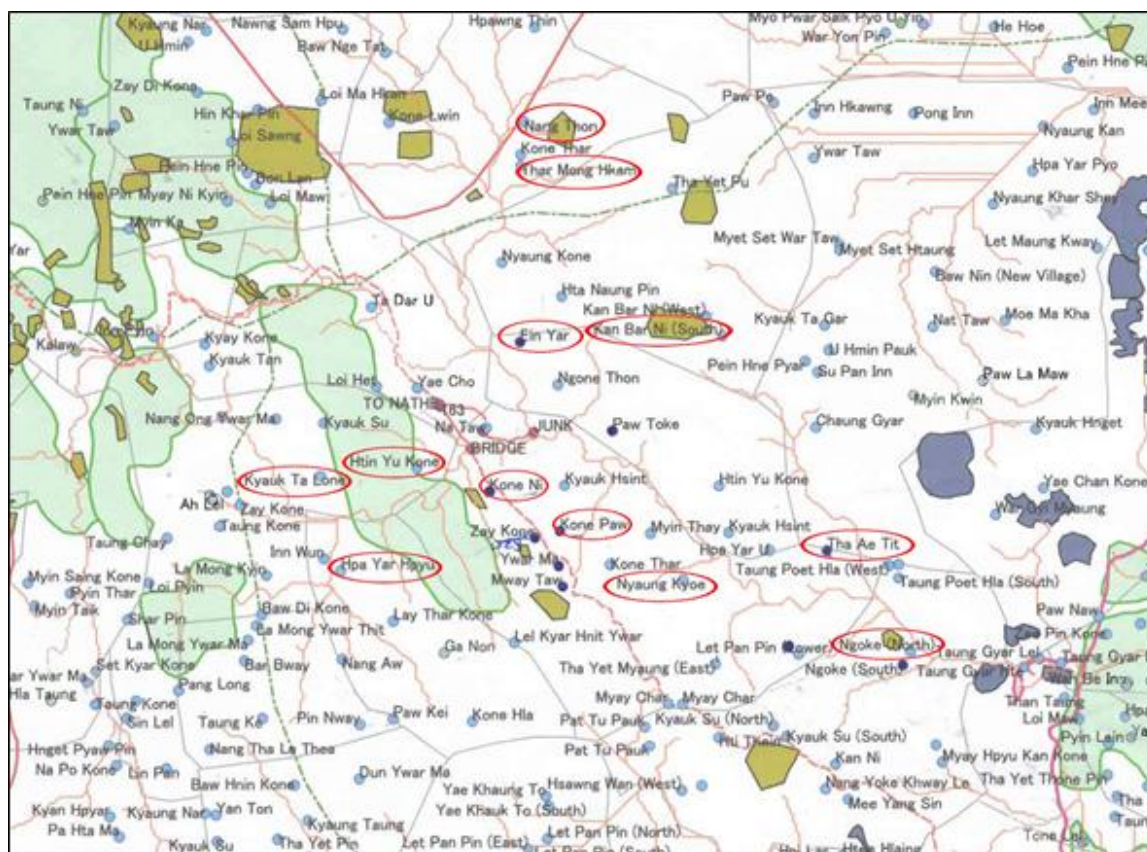
Among 57 villages in the selected six village tracts, the Project Expert Team and Kalaw FD office selected the following 12 villages as target sites for the socio-economic survey considering their accessibility, ethnicity, and existence of CF communities including potential ones.

### Target Villages selected for the Socio-Economic Survey

No.	Village	Village Tract	Accessibility	Ethnicity	Existence of CF
1	Kone Ni	Pin Hmi	Good	Paoh, Taung Yo	Registered
2	Kone Paw	Pin Hmi	ditto	Paoh	Submitted
3	Nyaung Kyo	Pin Hmi	ditto	Paoh	None
4	Htin Yu Kone	Myin Ma Hti	ditto	Paoh	Planned
5	Ywar Ma	Myin Ma Hti	ditto	Paoh	Registered
6	Hpa Yar Hpyu	Lei Kyar	ditto	Taung Yo	Planned
7	Thar Mong Hkam	Thar Mong Hkam	ditto	Danu	Registered
8	Ein Yar	Kan Bar Ni	ditto	Danu	None
9	Kan Bar Ni (South)	Kan Bar Ni	ditto	Danu	Registered
10	Nan Thon	Thar Mong Hkam	ditto	Danu	Registered
11	Tha Ae Thit	Pin Hmi	ditto	Tano	None
12	Ngoke (North)	Ngoke	ditto	Paoh	Registered

Source: JICA Project Expert Team (2019)

The locations of the selected villages are shown in the figure below.



### Location Map of the Target Villages selected for the Socio-Economic Survey

Source: JICA Project Expert Team (2020)

#### (4) Household Interview Survey

The interview survey was contracted out to a national NGO which has experiences in similar types of survey in the past for smooth operations. In April/ May 2019, the NGO carried out the questionnaire survey targeting 540 households in the 12 village, which results are compiled in **Attachment-12**. Also, some of them are highlighted in the sections below.

##### a. Demography

The population of the target villages varies from 215 to 560 peoples with the average of 372 persons per village, while the average number of households of the village is 95.4. The average number of family is estimated at 3.9 persons per family, while the average number of work force is 2.8 persons per family.

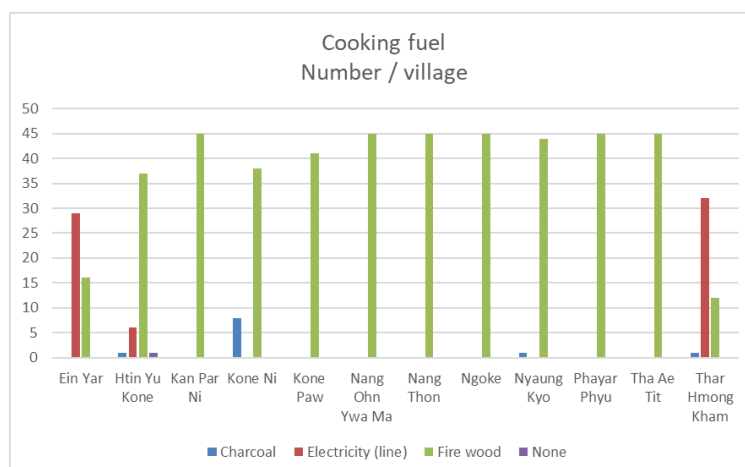
**Demography of Target Villages of HIS**

Village	Population	Total HHS	Family members	No. of Work force
1. Ein Yar	315	80	3.9	2.6
2.Htin Yu Kone	328	105	3.1	2.8
3. Kan Bar Ni (South)	441	182	2.4	3.0
4. Kone Ni	370	89	4.2	2.8
5. Kone Paw	170	41	4.1	2.5
6.Nang Ong Ywar Ma	530	116	4.6	2.7
7.Nang Thon	242	67	3.6	2.3
8. Ngoke (North)	560	120	4.7	3.1
9. Nyaung Kyo	396	85	4.7	2.7
10. Pha Yar Phyu	215	50	4.3	2.6
11. Thit Ae Tit	400	97	4.1	2.8
12.Thar Mong Hkam	495	113	4.4	3.1
Average	371.8	95.4	3.9	2.8

Source: JICA Project Expert Team (2020)

##### b. Cooking Fuel

In the target villages except Ein Yar and Thar Mong Hkam which have been already electrified, the main source of cooking energy is firewood.



Source: JICA Project Expert Team (2020)

#### Sources of Energy for Cooking in the Target Villages

##### c. Land for Cultivation and its Ownership

On average, one household has 1.27 ha of cropping area, which consists of 0.97 ha of operating area, 0.25 ha of unused area and 0.05 ha of land rent from others. More details of the land tenure

status in the villages are shown below.

### Status of Land Use per Household

(Unit: ha)

Village	Total Cultivating Area(ha)	Own arable land (Operating) (ha)	Own arable land (Not operating) (ha)	Tenant arable land (Operating) from others
1. Ein Yar	1.99	1.37	0.59	0.03
2.Htin Yu Kone	1.36	0.92	0.42	0.01
3. Kan Bar Ni (South)	2.14	1.75	0.24	0.15
4. Kone Ni	1.24	0.78	0.43	0.01
5. Kone Paw	1.36	1.01	0.25	0.05
6.Nang Ong Ywar Ma	0.90	0.79	0.10	0.01
7.Nang Thon	1.36	0.95	0.21	0.20
8. Ngoke (North)	1.04	0.99	0.05	0.00
9. Nyaung Kyo	1.39	1.21	0.18	0.00
10. Pha Yar Phyu	0.73	0.63	0.07	0.03
11. Thit Ae Tit	0.66	0.59	0.00	0.06
12.Thar Mong Hkam	1.40	0.65	0.51	0.03
Average	1.27	0.97	0.25	0.05

Source: JICA Project Expert Team (2020)

#### d. Access to the Drinking Water

Although the type of water sources used by villages varies among the villages, most of the villages depend on the piped water from springs and/or well water. The table below shows the water sources used by households in the target villages.

### Water Sources Used in the Target Village

Village	Type of water sources					Total
	Pipe from spring water	Tap water	Well	River	Others	
Ein Yar	1	6	35	-	3	45
	2.2%	13.3%	77.8%	0.0%	6.7%	100.0%
Htin Yu Kone	36	-	9	-	-	45
	80.0%	0.0%	20.0%	0.0%	0.0%	100.0%
Kan Par Ni	-	-	4	-	41	45
	0.0%	0.0%	8.9%	0.0%	91.1%	100.0%
Kone Ni	27	16	-	1	1	45
	60.0%	35.6%	0.0%	2.2%	2.2%	100.0%
Kone Paw	10	7	5	1	22	45
	22.2%	15.6%	11.1%	2.2%	48.9%	100.0%
Nang Ohn Ywa Ma	40	5	-	-	-	45
	88.9%	11.1%	0.0%	0.0%	0.0%	100.0%
Nang Thon	-	-	45	-	-	45
	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
Ngoke	10	-	15	9	11	45
	22.2%	0.0%	33.3%	20.0%	24.4%	100.0%
Nyaung Kyo	3	-	8	2	32	45
	6.7%	0.0%	17.8%	4.4%	71.1%	100.0%
Pha Yar Phyu	23	17	2	-	3	45
	51.1%	37.8%	4.4%	0.0%	6.7%	100.0%
Tha Ae Tit	3	1	20	11	10	45
	6.7%	2.2%	44.4%	24.4%	22.2%	100.0%
Thar Hmong Kham	-	27	16	-	2	45
	0.0%	60.0%	35.6%	0.0%	4.4%	100.0%
<b>Total</b>	<b>153</b>	<b>79</b>	<b>159</b>	<b>24</b>	<b>125</b>	<b>540</b>
	<b>28.3%</b>	<b>14.6%</b>	<b>29.4%</b>	<b>4.4%</b>	<b>23.1%</b>	<b>100.0%</b>

Source: JICA Project Expert Team (2020)



e. Agricultural Conditions

Crop Production

Major crops produced in each village and the estimated production of crops per household are summarized below.

**Major Crops Produced in the Target Villages**

(Unit: kg/HH)

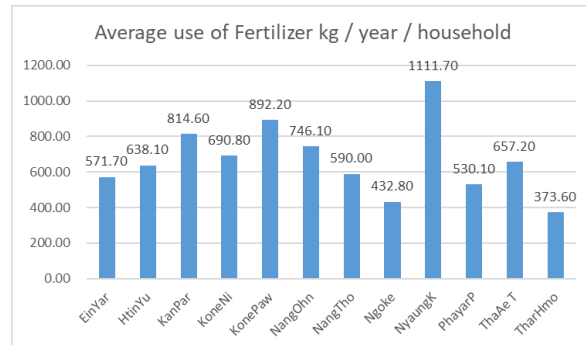
Village	Major crops (harvest volume/HH)
1. Ein Yar	Ginger (11,178.2), tomato (3,266.9), corn (2,445)
2. Htin Yu Kone	Cauliflower (7,200), pear (4,890), ginger (2,596.15)
3. Kan Bar Ni (South)	Potato (6,944.56), ginger (3,873.19), corn (3,514.09)
4. Kone Ni	Chinese cabbage (5,521.63), cabbage (4,511.36), ginger (3,747.7)
5. Kone Paw	Cauliflower (15,000), cabbage (13,733.3), tomato (5,883.9)
6. Nang Ong Ywar Ma	Cauliflower (5,075), ginger (3,518.25), tomato (2,526.5)
7. Nang Thon	Ginger (4,592.8), cauliflower (3,577.28), taro (3,239.63)
8. Ngoke (North)	Turmeric (16,300), tomato (5,283.45), corn (1,766.35)
9. Nyaung Kyoe	Chinese cabbage (4,690), potato (4,123.16), tomato (3,997.12)
10. Pha Yar Phyu	Cabbage (3,855.56), Chinese cabbage (3,622.22), tomato (2,928.57)
11. Thit Ae Tit	Potato (2,555.48), tomato (2,158.76), corn (1,670.75)
12. Thar Mong Hkam	Ginger (5,658.43), strawberry (2,320.12), taro (2,207.6)

*Source: JICA Project Expert Team (2020)*

In general, households of the target village produce crops mainly for selling (such as ginger and cauliflower) than for self-consumption.

Fertilizer Application

Several types of chemical fertilizer are used for many of crops produced in the villages, such as tomato, ginger and other vegetables. In Nyaung Kyo village where tomato, potato and cabbage are produced, the villagers use the highest volume of chemical fertilizer per household among the 12 villages.

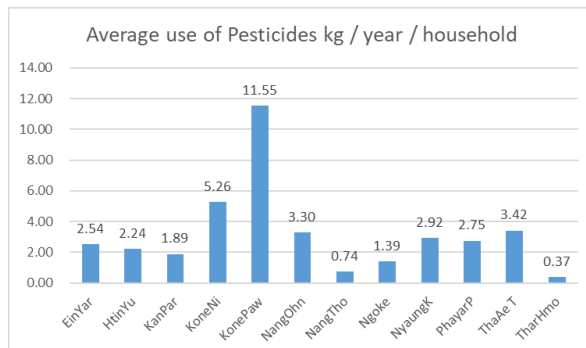


*Source: JICA Project Expert Team (2020)*

**Use of Fertilizer in the Target Village**

Pesticide Application

Likewise, a variety of pesticides are used for vegetable production. Among the target villages, households in Kone Paw village use the highest amount of pesticide, who mainly produce vegetables, such as cauliflower, cabbage and tomato.



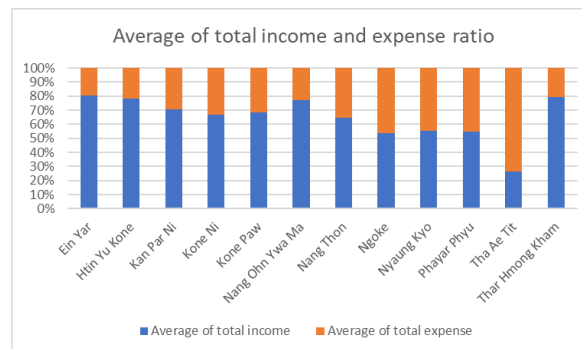
*Source: JICA Project Expert Team (2020)*

**Use of Pesticide in the Target Village**

f. Income and Expenditures

The sale of agricultural products is considered as the main source of income of households in the target villages, while clothes, education and maintenance of houses are main expenditures.

Annual balance of income and expenditures are illustrated in the graph shown right.



Source: JICA Project Expert Team (2020)

**Balance of Annual Income and Expenditure**

(5) Conduct of Participatory Rural Appraisal (PRA)

Out of the 12 target villages selected for the household interview survey, the Project Expert Team further selected the following four villages for the conduct of Participatory Rural Appraisal (PRA) based on the criteria such as e.g., accessibility, ethnicity and willingness to introduce CF.

**Target Villages selected for PRA**

Village	Village Tract	Accessability	Ethnicity	Existence of CF
Kone Ni	Pin Hmi	Good	Paoh, Taung Yo	Registered
Pha Yar Phyu	Lei Kyar	Ditto	Taung Yo	Planned
Ein Yar	Kan Bar Ni	Ditto	Danu	None
Nan Thon	Thar Mong Hkam	Ditto	Danu	Registered

Source: JICA Project Expert Team (2019)

The PRA survey, group discussions and exercises using PRA tools and techniques, were carried out by the same NGO as the one for the household interview survey from May 31 to June 10, 2019. The sessions and discussions organized in the target villages are summarized below.

### Sessions/Discussions organized by the PRA Survey

Sessions/discussions	Data and Information to be collected
1. Resource mapping/ Hazard mapping	<ul style="list-style-type: none"> <li>■ Present land use map</li> <li>■ Availability and locations of major natural resources</li> <li>■ Location of gully erosion</li> <li>■ Status of land (land ownership) in the villages</li> </ul>
2. Trend analysis	<ul style="list-style-type: none"> <li>■ Historical changes in natural resource uses and status of natural resources</li> </ul>
3. Seasonal calendar	<ul style="list-style-type: none"> <li>■ Seasonal major activities in farming, livelihood, and traditional events.</li> <li>■ Seasonal issues and natural hazards (e.g., water shortage, forest fires and gully erosion)</li> </ul>
4. Group discussions on current status of community forest and forest resource management	<p><u>For the villages which already has established CF</u></p> <ul style="list-style-type: none"> <li>■ General information of CF</li> <li>■ Basic rules in natural resource management in CF area</li> <li>■ Process of establishment of CF</li> <li>■ Forest management practices in CF</li> <li>■ Incentives, problems and concerns in CF management</li> </ul> <p><u>For the village without establishment of CF</u></p> <ul style="list-style-type: none"> <li>■ Interest in participation in CF</li> <li>■ Expectation from CF</li> <li>■ Obstacles for apply to CF</li> </ul> <p><u>Forest Management in the village</u></p> <ul style="list-style-type: none"> <li>■ Current status and management practice of forest</li> <li>■ Importance of the forest including willingness to convert the area to other purposes</li> </ul>
5. Group discussions on farming practices and agricultural resources	<ul style="list-style-type: none"> <li>■ Practice of shifting cultivation</li> <li>■ Practice of permanent farming, including farming practices, crop production, and soil conservation measures.</li> </ul>
6. Group discussions on Natural Resource Management	<ul style="list-style-type: none"> <li>■ Important natural resources and access to the resources</li> <li>■ Important agricultural products</li> <li>■ Market flow of the major resources</li> </ul>

Source: JICA Project Expert Team (2020)

Prior to the conduct of the PRA survey, the Project Expert Team provided guidance to the NGO using the guidelines and checklists for each session given in **Attachment-13**. The members of the Team also attended the PRA survey in the villages so that the experts could directly listen to the opinions and ideas of local households in the villages and provide advice to the NGO for effective data collection in the sessions on a timely manner.

The results of the PRA survey were compiled into a report shown in **Attachment-14**. Some findings on the current conditions of the selected four villages are summarized below.

### Characteristics of the Four Villages

Village	Main source of income	Registration of CF	Characteristics
Kone Ni	Agriculture (vegetables)	Registered	<ul style="list-style-type: none"> <li>■ The village has a strong leadership.</li> <li>■ The village has a forest management plan of CF.</li> <li>■ The productivity of vegetable is high owing to high input of fertilizer.</li> <li>■ Communities earn high cash income from agriculture.</li> <li>■ Some of communities use charcoal as a source of energy.</li> <li>■ Soil productivity seems to be lowered due to over dosage of chemical fertilizer.</li> <li>■ Communities has brought their agricultural products to the market (Aungbang) by themselves.</li> <li>■ The village has had support for CF and sustainable land management.</li> <li>■ Gully erosion has often occurred in the area.</li> </ul>
Pha Yar	Agriculture	Planned	<ul style="list-style-type: none"> <li>■ Communities have protected forests in the reserved forests on</li> </ul>



Village	Main source of income	Registration of CF	Characteristics
Phyu	(vegetables)		<p>their own initiative.</p> <ul style="list-style-type: none"> <li>■ The productivity of vegetables has been improved because of increase of inputs of fertilizer.</li> <li>■ The income from agricultural products has also increased because of increase of productivity.</li> <li>■ Some communities use an improved cooking stove.</li> <li>■ The volume of water at water sources has been reduced recently.</li> <li>■ There is a possibility of lowering the land productivity due to over dosage of chemical fertilizer.</li> <li>■ It is difficult to access the market during the rainy season.</li> <li>■ The number of gullies has increased in the area recently.</li> </ul>
Ein Yar	Agriculture (vegetables)	None	<ul style="list-style-type: none"> <li>■ Communities have protected forests around the village by the instruction given by FD.</li> <li>■ FD plans to register such forests as CF but the forests are located on the boundaries with the neighboring two villages.</li> <li>■ It seems that women in the village have actively participated in the village activities.</li> <li>■ The village has been electrified; hence the consumption of firewood seems to be less.</li> <li>■ The income from agricultural products, particularly ginger, has increased because of high inputs of fertilizer.</li> <li>■ Communities have faced a shortage of irrigation water.</li> <li>■ There is a possibility of lowering the land productivity due to over dosage of chemical fertilizer.</li> <li>■ There is no forest other than pine forests protected by communities in and around the area.</li> </ul>
Nan Thon	Agriculture (rice and vegetables)	Registered	<ul style="list-style-type: none"> <li>■ The main source of income is from agricultural production. The production of vegetables, such as chayote, ginger, and cauliflower, has increased recently.</li> <li>■ There are less forests existing in the area. Communities collect firewood in bushes and scrub forests along the river.</li> <li>■ The part of CF area has been used for farming.</li> <li>■ The majority of communities has less knowledge of CF.</li> <li>■ There is no irrigation facility in the village; hence, the production during the dry season is limited.</li> <li>■ There is a farmer who has tried to diversify crops. He could be a role model for other farmers.</li> <li>■ There is a possibility of lowering the land productivity due to over dosage of chemical fertilizer.</li> <li>■ The source of energy available in the area is limited.</li> </ul>

Source: JICA Project Expert Team (2019)

## (6) Market Survey of the Agricultural Products

In addition to the household interview survey and PRA survey, the Project Expert Team conducted a market survey with the aim to grasp the market trends of major agricultural products produced by the target villages. The results of the market survey are compiled in **Attachment-15** and summarized below.

### Results of the Market Survey of the Agricultural Products

Topics	Data obtained
1. Agricultural Products in Kalaw Township	<ul style="list-style-type: none"> <li>■ Major crops produced in the area are upland and lowland paddy, corn, beans, vegetables, peanuts, potato and ginger.</li> </ul>
2. Price of the commodities at the accessible	<ul style="list-style-type: none"> <li>■ Aung Ban, Heho, Mine Thaunt, Nyaung Shwe, Shwe Nyaung and Than Daung are the major markets surveyed in the Market Survey.</li> <li>■ The major commodities traded at the markets are listed below.</li> </ul>

markets	Major Commodities	Unit price at the market (MMK/viss*)					
		Aung Ban	Heho	Mine Thaunt	Nyaung Shwe	Shwe Nyaung	Than Daung
	<b>a. Vegetables</b>						
	Lentil	3,500	-	-	-	-	-
	Green Pepper	3,000	1,300	1,500	2,000	1,400	1,200
	Red Pepper	2,800	-	-	1,200	2,000	-
	Chili Pepper	2,800	3,000	2,000	2,000	3,000	2,000
	Snow Pea	2,500	-	-	4,000	-	-
	Tomato	1,600	2,000	1,500	1,000	1,500	1,600
	Bamboo Shoot	1,500	-	2,000	200	2,000	200
	Cabbage	1,300 MMK/pc	1,200 MMK/pc	500 MMK/pc	800 MMK/pc	1,200 MMK/pc	400 MMK/pc
	<b>b. Other crops</b>						
	Tea	5,250	7,000	4,250	6,500	6,250	4,250
	Ginger	2,300	2,200	1,500	2,000	2,500	2,500
	Garlic	1,600	2,200	2,000	4,000	500	1,500
	Turmeric (powder)	5,000	-	-	-	-	-
	<b>c. Fruits</b>						
	Avocado	500 MMK/pc	-	600 MMK/pc	750 MMK/pc	800 MMK/pc	-
	Mango	666 MMK/pc	205 MMK/pc	200 MMK/pc	500 MMK/pc	250 MMK/pc	300 MMK/pc
	Strawberry	2,500 MMK/ basket	2,000 MMK/ basket	2,300 MMK/ basket	2,000 MMK/ basket	-	2,500 MMK/ basket
	<b>d. Timber</b>						
	Timber	797,500 MMK/ ton	-	780,000 MMK/ ton	815,000 MMK/ ton	-	-
	<b>e. NTFP</b>						
	Honey	5,000 MMK/ bottle	-	-	3,333 MMK/ bottle	N/A	N/A
	Mushroom	6,000	-	-	-	N/A	N/A
	Bamboo	1,100 MMK/pc	-	-	2,500 MMK/pc	1,833 MMK/pc	-
	Charcoal	3,500 MMK/ sac	3,000 MMK/ sac	-	6,500 MMK/ sac	3,500 MMK/ sac	-

\*Note: 1 viss = 1.6kg  
N/A: Data not available

- The table above indicates that almost all the commodities are gathered at the Aung Bang market and handled at relatively higher unit prices.
- In addition to the commodities listed above, tea and turmeric (powder) are also traded at the markets at higher unit prices than those of other commodities.

3. Market flows of Agricultural Commodities

- The market flows of the major commodities in Kalaw sub-watershed, particularly around Aung Bang, are illustrated below.

```

graph TD
    Villages[Villages in surrounding area] --> AungBang[Aung Bang]
    AungBang --> Bangladesh[Bangladesh]
    AungBang --> Yangon[Yangon]
    AungBang --> Thailand[Thailand]
    AungBang --> Mandalay[Mandalay]
    AungBang --> Bago[Bago, Meiktila, Morayamin]
    AungBang --> NayPyiTaw[Nay Pyi Taw]
    AungBang --> China[China]
    
```

- Some of the agricultural commodities, such as turmeric, ginger, and maize, are further brought to foreign markets through the Aung Bang market. For instance, maize is exported by traders in Aung Bang to Thailand, while turmeric and ginger are exported

	by those in other major cities (e.g., Yangon and Mandalay) to Bangladesh and China, respectively.
4. Middlemen in the market flow	<ul style="list-style-type: none"> <li>■ Two types of the middleman were found at the Aung Ban market, namely, i) middlemen who trade rather small amount of agricultural products, and ii) middlemen who sell the products to large buyers in major cities, such as Yangon and Mandalay.</li> <li>■ The middlemen working in Aung Bang area charge MMK 20~50 per viss as a trading fee from farmgate to the market depending on the type of crops.</li> </ul>
5. Constraints on farmers' marketing	<ul style="list-style-type: none"> <li>■ The major constraints that local farmers have often faced when marketing their products are: i) fluctuation of the market demand especially in overseas, ii) famers' weak bargaining power, and iii) unstandardized products.</li> </ul>

*Source: JICA Project Expert Team (2020)*

### 2.2.4 Selection of Target Areas for Pilot Activities

#### (1) Target Area for Soil Control Measures

The Project Expert Team selected two existing gullies located in Kone Ni and Ein Yar villages. Both the sites meet the criteria for selection of the proposed sites for pilot activities, i.e., 1) accessibility even in the rainy season and 2) typical type of gully erosion in the area. In Kone Ni village, FD has built a simple check dam made of sandbags, which has already got damage and need repairing. After consultations with FD, Kone Ni village was selected as the site for pilot activities for gully erosion control, which would mainly focus on the rehabilitation of the existing structures and integration of multiple measures for erosion control. The pictures below show the existing gullies in Kone Ni and Ein Yar villages.

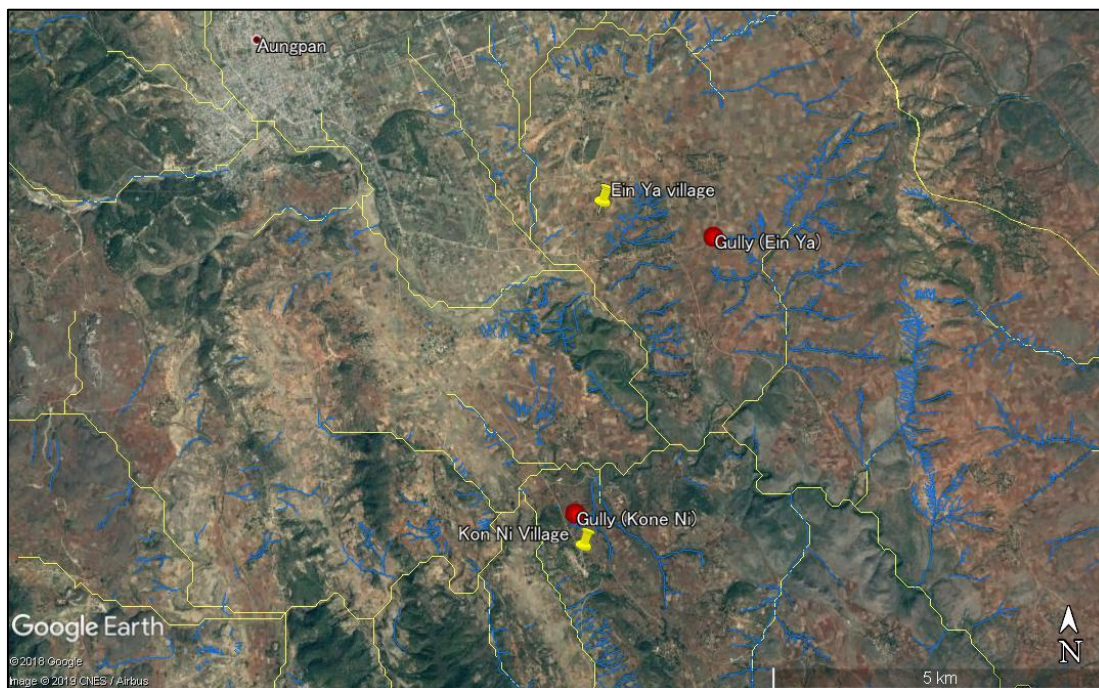


*Source: JICA Project Expert Team (2020)*

**Gully Erosion in Kone Ni village**

**Gully erosion in Ein Yar village**





Source: JICA Project Expert Team (2019)

### Location of target gully erosion

After selection of the target gully, the Project Expert Team conducted a simple longitudinal and cross section survey of the gully along with a drone-based topographic survey to supplement the ground survey and develop a plan view, longitudinal sectional view, and cross sectional view of the gully.

### (2) Target Area for Community Forest and Sustainable Natural Resource Management

Having reviewed the results of the PRA survey described in Section 2.2.3, the Project Expert Team in consultation with Kalaw Township FD selected Pha Yar Phyu village as the proposed site for pilot activities of CF and sustainable land management as local communities in the village showed their intention to protect degraded reserve forests existing near the village in the PRA survey. The table below shows the results of the evaluation of the four village where the PRA survey was conducted in terms of applicability of CF/ sustainable land management activities, potential positive and negative impacts, and potential difficulties.

#### Evaluation for Selection of Target Villages

Pilot Activities	Villages	Applicability	Potential positive impact	Potential negative impact	Difficulty
Introduction of valuable tree crops in the private farms	Kone Ni	Low	Medium	None	Medium
	Ein Yar	Medium	Medium	None	Low
	<b>Nang Thon</b>	<b>High</b>	<b>High</b>	<b>None</b>	<b>Low</b>
	<b>Pha Yar Phyu</b>	<b>High</b>	<b>High</b>	<b>None</b>	<b>Low</b>
Introduction of CF	Kone Ni	None	-	-	-
	Ein Yar	High	Medium	None	Medium <1
	Nang Thon	None	-	-	-
	<b>Pha Yar Phyu</b>	<b>High</b>	<b>High</b>	<b>None</b>	<b>Low</b>

Note: <1 The target area in Ein Yar is located outside the reserved forest and under management of GAD; hence, it would take time to establish CF in such an area.



Source: JICA Expert Team (2019)

## 2.2.5 Identification of Potential Activities

### (1) Soil Erosion Control Measures

Based on the results of the topographic survey at the target gully mentioned in Section 2.2.4, the Project Expert Team examined and finalized the soil erosion control measures to be installed. In the examination, the Team stressed that the techniques to be demonstrated should be the ones that FD and IWUMD could replicate in the field. The overall concept and the plan view of the proposed soil erosion control measures are outlined as shown in the table below.

#### Overall Concept of the Soil Erosion Control Measures in Kone Ni Village

Topic	Contents
Outline of Gully Erosion	<p>Location : Head of gully</p> <p>Condition : Erosion seems to be developed especially at the riverbeds, which results in the lack of balance at the foot of the slopes, and slope failure has occurred with the progress of erosion.</p> <p>Cause of erosion : Main cause of the erosion seems to be surface water flow and ground</p> <div style="display: flex; justify-content: space-around;">   </div> <p>water. Since the gully is located close to the farm, surface water is flown into the head of gully from the farm area. Also, some traces of ground water spouting were observed.</p>
Objectives of the Erosion Control Measures	The objective of the erosion control measures is to restore gully erosion site through i) controlling the progress of the erosion and ii) enhancing regeneration of vegetation by stabilizing the slopes.
Basic Strategy	<p>Though it is possible to divert the surface water flow by trenching to protect gully erosion, there would be another gully erosion affected by such surface water flow. In addition, to control ground water is difficult.</p> <p>Based on such assumption and conditions, the followings were set as basic strategies.</p> <ol style="list-style-type: none"> <li>(1) Diversion of the surface water flow downward without affecting the gully head</li> <li>(2) Control of the surface flow and ground water inside the gully erosion to avoid its progress downwards.</li> <li>(3) Enhancement of regeneration of vegetation through stabilization of riverbed and the foot of slopes.</li> </ol>
Principles for designing the infrastructure	<p>Target area of designing : Since the bedrock is exposed for 100m from the main river, the target area of designing the infrastructure is around 60 m in length from the edge of bedrock to the gully head.</p> <p>Principles for designing infrastructure: Main focus is put on installation of infrastructures not to occur erosion at the bed of gully erosion since the surface water flow and ground water are the principle causes for the progress of gully erosion. In concrete, the following infrastructures will be installed.</p> <ol style="list-style-type: none"> <li>(1) Waterway works to protect riverbed</li> <li>(2) Check dams to stabilize the riverbed to complement waterway works since the longer waterway works might decrease stabilization.</li> </ol>
General Design	<p>Waterway works : Total length : 60m</p> <p>Structure : Width 1.2m, Thickness 0.3m (Above the ground: 15~20cm, below the ground : 10 ~15cm), dry masonry</p> <p>Check dams :</p>



Topic	Contents
	<p>No. of check dams : In total 4 check dams including improvement of existing 2 check dams and new installation of 2 check dams</p> <p>Check dams will be installed at i) area where the waterway works could be installed within 10m in length and ii) area where the existing check dams can be utilized at most.</p> <p>Structure : Height: &lt;2m, width: 1m, mortal stone masonry</p>
Plan view of the location of the infrastructures	

Source: JICA Project Expert Team (2020)

## (2) Community Forest and Sustainable Natural Resource Management

### a. Development of Long-list of Possible Interventions

Based on the results of the PRA, the JICA Project Expert Team has identified the issues in land management, CF management and local livelihoods in the villages selected for the PRA survey. Major issues identified are summarized below.

#### Major Issues of Land Management, CF Management and Local Livelihoods

Topics	Issues	Consequences
Land Management	- Overexploitation of forests or extensive deforestation to expand farmlands	Lowering of forest ecosystem services, such as water harvesting, prevention of erosion, and provision of forest products
	- Progress of gully erosion particularly in Kone Ni and Ein Yar villages	Encroachment in farmlands and reduction of farmlands
CF Management	- Frequent forest fires in existing forests except Nhan Thon village	Poor results of reforestation programs/activities in CF areas
	- Less protection or management of community forests	Conversion of community forests into farmlands Improper management of existing forests in CF area
	- Less understanding of CF among communities in Nhan Thon village	Less interest in community forest and protection of forests in CF area
	- Less involvement of women in forest management	ditto
Local Livelihoods	- Overdose of farm inputs, particularly agrochemicals, for production of vegetables	High investment costs required for crop production
	- High dependency on F1 hybrid crops for crop production	ditto
	- Limited sources of fuel wood in the village	Longer time for collection of fuel wood

Topics	Issues	Consequences
	- Limited sources of water in the dry season	Longer time for collection/ fetching of water for domestic purpose in the dry season Shortage or fluctuation of crop production due to rainfall patterns

Source: JICA Expert Team (2020)

Consequently, the Team proposed the following interventions for improvement of land management, CF and improvement of local livelihoods as potential pilot activities.

### Long-list of Possible Interventions

Topics	Possible Interventions	Expected Activities of the Intervention
1. Improvement of land management	1.1 Introduction of valuable tree crops (e.g., fruit and/or industrial perennial crops) in the private farms, particularly backyard of houses	<ul style="list-style-type: none"> <li>- Selection of valuable trees and crops in a participatory manner</li> <li>- Provision of training in planting and designing a farm</li> <li>- Provision of seedlings to communities</li> <li>- Assistance in maintenance of seedlings</li> </ul>
	1.2 Introduction of cover crops and contour ditches with bunds to disperse water and slow down the speed of water infiltration	<ul style="list-style-type: none"> <li>- Selection of one or two farm/s as a demonstration plot/s</li> <li>- Provision of training in application of contour ditches and bunds in the demonstration plot/s</li> <li>- Provision of training in using cover crops as green manure in fallow period</li> <li>- Provision of seeds of green manure</li> </ul>
2. Community Forest	2.1 Afforestation/reforestation of trees which are fire resistant and whose branches can be used for fuel wood in CF area	<ul style="list-style-type: none"> <li>- Selection of tree species to be planted in CF area in a participatory manner</li> <li>- Identification of areas where seedlings are planed</li> <li>- Procurement of seedlings</li> <li>- Planting of seedlings with members of CF user group (CFUG)</li> <li>- Assistance in tending/maintenance of seedlings planted</li> </ul>
	2.2 Introduction of forest management and silvicultural practices to improve the existing pine forests in CF area with review and revision of the forest management plan	<ul style="list-style-type: none"> <li>- Participatory assessment of current status of existing forests in CF area</li> <li>- Discussion on future situation of forests in CF area among the members of CFUG</li> <li>- Development of a forest management plan together with the members of CFUG</li> <li>- Conduct of silvicultural practices according to the plan</li> </ul>
	2.3 Introduction of CF with full participation of local communities in accordance with the government Standard Operating Procedures (SOPs) for CF	<ul style="list-style-type: none"> <li>- Organization of a consultation meeting with local communities</li> <li>- Selection of the members of CFUG</li> <li>- Organization of CFUG with development of VMOF (vision, missions, objectives, and functions) and bylaws of CFUG</li> <li>- Identification and selection of existing forests which will be managed as CF</li> <li>- Assessment of existing forests in CF area with demarcation of its boundaries</li> <li>- Development of a forest management plan</li> <li>- Development of a supporting document to supplement the government SOPs for CF</li> </ul>
	2.4 Establishment of fuel wood plantation in a communal area	<ul style="list-style-type: none"> <li>- Identification of potential communal areas which can be used for fuel wood plantation</li> <li>- Selection of tree species and local communities who will participate in the activities</li> </ul>

Topics	Possible Interventions	Expected Activities of the Intervention
		<ul style="list-style-type: none"> <li>- Procurement of seedlings</li> <li>- Planting of seedlings with local communities selected</li> <li>- Assistance in tending/maintenance of seedlings planted</li> </ul>
	2.5 Enhancement of public awareness of the functions of forests in terms of water harvesting and occurrence of gullies	<ul style="list-style-type: none"> <li>- Development of public awareness materials</li> <li>- Selection of target villages</li> <li>- Development of a work plan of public awareness campaigns and sharing of roles/responsibilities among members of the working team</li> <li>- Conduct of the campaigns</li> </ul>
3. Improvement of local livelihoods	3.1 Introduction and demonstration of GAP (Good Agricultural Practices) including IPM (integrated pest management) in vegetable farming	<ul style="list-style-type: none"> <li>- Assessment of current farming practices of vegetable farming</li> <li>- Selection of a farm or plot which can be used as a demonstration plot</li> <li>- Development of standard guidelines for vegetable farming</li> <li>- Development of work plan of field training and weekly observation in the demonstration plot</li> <li>- Conduct of a series of farmers field schools on soil management and pest management</li> </ul>
	3.2 Value chain development of products produced through GAP	<ul style="list-style-type: none"> <li>- Assessment of existing marketing value chains of vegetables as well as those produced through GAP</li> <li>- Access to existing value chains of GAP products</li> <li>- Promotion and marketing of GAP products produced in the area on a trial basis</li> </ul>
	3.3 Diversification of sources of income or crops/ farm products produced	<ul style="list-style-type: none"> <li>- Assessment of potential crops and farm products which can be produced in the area and will be marketable in markets</li> <li>- Identification and selection of a farm or plot which can be used as a demonstration plot</li> <li>- Provision of training in production of crops/ farm products</li> <li>- Provision of technical assistance in introduction of new crops/ farm products</li> </ul>

Source: JICA Expert Team (2020)

b. Selection of Pilot Activities in Pha Yar Phyu Village

The Project Expert Team and Kalaw Township FD decided to implement the following pilot activities in Pha Yar Phyu village to protect the degraded reserve forests near the village and improve local livelihoods through production of valuable tree crops after discussions with local communities in Pha Yar Phyu village.

- a. Introduction of Community Forestry
- b. Introduction of Valuable Tree Crops to develop an Agroforestry Model

Although one of the ideas on pilot activities at the beginning of the design phase was to implement both gully erosion control and sustainable land management activities in the same village or micro watershed so as to demonstrate the synergy effect of both the activities, Nevertheless, the Project Expert Team decided to implement them in the different villages or micro watersheds due to the following reasons:



- Communities in Kone Ni village have little need to improve its CF area and less land to be used for sustainable land management; hence, it seems not easy to introduce effective and sustainable land management activities in the village.
- It was also difficult to implement the activities relating to agricultural development, such as introduction of sustainable agricultural practices in this year, as the rainy season has already begun.
- It might take longer time to obtain approval from GAD of the use of community land (land which does not belong to FD) for CF purpose. It is highly possible that the pilot activity of introduction of CF in areas without FD lands (e.g., reserve forests) could not be completed within six months.
- Local communities in Pha Yar Phyu expressed their intention to protect the degraded reserve forests, and in fact, they have protected the same on their own initiative without any instruction from FD as the water source for the village is located within the reserve forests.
- The main aim of the pilot activities in the design phase is to confirm the effects of the pilot activities and extract lessons learned from the implementation.

On August 1, 2019, Directors of Watershed Management Division and Training and Research Division of central FD visited Pha Yar Phyu village, and confirmed communities' willingness for forest conservation. Shan State FD also agreed on the implementation of the aforementioned two types of pilot activity in Pha Yar Phyu village.

## **2.2.6 Implementation of Pilot Activities**

### **(1) Soil Erosion Control Work at Kone Ni Village**

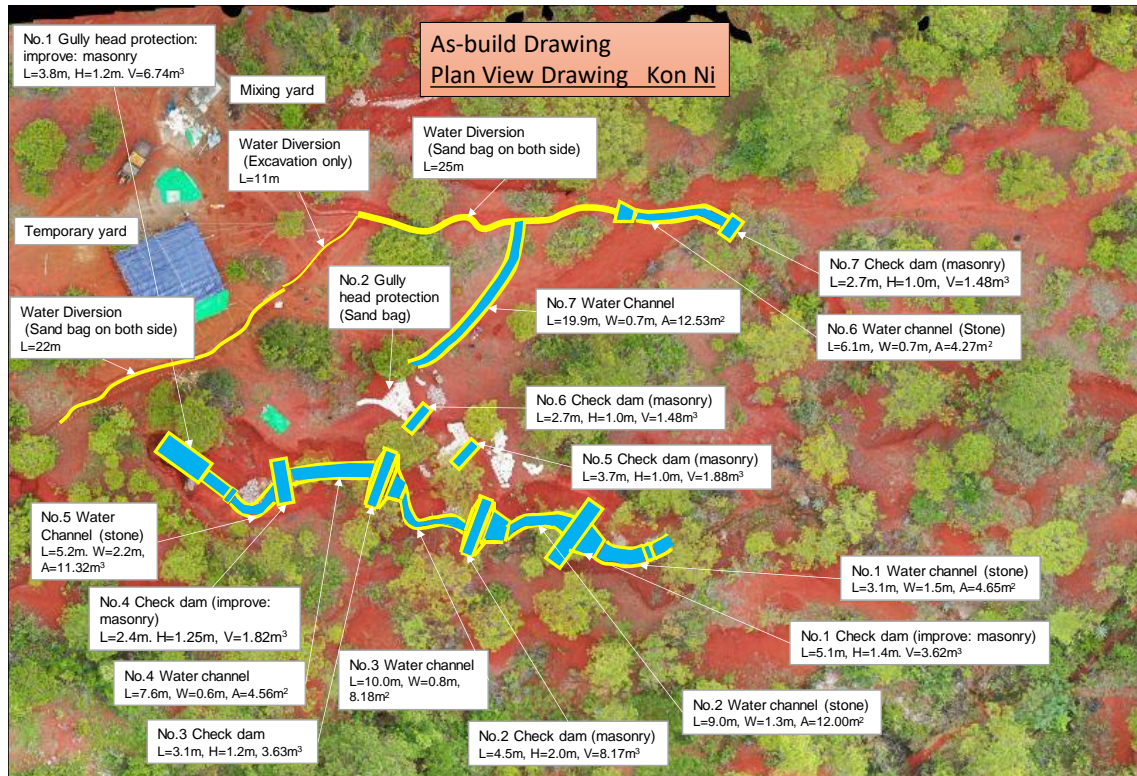
In July 2019, the Project Expert Team conducted the following works prior to the construction works.

- Basic plan of the erosion control measures
- Detailed designing of the erosion control measures
- Cost estimation of the construction works
- Construction plan with a detailed work schedule

The plans and designs/drawings developed by the Team were explained to the relevant offices of FD and IWUMD, namely Kalaw and Nyaung Shwe Township FD and Nyaung Shwe Township IWUMD, to obtain their feedbacks and opinions on the pilot activities.

During the preparatory work for construction, technical officials from Kalaw FD and Nyaung Shwe IWUMD worked with the Project Expert Team, while one deputy range officer from Kalaw FD has engaged in the supervision works together with the Team during the construction period. All the construction works were undertaken in July and August 2019.

Upon completion of the construction works, the Expert Team conducted the final inspection with Kalaw FD. The results of the inspection were compiled into a report with as-built drawings shown in **Attachment-16**. The plain view of the constructed facilities and photos taken during the inspection works are shown below.



Source: JICA Project Expert Team (2019)

**Plain Plan of the Pilot Activities of Gully Erosion Control in the Gully in Kone Ni**







Source: JICA Project Expert Team (2019)

### Inspection Works

## (2) Community Forest and Sustainable Natural Resource Management





### a. Implementation Plan








Prior to the implementation of pilot activities of CF and sustainable land management, namely, a) Introduction of Community Forestry and b) Introduction of Valuable Tree Crops for Agroforestry Model Development, the JICA Project Expert Team prepared the implementation plan shown in **Attachment-17** to share the work plan with FD of Shan State, Taunggyi district and Kalaw township and DoA of Kalaw township.

### b. Pilot Activities undertaken

The Project Expert Team carried out the following activities in Pha Yar Phyu village in the course of pilot activity implementation.

### Pilot Activities of CF and Sustainable Natural Resource Management Conducted

Pilot Activity	Activity	Date	Description	
CF/ Agroforestry	Consultation with the local community	July 30, 2019	Introduced the objectives and implementation plans of the proposed pilot activities. Confirmed the willingness of local communities in Pha Yar Phyu village.	
	Identification and selection of households who participate in the activities	August 5 and 8, 2019	Helped local communities select households who participate in the pilot activities: CF and Agroforestry. 50 HHs (all the households in the village) and 38 HHs were selected for CF and Agroforestry, respectively.	
CF	Discussion on vision, missions, objectives, and functions of CFUG	August 9, 2019	Helped local communities discuss and develop CF users group's (CFUG's) vision, missions, objectives, and functions.	
	Selection of members for CFUG Management Committee	August 31, 2019	Introduced the structure of CFUG management committee (CFUGMC) with the expected roles and responsibilities of the members of CFUGMC, such as leaders, vice leader, and cashier. Helped local communities in the selection of the CFUGMC members.	

Pilot Activity	Activity	Date	Description	
	Boundary survey of the proposed area for CF	Sep. 3, 2019	Conducted a perimeter survey of the proposed area for CF by walking through the boundaries with GPS and put marks on trees and stones along the boundaries. Developed a simple map with the boundaries of the proposed site.	
	Discussion on the draft bylaws of CFUG	Sep. 19 and 24, 2019	Helped CFUG members discuss and determine basic rules of CFUG to develop the bylaws.	
	Discussion on the proposal for establishment of CF and field observation of the proposed area for CF	Oct.5, 2019	Explained the draft proposal for establishment of CF to CFUG members. Conducted a joint preliminary survey of the current conditions of the proposed area for CF.	
	Introduction of the procedures for formation of a forest management plan and discussion on the proposed forest management activities and rules	Nov. 6, 2019	Explained the work plan and schedule for development of a draft forest management plan. Introduced major forest management activities to be proposed in the forest management plan with roles of CFUG members for the respective forest management activities.	
	Conduct of a simple field survey in the proposed area for CF	Nov. 19, 2019 Dec. 9, 2019	Conducted a field observation survey to confirm the present conditions of existing forests and open/ degraded areas in the proposed area for CF. Conducted a simple site survey to check i) existing vegetation cover, ii) slope condition, and iii) soil condition (soil pH) to clarify the characteristics of the proposed area for CF.	
	Discussion on a forest management plan	Dec.25, 2019	Explained the draft forest management plan developed by the Project Expert Team based on the surveys. Helped CFUG members understand the draft forest management plan through discussions on the same.	
Agroforestry	Procurement of planting materials and others	3 <sup>rd</sup> and 4 <sup>th</sup> weeks of August, 2019	Procured about 217 avocado seedlings from private nurseries in Taunggyi and around 2,200 kg of compost from the Japanese NGO (Terra People Association).	

Pilot Activity	Activity	Date	Description	
	Provision of training in planting of trees (Hole digging and Fertilizer application,)	August 30, 2019	Conducted a training course on the preparation of a farm for planting of avocado seedlings with the participation of 38 members. Introduced the techniques and knowledge on hole digging (size and depth of the hole), fertilizer application (amount of fertilizer and how to apply fertilizer), and refilling (how to refill the hole).	
	Provision of fertilizer	August 30, 2019	Provided around 20 ~ 100 kg of compost/member to the members who participated in the training courses according to the number of seedlings given to the members.	
	Training in planting of seedlings	Sep. 6, 2019	Conducted a training course on planting and protection of seedlings with the participation of 46 members. Introduced the techniques on planting, additional fertilization, and set-up of protective measure.	
	Provision of seedlings and protective nets	Sep. 6, 2019	Provided 2~10 seedlings /member and plastic net to those who participated in the training courses.	
	Training in making liquid fertilizer	Sep. 24, 2019	Conducted a training course on how to prepare materials for liquid fertilizer and make the fertilizer. Provided a plastic bucket to the members who participated in the training courses.	
	Training in tending seedlings	Oct. 7, 2019	Conducted a training course on how to maintain seedlings planted in their respective farms/ plots. Introduced the techniques on weeding, mulching, and simple irrigation with plastic pet bottle.	
	Training in the application of liquid fertilizer	Nov. 6, 2019	Conducted a training course on how and when to apply liquid fertilizer to seedlings planted.	

Source: JICA Project Expert Team (2020)

**Attachment-18** shows the memos of the meetings and training courses held over the course of implementation of the pilot activities.

c. Proposal for Establishment of CF in Pha Yar Phyu Village

The proposed area for CF in Pha Yar Phyu villag is part of Aung bang Reserved Forest, which is currently registered as the economic production circle. Such a type of reserved forest cannot be converted to CF in principle as forest resources in the reserved forest belong to the Union



Government.

Nevertheless, since some directors of FD at central level visited Pha Yar Phyu village and confirmed local communities' intention to protect existing forests in the reserved forest to conserve the sources of water for local communities of the village, FD decided to assess and examine the validity of CF establishment in the same area. On September 20, 2019, DG of FD issued a letter to Shan State FD requesting the Project Expert Team to prepare and submit a proposal for establishment of CF in the reserved forest for its review.

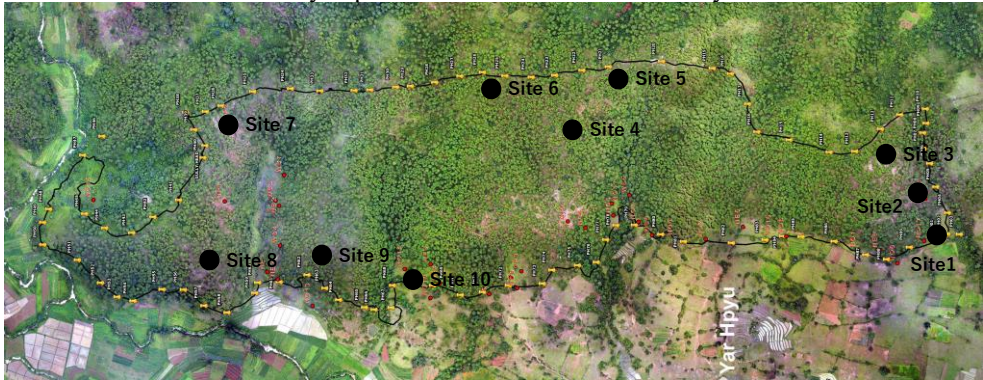
Upon receipt of the letter from DG, the Expert Team started the preparation of the proposal along with field surveys and meetings with local communities in Pha Yar Phyu village. On October 9, 2019, the Team submitted to FD the proposal as shown in **Attachment-19**.

At the 3<sup>rd</sup> JCC meeting held in February 19, 2020 as mentioned in 2.2.2, DG of FD, Chairperson of JCC, concluded that CF could not be implemented in the production circle in the current legal frame but a collaborative management scheme, such as Joint Forest Management, could be introduced in the same area on a trial basis. It was, therefore, recommended by the participants in the JCC meeting that the implementation phase of the Project provide further assist FD in the demonstration and institutionalization of a collaborative forest management/ joint forest management mechanism in the production circle of reserved forests.

d. Forest Management Plan developed by CFUG

A forest management plan of the proposed area for CF in Pha Yar Pyu village was developed through a series of discussions and field surveys described above with local communities in Pha Yar Phyu village. The plan indicates i) results of the field survey, ii) proposed forest management activities for improvement of forest conditions in the area, iii) roles and responsibilities of the relevant parties (CFUG, FD, and external organizations), iv) work plan of the forest management activities, and v) rules on forest management and benefit sharing. The forest management plan is presented in **Attachment-20** and outlined below.

**Outline of Forest Management Plan developed by Pha Yar Phyu CFUG**

Item	Contents
Results of the simple field survey	<ul style="list-style-type: none"> <li>■ Field survey consisting of the following field observation and test was conducted at the selected nine locations in the proposed area for CF.                             <ul style="list-style-type: none"> <li>i) the present vegetation (tree types/ species);</li> <li>ii) soil pH;</li> <li>iii) slopes;</li> <li>iv) density of existing trees; and</li> <li>v) location (georeferenced data) of the areas.</li> </ul> </li> <li>■ The locations of the surveyed points and the results of the survey are shown below.</li> </ul> <div style="text-align: center;">  <p style="text-align: center;"><b>Locations of the Surveyed Points</b></p> </div>



Item	Contents							Photos
	No.	Tree types/ species	pH/Moisture	Slope	Density	Height	Location	
	1	Schima Wallichii, Pinus lehasya and <b>Eupaterium odoratum</b>	Too hard to measure	7%	Low	2.5 ft	20°34'21.78" N 96°38'43.65"E	
	2	Terminalia belerica, Emblica officinalis, <b>Pinus lehasya,</b>	Same as above	20%	Low	30 ft	20°34'26.14" N 96°38'47.70"E	
	3	<b>Pinus lehasya,</b> Terminalia belerica, Emblica officinalis, Quercus serrata,	Same as above	10%	Low	25~30 ft	20°34'26.80" N 96°38'48.76"E	
	4	<b>Pinus lehasya,</b> Emblica officinalis, Terminalia belerica, Schima Wallichii	pH 6~7	9%	Low	40~50 ft	20°34'37.65" N 96°38'46.43"E	
	5	<b>Pinus lehasya,</b> Emblica officinalis, Terminalia belerica, Schima Wallichii, Eriolobus indica, Eugenia spp;	Too hard to measure	6%	Medium	35~40 ft	20°34'39.70" N 96°38'49.38"E	
	6	<b>Pinus lehasya,</b> Emblica officinalis, Terminalia belerica, banyan tree (Ficus), Eugenia spp;	Same as above	8%	Low	40 ft	20°34'45.08" N 96°38'48.79"E	
	7	<b>Pinus lehasya,</b> Emblica officinalis, Terminalia belerica, Schima Wallichii, banyan tree (Ficus)	Same as above	13%	High	7~ 10 ft	20°35'2.32"N 96°38'36.55"E	
	8	<b>Pinus lehasya,</b> Terminalia belerica, Schima Wallichii, Eriolobus indica,	Same as above	4%	Tea farm	35~ 40 ft	20°34'51.06" N 96°38'29.53"E	
	9	<b>Tea plant,</b> Schima Wallichii, Terminalia belerica, bamboo, Eriolobus indica,	Same as above	8%	Low	3 ft	20°34'45.06" N 96°38'35.81"E	
	10	<b>Pinus lehasya,</b> bamboo, Eriolobus indica,	Same as above	10%	Low	40~50 ft	20°34'37.50" N 96°38'36.56"E	
Forest management activities and roles of the relevant parties	<p>■ CFUG proposed several forest management activities, namely i) reforestation/ gap planting, ii) assisted natural regeneration (ANR), iii) forest protection works, and iv) agroforestry development as the major activities to be carried out by CFUG in the proposed area.</p> <p>■ CFUG also determined the roles and responsibilities of CFUG, FD, and other external supporting organizations in the respective forest management activities as shown below.</p>							
	<b>FM Activities</b>		<b>CFUG</b>	<b>FD</b>	<b>External Organization</b>			
	Reforestation	<ul style="list-style-type: none"> <li>◆ Identify the locations for reforestation.</li> <li>◆ Determine the number and type of species required for reforestation in collaboration with FD.</li> <li>◆ Transport seedlings from FD nursery to the village as well as the locations for reforestation.</li> <li>◆ Conduct reforestation activities (clearing, sticking, hole digging, planting, and tending) with technical assistance from FD.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Assist CFUG in the identification of the areas for reforestation.</li> <li>◆ Assist CFUG in the determination of the number and type of seedlings to be planted in the identified areas.</li> <li>◆ Prepare and provide the number and type of seedlings that CFUG requires for reforestation.</li> <li>◆ Assist CFUG in the conducts of the reforestation activities.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Facilitate the process and discussions for identification of the areas for reforestation, determination of the number and types of seedlings.</li> <li>◆ Procure seedlings that FD cannot provide.</li> <li>◆ Assist CFUG in the transportation of seedlings from FD nursery to the village.</li> <li>◆ Assist CFUG and FD in the conducts of the reforestation activities in a proper manner.</li> </ul>				
ANR with or without supplemental planting	<ul style="list-style-type: none"> <li>◆ Identify the locations for ANR.</li> <li>◆ Decide which trees should be left in the identified areas with technical assistance from FD.</li> <li>◆ Conduct ANR activities</li> </ul>	<ul style="list-style-type: none"> <li>◆ Assist CFUG in the identification of the areas for ANR.</li> <li>◆ Assist CFUG in the identification of wildings and trees to be maintained in the identified areas.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Facilitate the process and discussions for identification of the areas for ANR.</li> <li>◆ Assist CFUG in the transportation of seedlings from FD</li> </ul>					

Item	Contents			
		<p>(weeding, vine cutting, mulching, thinning, and supplemental planting) with technical assistance from FD.</p> <ul style="list-style-type: none"> <li>◆ Determine the number and type of species required in case supplemental planting is required.</li> <li>◆ Transport seedlings from FD nursery to the village as well as the locations for supplemental planting.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Assist CFUG in the selection and conduct of the necessary ANR activities.</li> <li>◆ Assist CFUG in the determination of the number and types of species for supplemental planting</li> <li>◆ Prepare and provide the number and type of seedlings that CFUG requires for supplemental planting.</li> <li>◆ Assist CFUG in the conducts of the supplemental planting activities.</li> </ul>	<p>nursery to the village.</p> <ul style="list-style-type: none"> <li>◆ Assist CFUG and FD in the conducts of the supplemental planting activities in a proper manner.</li> </ul>
	<p>Patrolling and preparation of firebreak lines</p>	<ul style="list-style-type: none"> <li>◆ Decide the patrolling routes and the frequency of patrolling works.</li> <li>◆ Identify the areas prone to forest fires and existing forests to be protected from fires.</li> <li>◆ Determine the locations where firebreak lines should be developed.</li> <li>◆ Conduct the patrolling works and firebreak</li> <li>◆ Repot any illegal case found during the patrolling works.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Assist CFUG in the determination of the locations where firebreak lines should be placed.</li> <li>◆ Conduct a field investigation when CFUG reports any illegal case.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Facilitate the process and discussions for identification of the locations of firebreak lines.</li> </ul>
	<p>Agroforestry in the encroachment areas</p>	<ul style="list-style-type: none"> <li>◆ Design the agroforestry models introduced in the encroachment areas including types of fruit or other valuable trees with technical assistance from FD.</li> <li>◆ Request FD or other organizations to provide seedlings of fruit and other valuable trees.</li> <li>◆ Transport seedlings from the nursery (if necessary).</li> <li>◆ Plant seedlings according to the design in a proper manner.</li> <li>◆ Plant annual crops according to the design (if necessary).</li> </ul>	<ul style="list-style-type: none"> <li>◆ Assist CFUG in designing the agroforestry models introduced in the encroachment areas in collaboration with DoA and other organizations.</li> <li>◆ Coordinate with any external organization/s to assist CFUG in the procurement of seedlings of fruit and other valuable trees.</li> </ul> <p>Assist CFUG in planting fruit and other valuable trees in a proper manner.</p>	<ul style="list-style-type: none"> <li>◆ Assist CFUG in designing the agroforestry models in collaboration with FD and DoA.</li> <li>◆ Provide seedlings of fruits and other valuable trees in coordination with FD and DoA.</li> <li>◆ Assist CFUG in planting CFUG in planting fruit and other valuable trees in a proper manner in collaboration with FD and DoA.</li> <li>◆ Assist CFUG in planting annual crops according to the design in collaboration with DoA.</li> </ul>
<p>Work plan of the forest management activities</p>	<ul style="list-style-type: none"> <li>■ CFUG developed annual and 3-year work plans of the forest management activities focusing on the determination of when and what to do in the respective forest management activities. The standard annual work plan of the forest management activities is shown below.</li> </ul>			

Item	Contents	Work Items																												
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6											
	<b>1. Gap planting</b>																													
	1) Determination of area	■																												
	2) Development of a proposal/request for seedlings	■	■																											
	3) Preparation of the area for planting seedlings.			■	■																									
	4) Transportation of seedlings from FD nursery					■	■																							
	5) Planting of seedlings in the selected area						■	■																						
	6) Tending of seedlings f								■	■	■	■	■	■	■	■	■	■	■											
	<b>2. ANR with/without planting</b>																													
	1) Determination of area	■																												
	2) Development of a request for seedlings (if necessary)																													
	3) Conducts of ANR activities	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■											
	4) Preparation for planting (If necessary)			■	■																									
	5) Transportation of seedlings (If necessary)				■	■																								
	6) Planting of seedlings in the selected area						■	■																						
	<b>3. Patrolling and Firebreak line</b>																													
	1) Determination of the route	■																												
	2) Walking through the route for the patrolling	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■											
	3) Determination of the area where fire break lines shall be developed	■																												
	4) Weeding and clearing along the line as firebreak lines		■	■																										
	<b>4. Agroforestry development</b>																													
	1) Selection of the plot/s	■																												
	2) Determination of the design	■																												
	3) Development of a proposal/request for seedlings	■																												
	4) Preparation of the area for planting seedlings.			■	■																									
	5) Transportation of seedlings from nursery					■	■																							
	6) Planting of seedlings in the selected area						■	■																						
	7) Planting annual crops						■	■																						
	8) Tending of seedling								■	■	■	■	■	■	■	■	■	■	■											
	Rules on forest management	<p>■ CFUG might be able to earn cash income from products, such as fruits, valuable trees and annual crops, produced in the 17 registered encroachment areas as they decide to use the same for agroforestry development. Hence, CFUG decided the rules and mechanism on benefit and budget management of CFUG as summarized below.</p> <table border="1"> <thead> <tr> <th>Points of discussions</th> <th>Results</th> </tr> </thead> <tbody> <tr> <td>Sources of benefit</td> <td>Agroforestry products, e.g., fruit, timber trees, firewood, agricultural products, etc., produced in the 17 encroachment areas</td> </tr> <tr> <td>Benefits to be shared</td> <td>Net profit after deduction of expenses (e.g., labor cost, transportation cost, and others) from total sales of agroforestry products.</td> </tr> <tr> <td>Mechanism of benefit sharing</td> <td>Net benefits will be kept as a village fund which will be used for community development activities (road improvement, school rehabilitation, water system improvement, accommodation for school teacher, etc.) and expenses for the forest management activities (e.g., labor cost, transportation cost, and fertilizer cost).</td> </tr> <tr> <td>Management of village fund</td> <td>A bank account will be opened in the bank at Augnbang. Three persons, i.e., chairman, secretary and treasurer, should be the signers of the bank account to avoid the abuse of the fund.</td> </tr> </tbody> </table>																			Points of discussions	Results	Sources of benefit	Agroforestry products, e.g., fruit, timber trees, firewood, agricultural products, etc., produced in the 17 encroachment areas	Benefits to be shared	Net profit after deduction of expenses (e.g., labor cost, transportation cost, and others) from total sales of agroforestry products.	Mechanism of benefit sharing	Net benefits will be kept as a village fund which will be used for community development activities (road improvement, school rehabilitation, water system improvement, accommodation for school teacher, etc.) and expenses for the forest management activities (e.g., labor cost, transportation cost, and fertilizer cost).	Management of village fund	A bank account will be opened in the bank at Augnbang. Three persons, i.e., chairman, secretary and treasurer, should be the signers of the bank account to avoid the abuse of the fund.
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Source: JICA Project Expert Team (2019)

## 2.2.7 Evaluation of Pilot Activities

### (1) Soil Erosion Control Work at Kone Ni Village

Up to February 2020, the Project Expert Team has conducted the 3-month monitoring after construction of the gully erosion control works at Kone Ni village. The results of the field observations are described below.



### Conditions of the Gully Erosion Control Works after Construction

Completion (End of July 2019)	After 1 month (02 Sep. 2019)	After 3 months (15 Nov. 2019)	After 6 months (15 Feb. 2020)
<b>No.1 Water Channel</b>			
			
<b>No.1 Check dam and No.2 Water Channel</b>			
			
<b>No.3 Check dam (front view) and No. 4 Water Channel</b>			
			
<b>No.4 Check (back site) dam, No.1 Gully head protection and No. 5 Water Channel</b>			
			
<b>No.1 Gully head protection</b>			
			
<b>Water diversion</b>			
			

*Source: JICA Project Expert Team (2020)*

It was confirmed that there was no severe damage made on the structure over six months after construction. It was also observed that soils eroded from the side slopes were checked and deposited on the water channels between the check dams. These are indications that the facilities have functioned well to reduce soil runoff flowing into the downstream.

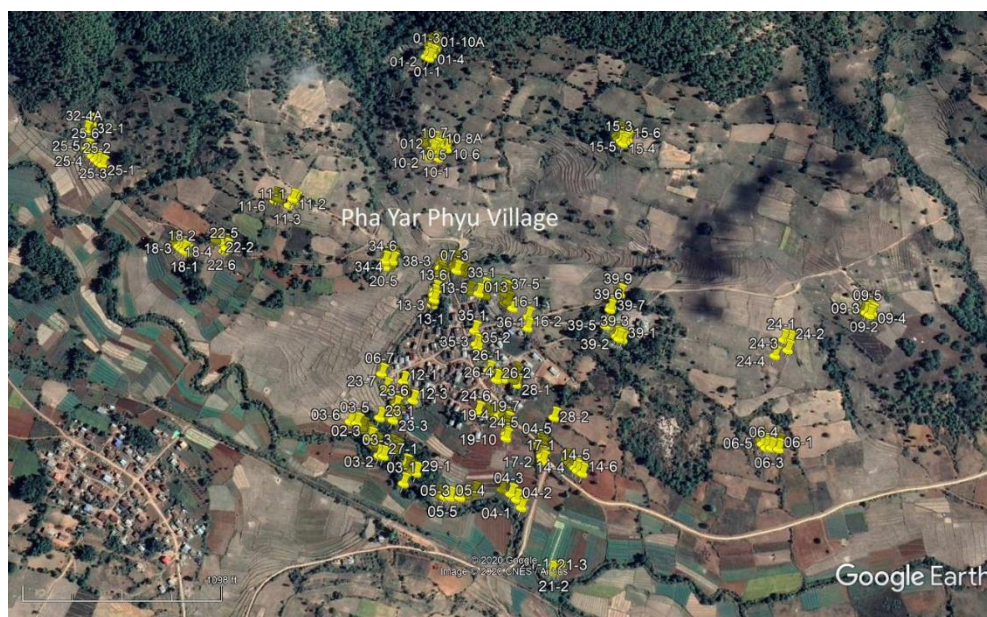
Some erosions were observed at the masonry works at the diversion channel, it was, however, judged



that they would not affect the main structures. Meanwhile, the plastic bags placed in the water diversion channels have been already decomposed. It is, therefore, advisable to build small embankments in the same places to protect the diversion channels.

## (2) Survival Rate Survey of Avocado Seedlings

On February 2020, the JICA Project Expert Team conducted a field investigation of the survival rate of avocado seedlings planted under the pilot activity of introduction of agroforestry model. As a result, 217 seedlings planted in the field were surveyed. The plantation sites were illustrated below.



Source: JICA Project Expert Team (2020)

### Distribution of Avocado Seedlings Planted

A total of 204 seedlings out of 217 seedlings were confirmed alive and average size of the seedlings was 1.3 cm in basal diameter and 47 cm in height as shown in **Table-2**. The results of the survey reveal that the survival rate of the seedlings planted is 94%, which is higher than the expectation as the mortality rate of the seedlings was estimated at 10% in the beginning.

## (3) Evaluation of Pilot Activities for CF and Introduction of Agroforestry Model

In order to evaluate the effectiveness of the pilot activities for CF and Introduction of Agroforestry Model and measure the level of community members' understanding of i) forest management plan and ii) agroforestry techniques learnt at the training sessions, the JICA Project Expert Team conducted an interview survey in February 2020. The results of the survey are shown in **Attachment-21** and summarized in the following sections.

### a. Evaluation of CF Introduction

The results of evaluation of the pilot activity of CF introduction are summarized below.

#### Results of Evaluation of Pilot Activity of CF Introduction

Topic	Description				
General features of the members sampled for the survey	<ul style="list-style-type: none"> <li>- Total number of the members sampled: 26 persons</li> <li>- Gender: Male 80.8%, Female 19.2%</li> <li>- Average age: 38 years old</li> </ul>				
Participation level at the activities	<ul style="list-style-type: none"> <li>- Average of participation level: 94.6% attended at the activities.</li> <li>- Participation level in each activity                             <table border="1" style="width: 100%; margin-top: 5px;"> <thead> <tr> <th style="background-color: black; color: white;">Topic</th> <th style="background-color: black; color: white;">%</th> </tr> </thead> <tbody> <tr> <td>a. Determination of the vision, missions and functions of CF user group</td> <td style="text-align: center;">92.3%</td> </tr> </tbody> </table> </li> </ul>	Topic	%	a. Determination of the vision, missions and functions of CF user group	92.3%
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Topic	Description																			
	<table border="1"> <tr> <td>b. Selection of CF user group (CFUG) members committee and determination of their roles and responsibility</td> <td>100.0%</td> </tr> <tr> <td>c. Determination of CF boundary</td> <td>80.8%</td> </tr> <tr> <td>d. Development of the bylaws of CFUG</td> <td>100.0%</td> </tr> <tr> <td>e. Development of Forest Management Plan</td> <td>100.0%</td> </tr> </table>	b. Selection of CF user group (CFUG) members committee and determination of their roles and responsibility	100.0%	c. Determination of CF boundary	80.8%	d. Development of the bylaws of CFUG	100.0%	e. Development of Forest Management Plan	100.0%											
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Members' perception of the importance of documents prepared through the activities	<table border="1"> <thead> <tr> <th rowspan="2">CF documents</th> <th colspan="3">Importance level (%)</th> </tr> <tr> <th>High</th> <th>Fair</th> <th>Low</th> </tr> </thead> <tbody> <tr> <td>a. CFUG By-laws (vision, missions, and functions of CFUG and roles and responsibilities of CFUGMC)</td> <td>100.0%</td> <td>0.0%</td> <td>0.0%</td> </tr> <tr> <td>b. Map of the target area for CF</td> <td>100.0%</td> <td>0.0%</td> <td>0.0%</td> </tr> <tr> <td>c. Forest Management Plan</td> <td>96.2%</td> <td>3.8 %</td> <td>0.0%</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>- The participants consider CFUG By-laws important as it functions as a basic law for CFUG. They like to promote members' understanding of the by-laws, especially the roles and responsibilities of CFUG.</li> <li>- Also, the map of the target area for CF is deemed to enhance recognition of the CF location among the community.</li> <li>- The forest management plan is also considered important to help the communities understand CF activities with its implementation schedule. However, some members expressed the difficulty to go through the document because of its volume.</li> </ul>	CF documents	Importance level (%)			High	Fair	Low	a. CFUG By-laws (vision, missions, and functions of CFUG and roles and responsibilities of CFUGMC)	100.0%	0.0%	0.0%	b. Map of the target area for CF	100.0%	0.0%	0.0%	c. Forest Management Plan	96.2%	3.8 %	0.0%
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Understanding of the CF documents	<table border="1"> <thead> <tr> <th rowspan="2">CF documents</th> <th colspan="3">Understanding level (%)</th> </tr> <tr> <th>High</th> <th>Fair</th> <th>Low</th> </tr> </thead> <tbody> <tr> <td>a. CFUG By-laws</td> <td>96.2%</td> <td>3.8%</td> <td>0.0%</td> </tr> <tr> <td>b. Forest Management Plan</td> <td>88.5%</td> <td>11.5 %</td> <td>0.0%</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>- The participants consider themselves to have rather high understanding of CFUG by-laws and the forest management plan since both the documents were based on the discussions made by themselves.</li> <li>- Meanwhile, some participants mentioned that the documents were rather difficult to understand because of its contents in CFUG by-laws and the volume of the forest management plan.</li> </ul>	CF documents	Understanding level (%)			High	Fair	Low	a. CFUG By-laws	96.2%	3.8%	0.0%	b. Forest Management Plan	88.5%	11.5 %	0.0%				
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Appropriateness of design of pilot project	<table border="1"> <thead> <tr> <th rowspan="2">Topic</th> <th colspan="3">Appropriateness (%)</th> </tr> <tr> <th>Well</th> <th>Fair</th> <th>Less</th> </tr> </thead> <tbody> <tr> <td>a. Timing of training</td> <td>76.9%</td> <td>23.1%</td> <td>0.0%</td> </tr> <tr> <td>b. Duration of training session</td> <td>92.3%</td> <td>7.7%</td> <td>0.0%</td> </tr> <tr> <td>c. Way of guiding at the training</td> <td>100.0%</td> <td>0.0 %</td> <td>0.0%</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>- One of the participants suggested that the activities of CF introduction should start earlier.</li> </ul>	Topic	Appropriateness (%)			Well	Fair	Less	a. Timing of training	76.9%	23.1%	0.0%	b. Duration of training session	92.3%	7.7%	0.0%	c. Way of guiding at the training	100.0%	0.0 %	0.0%
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Source: JICA Project Expert Team (2020)

In general, the level of participation in the activities is as high as 94.6% on average. In addition, most of the participants consider the documents prepared through the activities, such as CFUG by-laws, map of the target area for CF and forest management plan important for management of the area. They also seem to well understand the topics covered by the documents.

However, some participants pointed out the difficulties that they face in understanding of the documents, namely, difficulties to comprehend the terms used in the by-laws and the volume of the forest management plan.

#### b. Evaluation of Introduction of Agroforestry Model

#### Results of Evaluation of Pilot Activity of Introduction of Agroforestry Model

Topic	Description				
General features of the members sampled for the survey	<ul style="list-style-type: none"> <li>- Total number of the members of the activity: 38 persons</li> <li>- Gender: Male 100.0%</li> <li>- Average age: 38 years old</li> </ul>				
Participation level at the activities	<ul style="list-style-type: none"> <li>- Average of participation level: 88.9% attended at the activities.</li> <li>- Participation level in each activity</li> </ul> <table border="1"> <thead> <tr> <th>Topic</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>a. Training in land preparation</td> <td>81.6%</td> </tr> </tbody> </table>	Topic	%	a. Training in land preparation	81.6%
Topic	%				
a. Training in land preparation	81.6%				

Topic	Description															
	b. Training in planting seedlings		100.0%													
	c. Training in making liquid fertilizer		97.4%													
	d. Training in tending seedlings		73.7%													
	e. Training in application of liquid fertilizer		92.1%													
Level of application of the techniques learnt at the training	<p>- On average, 95.8 % of the members have applied the techniques learnt at the training in their own farms. The level of application by technique is shown below.</p> <table border="1"> <thead> <tr> <th>Topic</th> <th>Application level</th> </tr> </thead> <tbody> <tr> <td>a. Land preparation (hole digging by the size instructed, and application of organic compost (bokashi))</td> <td>97.4%</td> </tr> <tr> <td>b. Protection of the seedlings planted with net</td> <td>100.0%</td> </tr> <tr> <td>c. Weeding and mulching</td> <td>92.1%</td> </tr> <tr> <td>d. Pet bottle irrigation</td> <td>92.1%</td> </tr> <tr> <td>e. Preparation and application of liquid fertilizer to the avocado seedlings</td> <td>97.4%</td> </tr> </tbody> </table> <p>- Besides, 57.9 % of the members have used the liquid fertilizer for fertilization to other crops, such as mustard, cabbage, cauliflower, etc. They mentioned that they used liquid fertilizer for other crops on their own initiatives as liquid fertilizer was considered effective and easy to apply. Those who have yet to use liquid fertilizer for other crops expressed that they would like to see the effects of liquid fertilizer first.</p>				Topic	Application level	a. Land preparation (hole digging by the size instructed, and application of organic compost (bokashi))	97.4%	b. Protection of the seedlings planted with net	100.0%	c. Weeding and mulching	92.1%	d. Pet bottle irrigation	92.1%	e. Preparation and application of liquid fertilizer to the avocado seedlings	97.4%
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c. Weeding and mulching	92.1%															
d. Pet bottle irrigation	92.1%															
e. Preparation and application of liquid fertilizer to the avocado seedlings	97.4%															
Willingness to continue replication of techniques	<b>Topic</b>	<b>% of person who has willingness to continue</b>	<b>Reason for the willingness</b>													
	a. Land preparation (hole digging by the size instructed, and application of organic compost (bokashi))	100.0%	- Easy to apply - Effective results of the pilot project													
	b. Protection of the seedlings planted with net	100.0%	ditto													
	c. Weeding and mulching	100.0%	ditto													
	d. Pet bottle irrigation	100.0%	ditto													
	e. Preparation and application of liquid fertilizer to the avocado seedlings	100.0%	- Interested in using liquid fertilizer for the vegetables - Easy to apply - Effective results of the pilot project													
	<p>- All the members showed their willingness to continue all the techniques introduced by the pilot activity.</p> <p>- With regards to the preparation and application of liquid fertilizer, almost half of the members are interested to use for vegetable production.</p>															
Appropriateness of design of pilot project	<b>Topic</b>	<b>Appropriateness (%)</b>														
		<b>Well</b>	<b>Fair</b>	<b>Less</b>	<b>N/A*</b>											
	a. Timing of training	55.3%	36.8%	7.9%	0.0%											
	b. Duration of training session	89.5%	7.9%	2.6%	0.0%											
	c. Way of guiding at the training	94.7%	5.3 %	0.0%	0.0%											
	d. Materials provided at the training	94.7%	5.3 %	0.0%	0.0%											
	e. Support by the field staff for application of the techniques	94.7%	2.6%	0.0%	2.6%											
	<p>- The participants pointed out that the commencement of the activity was late since the rainy season had already started.</p>															

Note\*: Data not available

Source: JICA Project Expert Team (2020)

Although the members of the pilot activity were selected through the consultations with villagers including village chief, only male members actively participated in the activities. It was necessary to facilitate women's participation over the course of the pilot activity implementation.

With regards to the participation level, 88.9% of the members participated in the training courses on average. The results also indicate the high level (95.8% of the members) of application of the techniques introduced by the training courses in their own farms. Accordingly, the members who attended the training shared what they learnt in the training courses with the absent members after the training. As for the application of liquid fertilizer, 57.9% of the members have also used it for vegetable farming on their own initiatives.

All the members showed their willingness to continue all the techniques introduced by the pilot project in their own farms. Almost half of the members mentioned that the pilot activity should have commenced earlier as it had started in the middle of the rainy season.

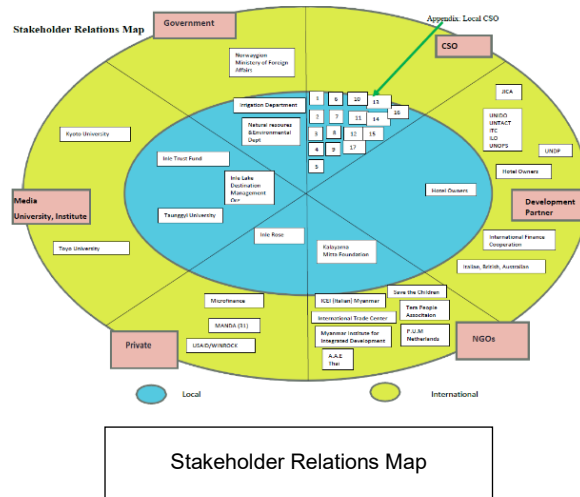
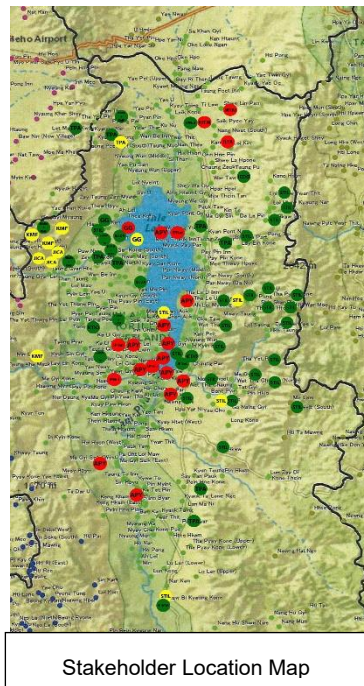
### **2.2.8 Stakeholder Analysis**

Many organizations and groups have worked in and around Inle Lake for environmental conservation and watershed management of Inle Lake. However, they seem to have not coordinated their activities with each other; hence some overlaps have been confirmed in their works. In order to facilitate their understanding of exiting activities done in and around Inle Lake among relevant stakeholders, the Project Expert Team together with Terra People Association, a Japanese NGO working in Taunggyi, has a stakeholder analysis workshops on December 23, 2019 and March 6, 2020 with the participation of 44 and 33 persons from the relevant organizations respectively.



In the workshops, the participants analyzed the stakeholders (e.g., NGOs, private companies, and donor-funded projects) and identified the locations where they have worked and the types of activities which they have conducted in the field. In the end of the workshop, the participants developed the following outputs:

- a. Stakeholder Matrix: A table describes the activities done by the organizations
- b. Stakeholder Relations Map: A chart classifies the organizations in term of the sectors which the organizations belong to.
- c. Stakeholder Location Map: A map shows the locations where the organizations have worked.



Source: JICA Project Expert Team (2020)

According to the results of the questionnaire survey made by the Project Expert Team after the workshop, many participants appreciated the workshops commenting that they were good opportunities to know about the actors/ organizations working around Inle Lake and their activities. There was also a suggestion that the Inle Lake Management Authority should be established and operationalized promptly.

## 2.3 Development of Overall Plans for Integrated Management of Inle Lake Watershed

### 2.3.1 Monitoring Plan of Soil Erosion and Influx Sediment

In order to continue the monitoring of the progress of soil erosion, river discharge and suspended sediment in the major rivers, the JICA Project Expert Team has developed the monitoring plan as shown in **Attachment-22**. Its outline is highlighted below.

#### Outlines of Monitoring Plan of Soil Erosion and Influx Sediment

Topic	Description
1. Monitoring of soil erosion	
1) Monitoring of progress of gully erosion by trail cameras	<ul style="list-style-type: none"> <li>■ Timing of data collection : once a month</li> <li>■ Place : Kone Ni village and Ein Yar village</li> <li>■ Responsible: Working group/FD staff</li> </ul>
2) Soil water pressure measurement	<ul style="list-style-type: none"> <li>■ Equipment to be used: soil pressure gauge</li> <li>■ Place: at the head of the gully</li> <li>■ Timing of data collection : during the rainfall</li> <li>■ Responsible: Working group/FD staff</li> </ul>
3) Shear test on soil types	<ul style="list-style-type: none"> <li>■ Soil sampling: Soil core samples to be taken in the major soil types for laboratory analysis.</li> <li>■ Analysis: After artificially saturating sampled soils with water, shear resistance of soil samples shall be measured.</li> <li>■ Timing of data collection: in the dry seasons when the site is accessible</li> </ul>
2. Monitoring of discharge of sediments	
1) Monitoring of water discharge	<ul style="list-style-type: none"> <li>a. Measurement of water level</li> <li>■ Equipment to be used: water level gauge</li> </ul>

Topic	Description
	<ul style="list-style-type: none"> <li>■ Method: automatic measurement</li> <li>■ Frequency of data collection: every hour</li> <li>■ Place: four major rivers</li> <li>■ Responsible: Working group/IWUMD staff</li> </ul> <p>b. Measurement of river flow velocity</p> <ul style="list-style-type: none"> <li>■ Equipment to be used: electronic magnetic water velocity gauge</li> <li>■ Method: manual measurement</li> <li>■ Frequency of data collection: occasionally</li> <li>■ Place: four major rivers</li> <li>■ Responsible: Working group/IWUMD staff</li> </ul>
2) Monitoring of Total Sediment Solid (TSS)	<ul style="list-style-type: none"> <li>■ Method : Regular sampling by auto-water sampler and analysis at FRI or another laboratory</li> <li>■ Frequency : <ul style="list-style-type: none"> <li>a. dry season: once per 24 days</li> <li>b. Rainy Seasons: when the water level reaches to a certain height</li> </ul> </li> <li>■ Place: middle basin of Kalaw river and selected one specified river.</li> <li>■ Sample analysis: TSS analysis (It can be ordered to FRI for the time being, but a laboratory should be set up at IWUMD Nyaung Shwe in future.</li> <li>■ Responsible: Working group/IWUMD staff</li> </ul>
3) Verification of sedimentation condition at alluvial fan and Inle Lake	<ul style="list-style-type: none"> <li>■ Method: Granulometry and C-14 absolute dating method of soils</li> <li>■ Frequency: occasionally</li> <li>■ Place: Kalaw alluvial fan, floating garden and Kalaw/Namlet river estuary</li> <li>■ Responsible: Working group/FD staff</li> </ul>
4) Monitoring condition of soil inflow from river	<ul style="list-style-type: none"> <li>■ Equipment to be used: trail camera</li> <li>■ Frequency: once a month</li> <li>■ Place: exit area of the limestone cave at lower Kalaw river</li> <li>■ Responsible: Working group/FD staff</li> </ul>

Source: JICA Project Expert Team (2020)

### 2.3.2 Overall Plan for Sediment Control

Based on the pilot activity of soil erosion control measures, the Project Expert Team developed an overall plan for sediment control as shown in **Attachment-23**. The table below shows its summary. Gully types listed below are introduced and explained in the Gully Analysis report described in Section 2.2.1 and **Attachment-24**.

#### Outlines of Overall Plan for Sediment Control

Topic	Description																	
Basic concepts	<ul style="list-style-type: none"> <li>- Countermeasures are proposed on the basis of the current technical level and the capacity of the counterpart agencies.</li> <li>- Vegetative measures are fully used to maximize the effect and also to reduce the costs/ inputs in consideration of the budget limitation of the government.</li> </ul>																	
Countermeasures by gully type*	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Gully Type</th> <th style="width: 30%;">Major Erosion Mechanism</th> <th style="width: 40%;">Outline of Countermeasures</th> </tr> </thead> <tbody> <tr> <td>1. Channel-form</td> <td>Side slopes are eroded by water flow.</td> <td><b>Revetment and girdle:</b> to support revetment.</td> </tr> <tr> <td>2. Mountainous area</td> <td rowspan="2">Gully bed is eroded by water flow vertically. ↓</td> <td rowspan="2"><b>Water channel:</b> to protect gully bed. <b>Check dam:</b> to support water channel and protect gully bed and slope foot.</td> </tr> <tr> <td>3. Mid-scale with vegetation</td> </tr> <tr> <td>4. Mid-scale without vegetation</td> <td>Slope foots become unstable. ↓</td> <td rowspan="3"><b>Check dam:</b> to protect gully bed and slope foot and support revetment. <b>Revetment:</b> to stabilize slope foot.</td> </tr> <tr> <td>5. Large-scale with vegetation</td> <td>Small scale slope failure occurs at lower side of slope. ↓</td> </tr> <tr> <td>6. Large-scale without vegetation</td> <td>Slope failure expands up to</td> </tr> </tbody> </table>	Gully Type	Major Erosion Mechanism	Outline of Countermeasures	1. Channel-form	Side slopes are eroded by water flow.	<b>Revetment and girdle:</b> to support revetment.	2. Mountainous area	Gully bed is eroded by water flow vertically. ↓	<b>Water channel:</b> to protect gully bed. <b>Check dam:</b> to support water channel and protect gully bed and slope foot.	3. Mid-scale with vegetation	4. Mid-scale without vegetation	Slope foots become unstable. ↓	<b>Check dam:</b> to protect gully bed and slope foot and support revetment. <b>Revetment:</b> to stabilize slope foot.	5. Large-scale with vegetation	Small scale slope failure occurs at lower side of slope. ↓	6. Large-scale without vegetation	Slope failure expands up to
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Prioritization of countermeasures by gully type	The countermeasures were evaluated in terms of 1) emergency, 2) risk on property, 3) workability of construction, 4) safety during construction, and 5) construction experience of the government and contractors to select priority ones, as shown below.																																																																																																					

Topic	Description																																																
	Gully Type	Emergence	Risk	Workability	Safety	Experience	Total Evaluation																																										
	1. Channel-form	High	Very high	Low or trial case	Low or trial case	High	High (-)																																										
	2. Mountainous area	High	Very low	High	High	High	Low or trial case																																										
	3. Mid-scale with vegetation	Low or trial case	High	High	High	High	High																																										
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	6. Large-scale without vegetation	Very high	High	Very low	Very low	Very low	Very low																																										
Draft short-term plan	<p>- The results of the evaluation indicate that natural waterway type and medium-scale gully are evaluated as high priority ones. Thus, the stress of the 10-year plan is placed on the same types of gullies. The plans to be implemented by FD/IWUMD is summarized as follows.</p> <table border="1"> <thead> <tr> <th>Gully Type</th> <th colspan="3">1<sup>st</sup> 5-Year Plan</th> <th colspan="3">2<sup>nd</sup> 5-Year Plan</th> </tr> <tr> <th>Responsible Agency</th> <th>Channel-form</th> <th>Small scale*</th> <th>Medium scale</th> <th>Channel-form</th> <th>Small scale*</th> <th>Medium scale</th> </tr> </thead> <tbody> <tr> <td>Kalaw FD</td> <td>-</td> <td>50</td> <td>-</td> <td>-</td> <td>50</td> <td>3</td> </tr> <tr> <td>Nyaunshwe FD</td> <td>10</td> <td>15</td> <td>-</td> <td>15</td> <td>15</td> <td>3</td> </tr> <tr> <td>Nyaunshwe IWUMD</td> <td>5</td> <td>10</td> <td>3</td> <td>2</td> <td>3</td> <td>5</td> </tr> <tr> <td>Total</td> <td>15</td> <td>75</td> <td>3</td> <td>17</td> <td>68</td> <td>11</td> </tr> </tbody> </table> <p><i>Note*: Small scale gully is part of medium scale gullies, whose depth is less than 15m and more feasible for the government agencies to handle in terms of size.</i></p>							Gully Type	1 <sup>st</sup> 5-Year Plan			2 <sup>nd</sup> 5-Year Plan			Responsible Agency	Channel-form	Small scale*	Medium scale	Channel-form	Small scale*	Medium scale	Kalaw FD	-	50	-	-	50	3	Nyaunshwe FD	10	15	-	15	15	3	Nyaunshwe IWUMD	5	10	3	2	3	5	Total	15	75	3	17	68	11
Gully Type	1 <sup>st</sup> 5-Year Plan			2 <sup>nd</sup> 5-Year Plan																																													
Responsible Agency	Channel-form	Small scale*	Medium scale	Channel-form	Small scale*	Medium scale																																											
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Source: JICA Project Expert Team (2020)

### 2.3.3 Community Forestry Promotion Plan

Having reviewed and analyzed the district 10-year master plan for CF establishment developed by Taunggyi FD considering the results of the pilot activities as well as current government capacity, the Project Expert Team developed a 5-year (2020/21-2024/2025) action plan for scale-up of CF in Inle Lake watershed. The plan is shown in **Attachment-25** and highlighted below.

#### Outlines of Community Forestry Promotion Plan

Topic	Description
Basic concepts	<ul style="list-style-type: none"> <li>i) Contribution to the achievement of the district master plan</li> <li>ii) Ensuring of the sustainability of CFUGs (or Sufficient capacity enhancement of village leaders and members of CFUGs) through application of the process/ procedures demonstrated in the pilot activity during the design phase of Component 2</li> <li>iii) Contribution to sustainable land and forest management along with livelihood improvement in the watershed</li> <li>iv) Establishment of CF not only in Reserved Forest but also outside Reserved Forest;</li> <li>v) Enhancement of the capacity of technical and field officers of FD townships; and</li> <li>vi) Development of a/ model/s of a new instrument for collaborative protected area management or Joint Forest Management.</li> </ul>
Target areas	- Target areas proposed by Community Forestry Promotion Plan is i) Reserved Forest, ii) unclassified forests (forests outside Reserved Forest) and iii) Reserved Forest classified as the commercial working circle.

Topic	Description						
Five years targets	<b>Year</b>	2020-21	2021-22	2022-23	2023-24	2024-25	Total.
	<b>Township</b>						
	10-year plan	<i>Acre (No.)</i>	<i>Acre (No.)</i>	<i>Acre (No.)</i>	<i>Acre (No.)</i>	<i>Acre (No.)</i>	<i>Acre (No.)</i>
	Kalaw, Pinlaung	594 (3)	791 (6)	1,442 (10)	854 (22)	765 (19)	4,446 (60)
	Nyaung Shwe	2,088 (N/A)	1,240 (22)	551 (13)	2,044 (11)	628 (8)	6,551 (> 54)
	Target with support of Component 2	<i>No.</i>	<i>No.</i>	<i>No.</i>	<i>No.</i>	<i>No.</i>	<i>No.</i>
	Kalaw <1	2	4	4	-	-	10
	Nyaung Shwe	2	4	4	-	-	10
<i>Note: The numbers include the implementation of the FMP in Pha Yar Phyu village. Source: Ten years plan on CF establishment (2017-2027) at Taunggyi District FD, MONREC and JICA Expert Team (2020)</i>							
Major activities to be conducted in CF Promotion	<ul style="list-style-type: none"> <li>- Introduction of CF</li> <li>- Implementation of CF FMP for 1~2 years</li> <li>- Coordination with other stakeholders who may work in CF villages</li> <li>- Review and revision of CF Forest Management Plan (if necessary)</li> </ul>						
Organizations involved in CF Promotion	<ul style="list-style-type: none"> <li>- FD township offices at Nyaung Shwe and Kalaw : main implementing bodies for CF promotion</li> <li>- CF District Working Group and FD Taunggyi district: provision of necessary policy and administrative support to the township offices so that they could expand CF in their jurisdictional areas smoothly in a proper manner</li> <li>- General Administration Department (GAD) and Department of Agricultural Land Management and Statistics (DALMS) : involvement in the process when non-classified forests are targeted for CF</li> <li>- Department of Agriculture (DoA) : playing a role in supporting local communities in CF village for improvement of land management and crop production</li> <li>- CSOs and other external organizations, e.g., development partners' projects: important players for CF promotion</li> </ul>						

Source: JICA Project Expert Team (2020)

## 2.4 Project Seminars

With an aim to introduce the purpose and outline of Component 2 of FDSNR and accomplishments made by the project to stakeholders relevant to Inle Lake watershed management, the Project Expert Team held two project seminars as listed below.



- Kick-off Seminar on August 2, 2019
- 2<sup>nd</sup> Project Seminar on February 20, 2020

The detailed reports on the seminars are shown in **Attachment-26**, and some highlights of discussions in the meetings are summarized below.

### Summary of Project Seminars held by the Project Expert Team

#### a. Kick-off Seminar

Items	Descriptions
Date	August 2, 2020
Venue	Hupin Hotel, Khaung Daing, Nyaung Shwe
Participants	More than 60 participants (Minister of MONREC, Shan State, Minister of Inthar Affair, Shan State, DDG of FD, DDG of IWUMD, Director of WMD of FD, Government Officials of the relevant departments at state, district and township levels, Representatives of CSOs, Representatives of Donor agencies, Academic, and Representatives of JICA Offices)
Discussions	<p>The JICA Project Team introduced the outline and work plan of the design phase of Component 2 covering the following sessions in the seminar.</p> <ul style="list-style-type: none"> <li>■ Session 1: Overall framework of Component 2, particularly its design phase</li> <li>■ Session 2: Assessment of soil erosion potentials in Inle Lake watershed</li> <li>■ Session 3: Possible mechanism of gully erosion in Kalaw sub-watershed</li> </ul>


Items	Descriptions														
	<ul style="list-style-type: none"> <li>■ Session 4: Ideas on potential measures effective in Reducing the progress of gully erosion</li> <li>■ Session 5: Proposed plan of monitoring of river discharge and suspended sediment of the major rivers</li> <li>■ Session 6: Current socio-economic conditions and major issues on land and forest management in Kalaw sub-watershed</li> <li>■ Session 7: Major activities in the next 6 months</li> </ul> <p>Some highlights of the comments given by the participants in the meeting are summarized below.</p> <p style="text-align: center;"><b>Comments and Answers in the Kick-off Meeting</b></p> <table border="1" data-bbox="411 555 1377 1525"> <thead> <tr> <th data-bbox="411 555 810 584">Comments made by the participants</th> <th data-bbox="810 555 1377 584">Answers made by the Team/FD</th> </tr> </thead> <tbody> <tr> <td data-bbox="411 584 810 779">Is the construction of a series of masonry check dams effective and efficient in controlling gully erosion?</td> <td data-bbox="810 584 1377 779">The masonry check dams can maintain its effect for about 15 years, while the effect of sandbag check dam or stone check dam with wooden frame might last only for four to five years. 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Source: JICA Project Expert Team (2020)

**b. 2<sup>nd</sup> Project Seminar**

Items	Descriptions																				
Date	February 20, 2020																				
Venue	Royal Taunggyi Hotel, Taunggyie																				
Participants	About 70 participants (Minister of MONREC, Shan State, Minister of Inthar Affair, Shan State, DDG of IWUMD, Director of WMD of FD, Government Officials of the relevant departments at state, district and township levels, Representatives of CSOs, Representatives of Donor agencies, Academic, and Representatives of JICA Offices)																				
Discussions	<p>The JICA Project Team introduced the outline and work plan of the design phase of Component 2 covering the following sessions in the seminar.</p> <ul style="list-style-type: none"> <li>■ Session 1: Outline of the Works of Design Phase of Component 2</li> <li>■ Session 2: Soil erosion potential and proposed measures for soil erosion control in Inle Lake watershed</li> <li>■ Session 3: Analysis of sedimentation mechanism in Inle Lake and proposed monitoring plan of the sedimentation process</li> <li>■ Session 4: Analysis of socio-economic conditions in the watershed in relation to sustainable land and forest management</li> <li>■ Session 5: Potential measures for sustainable land management based on the pilot activity (introduction of agroforestry model)</li> <li>■ Session 6: Proposed measures for sustainable forest management based on the pilot activity (introduction of CF)</li> <li>■ Session 7: Overall picture of the second phase of Component 2</li> </ul> <p>Some highlights of the comments given by the participants in the meeting are summarized below.</p> <p style="text-align: center;"><b>Comments and Answers in the Project Seminar</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #cccccc;">Comments made by the participants</th> <th style="background-color: #cccccc;">Answers made by the Team/FD</th> </tr> </thead> <tbody> <tr> <td>Does the Project cover the control of water pollution of the Inle Lake?</td> <td>The Project just focuses on sediment flow to the lake, not water quality.</td> </tr> <tr> <td>It is recommended to use indigenous species for the reforestation in the lake watershed area.</td> <td>The Project also consider that the use of indigenous species is recommended and the species to be planted would be finally selected through consultation with FD.</td> </tr> <tr> <td>The socio-economic survey needs to cover the status of water pollution caused possibly by detergents used by households in the watershed.</td> <td>The Project would consider including such topic in the following phase.</td> </tr> <tr> <td>Regarding the data of water level, especially that of Intain river could be changed largely in the different season, which was not covered in the Project.</td> <td style="text-align: center;">-</td> </tr> <tr> <td>Human activities, such as raising two crops per year as well as pumping up the river water for agricultural purpose could affect the data of water level.</td> <td style="text-align: center;">-</td> </tr> <tr> <td>Small-scale waste management treatment facilities should be installed by the Project in the watershed.</td> <td style="text-align: center;">-</td> </tr> <tr> <td>The Project should provide capacity building to CSO which is one of the key players in conservation of the Inle Lake.</td> <td>The socio-economic survey under the Project was conducted by FRED A, one of the leading NGO in the country, with the technical supports by the Project.</td> </tr> <tr> <td>Does the project has intention to conduct value change assessment to support the marketing of the products from the Pilot Project, such as Avocado.</td> <td>The Project proposed some measures to support marketing of the agricultural products through introduction of e.g., Good Agricultural Practice (GAP) .</td> </tr> <tr> <td>Are the techniques proposed in the potential measures for sustainable land use management, such as "introduction of cover crops and contour ditches with bunds to disperse water and slow down the speed of water infiltration", similar with Sloping</td> <td>Yes.</td> </tr> </tbody> </table>	Comments made by the participants	Answers made by the Team/FD	Does the Project cover the control of water pollution of the Inle Lake?	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Items	Descriptions	
	Agriculture Land Techniques (SALT)?	
	It is recommended to visit the pine plantation in Taung Lay Lone reserved forest, where the SALT has been applied.	—
		

Source: JICA Project Expert Team (2020)

## 2.5 Preparation of Draft Technical Manuals/ Guidelines and Procedures for the Major Project Activities

The Project Expert Team also drafted the following technical manuals/ guidelines/ procedures for the key project activities based on the experiences of the project activities carried out by the Project Expert Team in the design phase, such as drone survey, water turbidity assessment, river monitoring, and pilot activities. The main aim to develop the draft manuals and guidelines is to enable the working groups for Component 2 and other technical officials from the relevant departments to effectively implement the project activities in the implementation phase.

- a) Draft Technical Manual for Topographical Measurement by UAV
- b) Draft Procedures for Lake Water Quality Assessment with UAV
- c) Draft Procedures for Gully Erosion Control Countermeasures
- d) Draft River Monitoring Manual
- e) Draft Procedures for New Introduction and Establishment of CF
- f) Draft Field Manual for Introduction of Agroforestry Models

**Attachment-27** shows the draft manuals and guidelines developed by the Project Expert Team.

## 2.6 Training Course in Japan for the Project Counterparts

The Project Expert Team arranged and conducted a 2-week training course in Japan (from Dec. 1 to 14, 2019) in coordination with relevant Japanese organizations as shown below.

### Schedule of the Training Course in Japan

Date	Activity
Dec. 1 (Sun)	Move to Narita
Dec. 2 (Mon)	Orientation of the training course, Courtesy call to JICA
Dec. 3 (Tue)	Courtesy call to and Lecture at Forest Agency, Lectures on soil conservation and history of Inle Lake
Dec. 4 (Wed)	Visits to Forest Research and Management Organization and Central Research Center of Nippon Koei
Dec. 5 (Thu)	Visit to Kasumigaura Kohoku Regional Sewerage System
Dec. 6 (Fri)	Field observation of the soil conservation works in Saitama Prefecture
Dec. 7 (Sat)	Rest day
Dec. 8 (Sun)	Move to Nagano
Dec. 9 (Mon)	Lectures on “Disaster Prevention and Mitigation Efforts using ICT in Nagano Prefecture” and “Guidelines on the Development of Disaster-resistant Forests”
Dec. 10 (Tue)	Field observation of the soil conservation works in Yokokawa Yama in Nagano Prefecture
Dec. 11 (Wed)	Lecture and field observation of the environmental conservation in Suwa Lake

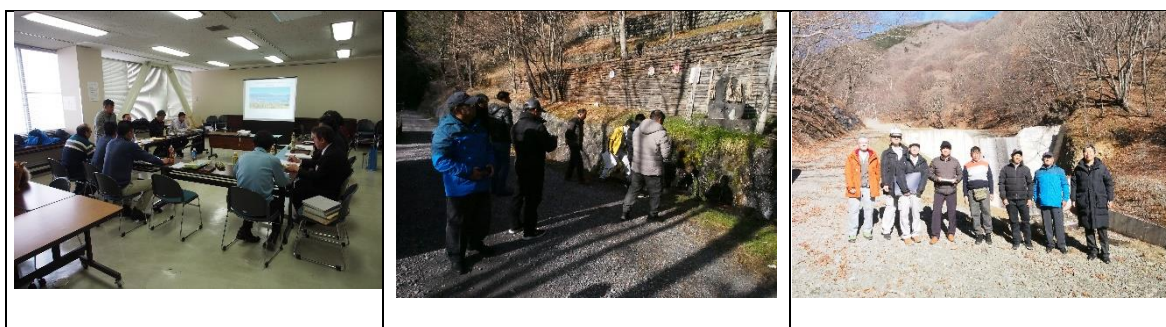
Date	Activity
	Visit to Jinguji Forestry Production Cooperative to have a lecture and exchange views
Dec. 12 (Thu)	Move to Tokyo, Preparation of action plans
Dec. 13 (Fri)	Presentation of the action plans
Dec. 14 (Sat)	Travel to Yangon

*Source: JICA Project Expert Team (2020)*

A total of five government officials from the relevant offices, namely GAD, FD, and IWUMD, participated in the training course and deepened the knowledge about integrated watershed management through field observation and exchange of the views with the government officials in Japan. The participants in the training course are listed below.

- a. Mr. Soe Soe Zaw : Deputy Director General of General Affaire Department (GAD) of Shan State (Secretary of the Cabinet of the Government of Shan State)
- b. Mr. Chit Oo : Assistant Director of Watershed Management Division, Forest Department (FD)
- c. Mr. Aung Myo Khain : Assistant Director of Forest Department (FD) of Taunggyi District, Shan State
- d. Mr. Kyaw Kyaw Oo : Assistant Director of Irrigation Water Utilization and Management Department (IWUMD) of Nyaung Shwe Township
- e. Mr. Mya Win Kaung : Staff Officer of Forest Department of Kalaw Township, Taunggyi District, Shan State

The action plan developed by the participants is shown in **Attachment-28**.



**Counterpart Training in Japan in December 2019**

*Source: JICA Project Expert Team (2020)*

## **2.7 Public Relations**

The Project Expert Team has kept updating its Facebook account in accordance with the progress of the project activities. In total, more than 2,000 people accessed to the site with the average of around 100 visitors to 1 posting.

The Team also issued and distributed a project newsletter shown in **Attachment-29** to the relevant government offices, donor-supported projects, and CSOs related to Inle Lake watershed management.

Furthermore, a project pamphlet has been drafted by the Team as shown in **Attachment-30**. The draft pamphlet will be further reviewed and revised in consultation with FD and FDSNR in the implementation phase. After finalization of the English version of the same, the Team will translate the final version into Myanmar language so that it could be got across as many stakeholders related to the lake as possible.

### 3. Project Inputs

#### 3.1 Japanese Side

##### (1) Project Expert

A total of 10 experts have engaged in the project. The actual assignment schedule as compared to the one planned is shown in **Table 3**. The following table shows its summary.

**Assignments of the Project Experts**

Position	Name	Total MM of the experts
Team Leader/Integrated Watershed Management	Yoji Mizuguchi	4.25 MM
Co-Team Leader/Livelihood Development/Community Forest	Junko Kikuchi	2.30 MM
Soil Erosion/Planning for Sediment Control (1)	Hiroki Ochiai	1.07 MM
Soil Erosion/Planning for Sediment Control (2)	Hideki Imai	3.00 MM
Socio-economic Survey (e.g., Household Level Economy, Indigenous People, and Communities' Interest)	Toru Inada	1.63 MM
Land Use and Topographic Survey	Asuka Wachi/Kim Jonghwan	3.00 MM
Procurement/Laser Survey	Kei Suzuki	3.28 MM
Installation of Equipment and Soil Survey	Mitsunori Sonoda	0.33 MM
River Monitoring	Souchiro Fujii	0.27 MM
Project Coordinator/ Monitoring of Pilot Activities/Planning of Training	Yayoi Yoshioka/Shigeru Takahara	2.32 MM

Source: JICA Project Expert Team (2020)

##### (2) Project Equipment

As shown in Section 2.1.7, the Project Expert Team procured several types of project equipment mainly for monitoring of river discharge and suspended sediment in river flow. The following table shows the type and number of project equipment procured over the course of the project implementation.

**Equipment Procured**

Equipment	No.	Purposes	Remark
Auto water sampler	1 unit	Monitoring of TSS in river flow	with Auto water level gauge and cross section current meter
Auto water level gauge	5 units	Monitoring of water level in river	-
Soil sampler	1 unit	Soil survey in alluvial fun	-
Multi sampler	1 unit	Soil survey of bottom soils in floating gardens and lake	-
Trail camera	4 units	Observation of gully process and flow of Kalaw river at the outlet from the cave	-
Auto rain gauge	2 units	Collection of rainfall data	-
Photo copy machine	1 unit	Office equipment for the project team	-

Source: JICA Project Expert Team (2020)

It was agreed by FD and JICA that all the project equipment should be managed and maintained by JICA and its project team until the end of the Project (FDSNR), as they would be used for the project activities and technical officials of the relevant government offices still need times to learn how to manage and handle the equipment through the implementation of Component 2.

##### (3) Others (Training)

As described in Section 2.6 in this report, five government officials participated in the training course in Japan, which was arranged and organized from December 1 to 9, 2019.

### 3.2 Myanmar Side

#### (1) Counterparts

##### a. Working Groups

As described in Section 2.1.3, two working groups composed of the members listed below started the field works in collaboration with the Project Expert Team.

#### **Members of the Working Groups for Component 2**

##### **1) Working Group for River Monitoring and Erosion Control**

<b>Members</b>	<b>Organizations</b>	<b>Position</b>
Group Leader	FD at Nyaung Shwe Township	Staff Officer
Members	FD at Kalaw Township	Staff Officer
	DALS at Taunggyi District	Staff Officer
	IWUMD at Nyaung Shwe Township	Assistant Engineer
	IWUMD at Nyaung Shwe Township	Assistant Engineer
	WMD in FD at National Level	Range Officer
	WMD in FD at National Level	Range Officer

##### **2) Working Group for Community Forestry and Sustainable Land Management**

<b>Members</b>	<b>Organizations</b>	<b>Position</b>
Group Leader	FD at Nyaung Shwe Township	Staff Officer
Members	FD at Kalaw Township	Staff Officer
	GAD at Nyaung Shwe Township	Deputy Township Officer
	DoA at Nyaung Shwe Township	Staff Officer
	DoA at Kalaw Township	Staff Officer
	DALS at Nyaung Shwe Township	Assistant Staff Officer
	DALS at Kalaw Township	Assistant Staff Officer

*Source: JICA Project Expert Team (2020)*

##### b. Sub-PMU

A project steering and management committee at component level, named Sub-project Management Unit (Sub-PMU) has been formed with the official letter signed by H.E. Minister of MONREC on October 9, 2019, as described in Section 2.1.3. A total of 12 government officials from the relevant departments at central, state, and district level are selected as members of Sub-PMU.

#### (2) Project Equipment and Facilities

Although there is an office space available in the compound of FD, Nyaung Shwe Township, the conditions of the building need renovating; hence, the Project Expert Team has yet to use such a space for the project office.

## 4. Achievement of the Project

### (1) Project Output

The verifiable indicators given to Output 2/ Component 2 in the revised Project Design Matrix (PDM) of FDSNR are as follows:

- 1) JICA recommendation for integrated watershed management is incorporated into the Inle Lake Conservation Plan.
- 2) At least 5 types of measures for better watershed management following the JICA recommendations in the project site are tested.
- 3) The number of community forests developed in the Project site is increased at least by 20% compared to the one in 2016.
- 4) CF Guideline developed for Taunggyi is authorized by the FD and applied to all the FD township offices in the Inle Lake region. Action plan of District level Working Group for CF are approved and budgeted.

The design phase of Component 2 has specifically addressed the indicators 2) and 4). The table below explains how the design phase could contribute to the achievement of such indicators.

#### **Contribution of Component 2 to the Verifiable Indicators under the Revised PDM**

Indicators	Results of the Project
At least 5 types of measures for better watershed management following the JICA recommendations in the project site are tested.	As of the end of August 2020, the three types of pilot activities listed below have been implemented in the field as potential measures for sustainable watershed management. <ol style="list-style-type: none"> <li>a) Construction of check dams with water courses in the gully head</li> <li>b) Introduction of valuable tree crops in home gardens/ upland farms to introduce an agroforestry model</li> <li>c.) Introduction of community forestry in the reserved forest</li> </ol> The results of the activity a) reveals that the soil erosion control works tested in the field would be effective in reducing soil runoff from the existing gully, while those of the activities b) and c) suggest that they could contribute to the increase of vegetation cover and the reduction of deforestation in the watershed. It is, therefore, judged that these activities could be considered as proposed measures for effective watershed management, which could be recommended by Component 2.
CF Guideline developed for Taunggyi is authorized by the FD and applied to all the FD township offices in the Inle Lake region. Action plan of District level Working Group for CF are approved and budgeted.	The Project Expert Team drafted the following CF-related technical guidelines/ procedures based on the experiences of the pilot activities. <ol style="list-style-type: none"> <li>a) Draft Procedures for New Introduction and Establishment of CF</li> <li>b) Draft Field Manual for Introduction of Agroforestry Models</li> </ol> The Team also developed overall plans for CF promotion and agroforestry introduction in Inle Lake watershed. Both the types of document could be used for development of CF guidelines and a district action plan for CF in the implementation phase, respectively.

*Source: JICA Project Expert Team (2020)*

### (2) Project Activities

The level of accomplishment in the project activities of Component 2 as of the end of September 2020 is summarized in the table below.



**Accomplishments made for Fulfillment of the Tasks given in the Revised PDM**

Activities in PO	Accomplishments made in this reporting period
<p>2.1 Support institutional and financial arrangements for collaborative work among the governmental organizations, the Inle Lake Authority, and the other relevant stakeholders</p>	<ul style="list-style-type: none"> <li>- The Project has established Sub-PMU responsible for monitoring and management of the pilot project. The 1<sup>st</sup> meeting of Sub-PMU was held in February 4 to share the major accomplishments made by Component 2 as well as to introduce the functions of Sub-PMU and the schedule of Sub-PMU’s meetings in 2020.</li> <li>- The working groups for Component 2 have been set up with the initiative of MONREC for the collaborative implementation of the project activities. The meetings were organized in November 18, 2019, January 10 and February 17, 2020 to share the progress of the pilot activities and discuss the technical issues during its implementation.</li> </ul>
<p>2.2 Carry out a baseline survey on the necessary fields such as land use, population, local livelihoods, household economy, and agriculture etc.</p>	<ul style="list-style-type: none"> <li>- Household interview survey and PRA were completed in the target villages to grasp current social economic condition and practice of natural resource management in the villages.</li> <li>- The results of the above surveys were compiled in the form of report to submit to FD.</li> <li>- The baseline of socio-economy, issues of agricultural practices, current status of CF, forest management and land use were confirmed. Based on its analysis, the possible interventions for CF and Sustainable Land Use Management were identified.</li> </ul>
<p>2.3 Promote fact-based understanding of perceived phenomena</p>	<ul style="list-style-type: none"> <li>- The samples of the surface of water were collected at water channel passing through floating gardens to analyze volume of TSS. Also, drone survey was conducted to assess the turbidity in the above water channel. The results of such sampling and assessment indicate that the suspended sediment flows directly into the lake in case there is no floating garden and that floating gardens reduce the velocity of water flow and check suspended sediment.</li> <li>- Core sampling was conducted in the floating gardens, estuaries of Kalaw and Namlet rivers, and center of the lake, to take soil samples from lakebed. The samples taken were sent to Japan for analyses of radio carbon dating (C-14) and soil particle size. The results of the analyses indicate that the deposition rate may be higher in the floating gardens and lower in the center of Inle Lake, as deposition was significantly observed in the middle of floating garden and less in the outer edge of the garden or the lake shore. It can support the results of TSS assessment of surface water in floating garden, where floating gardens may function to check suspended sediment in the flow as they could reduce water velocity.</li> <li>- In order to monitor the river discharge of the major four rivers continuously, the water level gauges were installed.</li> <li>- The auto-sampler was also installed on Kalaw river to collect the water sample continuously. The water samples taken were sent to FRI for TSS analysis.</li> <li>- The rain gauges were installed in Kalaw sub-watershed to grasp the rainfall pattern in the sub-watershed.</li> <li>- Trail cameras were placed at the existing two gullies and the outlet of Kalaw river from the cave to monitor the progress of gully erosion and the outflow from the outlet in the rainy season.</li> <li>- The pilot project of gully erosion control constructed masonry check dams and water channels with vegetative slope protection works at the existing gully in Kone Ni village in Kalaw sub-watershed.</li> <li>- The conditions of the erosion control works in Kone Ni village were periodically monitored every three months (November 2019 and February 2020). As a result, there have been no major damage overserved at the structures. It was also observed that the soil from the side of gully was deposited in the water channels, which was the evidence of the function to prevent the progress of soil erosion in the gully.</li> </ul>

<b>Activities in PO</b>	<b>Accomplishments made in this reporting period</b>
2.4 Conduct demonstrative measures against key drivers of sedimentation	<ul style="list-style-type: none"> <li>- The pilot project of gully erosion control constructed masonry check dams and water channels with vegetative slope protection works at the existing gully in Kone Ni village in Kalaw sub-watershed.</li> <li>- The conditions of the erosion control works in Kone Ni village were periodically monitored every three months (November 2019 and February 2020). As a result, there have been no major damage observed at the structures. It was also observed that the soil from the side of gully was deposited in the water channels, which was the evidence of the function to prevent the progress of soil erosion in the gully.</li> <li>- In August 2019, the pilot activities of CF and sustainable land management, such as i) introduction of CF and ii) introduction of agroforestry model, has started in Pha Yar Phyu village located in Kalaw sub-watershed. The former pilot activity involved all the households in the village, i.e., 50 households, while 38 households took part in the latter.</li> <li>- The main activities conducted by the respective pilot activities are:               <ul style="list-style-type: none"> <li>i) Formation of CF User Group (CFUG), development of by-laws of CFUG, determination of the boundary of the proposed area for CF, preparation and submission of proposal for establishment of CF and formation of forest management plan</li> <li>ii) Selection of species to be planted, land preparation, planting seedlings, tending of the seedlings, and preparation and application of liquid fertilizer</li> </ul> </li> <li>- Overall plans for sediment control and CF promotion in Inle Lake watershed were developed by the Project Expert Team based on the results of the pilot activities.</li> </ul>
2.5 Strengthen forest management in the watershed	<ul style="list-style-type: none"> <li>- The Project Expert Team developed i) a 5 years CF promotion plan in Inle Lake watershed and ii) draft procedures for introduction of CF based on the results of the pilot activity. Both the documents could be further improved and refined for promotion of CF as well as strengthening of FD's capacity for forest management in the watershed.</li> </ul>
2.6 Incorporate findings into further policy and planning processes	<ul style="list-style-type: none"> <li>- None</li> </ul>
2.7 Carry out public relations and advocacy activities such as knowledge sharing workshop(s) with stakeholders such as local governments, NGOs and communities.	<ul style="list-style-type: none"> <li>- The Facebook site of Component 2 was opened to introduce the project as well as to share and update its progress periodically.</li> <li>- Stakeholder workshops were held in collaboration with Tierra People Association to introduce the project and exchange opinions among the stakeholders.</li> <li>- On August 2 2019, the kick-off meeting was organized to introduce the objective and outline of the project. In addition, the 2<sup>nd</sup> project seminar was convened on February 20, 2020 to share the outputs of the project as well as the prospect for the implementation phase of the Component 2 with the stakeholders.</li> </ul>

Source: JICA Expert Team (2020)

## **5. Lessons Learned and Recommendations for the Implementation Phase of Component 2**

Through the implementation of the Project, the following lessons learned and recommendation were extracted as inputs to the design of the next phase of Component 2.

### **(1) Appropriate Scheduling of the Activities**

The pilot activities of gully erosion control, CF, and sustainable land management are also significantly affected by the season. Erosion control works and CF should be implemented in the dry season, while those of sustainable land management, such as agroforestry, should be carried out in the rainy season. It is, therefore, important to develop detailed work plans of the countermeasures including planning, designing, and actual implementation of the works in the field considering the timing of the rainy/ dry season in the beginning of the implementation phase. Particularly in the gully erosion control, construction works should be completed before the rainy season. Adequate time should be allocated for construction and inspection in the field even for small scale facilities/ structures.

### **(2) Close Coordination with Government Agencies to Select Target Area of CF**

As for the introduction of CF, the proposal for establishment of CF has yet to be approved within the project period since the proposed area for CF is registered as the economic production circle which is out of the scope for CF introduction under current legal framework of the government. Hence, the CF proposed sites should be selected in close coordination and consultation with FD and GAD offices concerned so as to clarify the status of the land prior to the field activity.

### **(3) Adoption of Collaborative Management to Production Forest**

As mentioned above, the proposed CF area in Pha Yar Phu is part of the economic production circle of Reserved Forest, which is difficult to introduce CF in. Under such circumstances, some collaborative management schemes shall be considered, e.g., Joint Forest Management and collaborative forest management, to promote forest management in participatory manner even in such a restricted area. Further consideration of the proposed scheme should be made in the implementation phase based on similar cases in other Asian countries.

### **(4) Continuous Support to Sub-PMU and Working Groups**

During the Project, collaborative organizational set-ups were developed such as i) Sub-PMU and ii) working groups for the field activities. Although those organizations were officially formed with approval by H.E. Union Minister in October 2019, their involvement in the project is still limited. In the implementation phase, it is, therefore, essential to facilitate their involvement and participation in the project activities, so that both the organizations could function as i) a collaborative platform for effective integrated watershed management and ii) field working bodies of key activities for sediment control and sustainable forest and land management in the watershed, respectively. By doing so, both the bodies and their members would be the main players for integrated watershed management of Inle Lake even after the end of the project.

## ***Tables***

**Table 1 Meetings with Relevant Organizations**

No.	Date	Person/Organization visited	Topics discussed
1.	March 21, 2019	- JICA expert dispatched at IWUMD - FD (DDG and directors in am and technical staffs in pm)	Plan of project activities
2.	March 25, 2019	- Shan State and Taunggyi District FD - Minister of Environment - IWUMD	Plan of project activities and implementation setup required
3.	March 26, 2019	- Nyaung Shwe Township IWUMD - Minister of Inthar Affairs - Nyaung Shwe Township FD - DDG of IWUMD	ditto
4.	March 28, 2019	- Shan State and Taunggyi Township DoA	ditto
5.	April 1, 2019	- UNDP Project	Overall and progress of the projects of both parties
6.	April 5, 2019	- DALMS, DoA	Plan of project activities and implementation setup required
7.	May 27, 2019	- ShanState FD - Kalaw Township FD	Progress of the project activities
8.	May 28, 2019	- Nyaung Shwe Township IWUMD - Nyaung Shwe Township GAD	ditto Plan of project activities
9.	May 31, 2019	- Taunggyi District GAD	Plan of project activities
10.	June 3, 2019	- Kalaw Township GAD  - UNDP Project	Plan of project activities and collaboration in the activities in the communities Progress and results of the project
11.	July 2, 2019	- Shan State, Taunggy District and Nyaung Shwe Township FD	Progress of the project activities including pilot activities
12.	July 3, 2019	- Kalaw Township FD and DOA	Implementation setups of the pilot activities
13.	July 25, 2019	- Shan State and Taunggyi District FD - Taunggy GAD - Minister of Shan State Ministry of Environment and Natural Resources - Minister of Inthar Affair	Progress of the project, especially the pilot activities and request for participation in the kick-off meeting
14.	July 26, 2019	- Kalaw Township FD and DOA	Implementation of pilot activities



No.	Date	Person/Organization visited	Topics discussed
15.	July 29, 2019	- ShanState DALMS - Shan State and Taunggye District DOA - Nyaung Shwe Township IWUMD - Nyaung Shwe Township FD	Progress of the project, especially in the pilot activities and request for the participation in the kick-off meeting
16.	August 27, 2019	- Kalaw Township FD and DOA	Implementation of the pilot activities especially in the training of tree planting and land preparation
17.	September 9, 2019	- WMD, FD	Progress of the project and introduction of CF
18.	September 12 and 26, 2019	- Shan State FD	Introduction of CF
19.	September 16 and 24, 2019	- Kalaw FD	Bylaws of CFUG
20.	September 18, 2019	- Kalaw FD and DoA	Implementation of pilot activities, especially in the training of making liquid fertilizer
21,	September 19, 2019	- WMD	Progress of river monitoring
22	October 3, 2019	- Shan State and Taunggyi District FD	Progress of the project and introduction of CF in Pha Yar Phyu
23	October 4, 2019	- Kalaw Township FD	Progress of the project and process of the request letter for CF registration of Pha Yar Phyu
24	October 4, 2019	- Kalaw Township DOA	Implementation of pilot activities including training of making liquid fertilizer and process of training of tending seedlings
25	October 9, 2019	- WMD	Progress of the project, submission of the request letter for CF registration and training on gully erosion control
26	November 5, 2019	- Nyaung Shwe Township FD	Progress of the project and commencement of the activities of working groups
27	November 6, 2019	- Kalaw Township FD	Progress of the CF introduction and process of formulation of forest management plan
28	December 23, 2019	- Shan State DALMS  - Taunggyi District GAD - Shan State FD and Taunggyi District FD - Nyaung Shwe Township IWUMD  - Kalaw Township FD	Overall of the project, progress of the project activities and request of the participation in Sub-PMU  Progress of the project and activities of Sub-PMU ditto  Progress of project and request for the participation in Sub-PMU  Progress of CF introduction and process of the formulation of forest management plan with

No.	Date	Person/Organization visited	Topics discussed
			CFUG
29	December 24, 2019	- Shan State DoA	Progress of the project and request for the participation in Sub-PMU
30	January 8, 2020	- Kalaw Township FD	Progress of CF introduction and draft forest management plan
31	January 13, 2020	- WMD, FD	Progress of the project activities
32	February 17, 2020	- Shan State and Taunggyi District DALMS and FD - Community Forestry District Working Group of Taunggyi District (Taunggyi District FD) - Shan State GAD - Shan State FD	Request for participation in the Sub-PMU meeting and project seminar Draft CF promotion plan  Structure of Sub-PMU Accomplishment made by the project and agenda of the project seminar

**Table 2 Results of survival rate survey of the seedlings planted**

**Bu Ta Htaung Specie**

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
1	A	1.3	46	
2	A	1.3	30	
3	A	1.3	57	
4	A	1.3	62	
5	A	1.3	26	
6	A	1.3	38	
7	A	1.5	77	
8	A	1.3	62	
9	A	1.3	40	
10	A	1.7	52	
11	A	1.5	52	
12	A	1.0	36	
13	A	1.3	52	
14	A	1.3	53	
15	A	0.8	35	
16	A	1.7	95	
17	A	1.3	60	
18	A	1.3	35	
19	A	1.3	52	
20	A	1.8	80	
21	A	1.7	55	bad condition
22	A	1.3	38	
23	A	1.3	20	
24	A	1.5	53	
25	A	1.3	50	
26	A	1.2	25	
27	A	1.3	70	
28	A	1.3	45	
29	A	1.3	44	
30	A	1.3	30	
31	A	1.5	50	
32	A	1.3	36	
33	A	1.3	60	
34	A	1.3	50	
35	A	1.0	35	
36	A	1.3	60	
37	A	1.3	30	
38	A	1.3	33	

**Table 2 Results of survival rate survey of the seedlings planted**

**Bu Ta Htaung Specie**

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
39	A	1.3	40	
40	A	1.7	93	
41	A	1.3	58	
42	A	1.2	35	
43	A	1.3	55	
44	A	1.3	40	
45	A	1.3	33	
46	A	1.3	63	
47	A	1.0	40	bad condition
48	A	1.3	50	
49	A	1.7	90	
50	A	1.3	33	
51	A	1.7	70	
52	A	1.3	63	dry
53	A	1.3	50	dry
54	A	1.3	53	
55	A	1.3	40	
56	A	1.3	28	bad condition
57	A	1.3	37	
58	A	1.2	35	
59	A	1.3	50	
60	D	-		
61	A	1.3	44	
62	A	1.3	50	
63	A	1.0	30	
64	A	1.0	30	
65	A	1.3	28	
66	A	1.3	32	
67	A	1.3	33	
68	A	1.3	35	
69	A	1.3	30	
70	A	1.7	72	
71	A	1.3	55	
72	A	1.5	38	

Table 2 Results of survival rate survey of the seedlings planted

Bu Ta Htaung Specie

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
73	A	1.7	55	
74	A	1.3	35	
75	A	1.3	33	
76	A	1.8	90	
77	A	1.5	43	
78	A	1.3	50	
79	A	1.3	38	
80	A	1.0	30	
81	D	1.0	40	dry and can't alive
82	D	-		someone cut on purpose
83	D	-		
84	D	-		
85	D	-		
86	A	1.3	40	
87	A	1.3	42	
88	A	1.3	50	bad condition
89	A	1.3	30	
90	A	1.3	30	
91	A	1.3	28	
92	A	1.3	50	
93	A	1.7	72	
94	A	1.0	35	
95	A	1.0	50	
96	A	0.7	31	
97	A	1.0	35	
98	A	1.0	40	
99	A	1.0	40	
100	A	1.3	38	
101	A	1.5	60	
102	A	1.3	51	
103	A	1.3	42	
104	A	1.7	75	
105	A	1.5	57	
106	A	1.3	40	
107	A	1.3	38	
108	A	1.5	53	



Table 2 Results of survival rate survey of the seedlings planted

Bu Ta Htaung Specie

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
109	A	1.5	58	
110	A	1.7	88	
111	A	1.5	76	
112	A	1.5	70	
113	A	1.3	65	
114	A	1.0	25	
115	A	1.2	35	
116	A	1.3	44	
117	A	1.3	70	
118	A	1.3	50	
119	A	1.3	39	
120	A	1.5	60	
121	A	1.3	58	
122	A	1.3	46	
123	A	1.0	43	
124	A	1.7	52	
125	A	1.3	50	
126	A	1.3	30	
127	A	1.7	90	
128	A	1.3	32	
129	A	1.5	85	
130	A	1.7	90	
131	A	1.3	34	
132	A	1.3	53	
133	A	1.3	38	
134	D	-		
135	A	1.3	48	
136	A	1.3	40	
137	A	1.8	73	
138	A	1.0	40	
139	D	-		
140	A	1.2	33	
141	D	-		
142	A	1.3	58	
143	A	1.7	90	
144	A	1.0	20	

**Table 2 Results of survival rate survey of the seedlings planted**

**Bu Ta Htaung Specie**

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
145	A	1.3	60	
146	A	1.0	26	
147	D	-		
148	A	1.5	60	
149	A	1.7	82	
150	A	1.3	50	
151	A	1.3	30	
152	A	1.3	60	
153	A	1.3	42	bad condition
154	A	1.3	30	
155	A	1.3	41	
156	A	1.3	48	
157	A	1.7	58	
158	A	1.7	84	
159	A	1.3	68	
160	A	1.0	24	bad condition
161	A	1.5	38	
162	D	-		
163	D	-		
164	A	1.2	30	
165	A	1.3	34	
166	A	1.2	20	bad condition
167	A	1.3	30	
168	A	1.3	36	
169	A	1.3	70	
170	A	1.3	30	
171	A	1.3	68	
172	A	1.5	60	
173	A	1.0	30	bad condition
174	A	1.0	30	bad condition
175	A	1.3	50	
176	A	1.2	38	
177	A	1.3	40	
178	A	1.3	60	bad condition

**Table 2 Results of survival rate survey of the seedlings planted**

**Bu Ta Htaung Specie**

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
179	A	1.5	50	
180	A	1.3	44	
181	A	1.3	66	
182	A	1.3	34	
183	A	1.3	46	
184	A	1.3	30	
185	A	1.3	40	
186	A	1.3	80	
187	A	1.0	36	
188	A	1.0	30	bad condition
189	A	1.2	39	
190	A	1.0	30	
191	D	0.7	20	
192	A	1.0	33	
193	A	1.0	32	
194	A	1.3	40	
195	A	1.0	35	bad condition
196	A	1.3	40	
197	A	1.3	41	
198	A	1.5	55	
199	A	1.3	77	bad condition
200	A	1.5	78	
201	A	1.3	26	
202	A	1.0	30	bad condition
203	A	1.0	30	
204	A	1.2	48	
205	A	1.3	40	
206	A	1.0	30	
207	A	1.5	90	
208	A	1.3	75	
209	A	1.3	52	
210	A	1.7	108	
<b>Avrage</b>		<b>1.3</b>	<b>47.8040201</b>	
				Dead = 13
				Alive = 197
				bad condition = 14

Table 2 Results of survival rate survey of the seedlings planted

Bu Ta Htaung Specie

No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
<b>Amara Specie</b>				
No.	Alive (A) or Dead (D)	Root diameter (cm)	Height (cm)	Remarks
1	A	1.3	30	Amara Specie
2	A	1.3	32	Amara Specie
3	A	1.2	32	Amara Specie
4	A	1.7	50	Amara Specie
5	A	1.3	40	Amara Specie
6	A	1.5	54	Amara Specie
7	A	1.3	40	Amara Specie
<b>Avrage</b>		<b>1.3</b>	<b>47.43267357</b>	
				Dead = 0
				Alive = 7
				bad condition = 0

**Table 3 Assignment Schedule of the Experts for the Project for Capacity Building for Sustainable Natural Resource Management (Component-2)**

	Technical Area	Name	2019												2020									M/M		
			2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	Field	Home	Total	
In Field (Myanmar)	Team Leader/Integrated Watershed Management	Yoji Mizuguchi		■	■	■	■	■	■	■	■	■	■	■	■	■							3.60		3.60	
	Co-Team Leader/Livelihood Development/Community Forest	Junko Kikuchi		■	■	■	■	■	■	■	■	■	■	■	■	■	■							2.30		2.30
	Soil Erosion/Planning for Sediment Control(1)	Hiroki Ochiai		■					■	■	■	■	■	■	■	■								0.87		0.87
	Soil Erosion/Planning for Sediment Control(2)	Hideki Imai		■		■	■	■	■	■	■	■	■	■	■	■								2.50		2.50
	Socio-economic Survey on house-hold level, indigenous people, and community's interest, etc.	Toru Inada		■	■	■	■	■	■	■	■	■	■	■	■	■								1.63		1.63
	Land Use and Topographic Survey	Asuka Wachi/ Jonghwan Kim		■	■	■	■	■	■	■	■	■	■	■	■	■								2.00		2.00
	Procurement/Laser Survey	Kei Suzuki		■	■	■	■	■	■	■	■	■	■	■	■	■	■							2.53		2.53
	Instration of Equipment and Soil Survey	Mitsunori Sonoda								■	■	■	■	■	■	■								0.33		0.33
	River Monitoring	Souichiro Fujii							■	■	■	■	■	■	■	■								0.27		0.27
	Project Coordinator/Monitoring of Pilot Activities	Yayoi Yoshioka		■	■	■	■	■	■	■	■	■	■	■	■	■	■							1.37		1.37
<b>Sub-total (In Myanmar)</b>																							<b>17.40</b>		<b>17.40</b>	
In Home (Japan)	Team Leader/Integrated Watershed Management	Yoji Mizuguchi		□																				0.65	0.65	
	Co-Team Leader/Livelihood Development/Community Forest	Junko Kikuchi																						0.00	0.00	
	Soil Erosion/Planning for Sediment Control(1)	Hiroki Ochiai																						0.20	0.20	
	Soil Erosion/Planning for Sediment Control(2)	Hideki Imai																						0.50	0.50	
	Socio-economic Survey on house-hold level, indigenous people, and community's interest, etc.	Toru Inada																						0.00	0.00	
	Land Use and Topographic Survey	Asuka Wachi					□																	1.00	1.00	
	Procurement/Laser Survey	Kei Suzuki																						0.75	0.75	
	Project Coordinator/Monitoring of Pilot Activities	Yayoi Yoshioka																						0.25	0.25	
Planning of Training	Yayoi Yoshioka/Shigeru Takahara																						0.70	0.70		
<b>Sub-total</b>																							<b>4.05</b>	<b>4.05</b>		
<b>Total</b>																							<b>17.40</b>	<b>4.05</b>	<b>21.45</b>	
Legend:			■ In Field (Myanmar)	□ In Home (Japan)	□ In Field (Myanmar)	▲ Submission of Ref Work Plan				▲ Progress Report 1				▲ Progress Report 2						▲ Final Report						

## ***Figures***



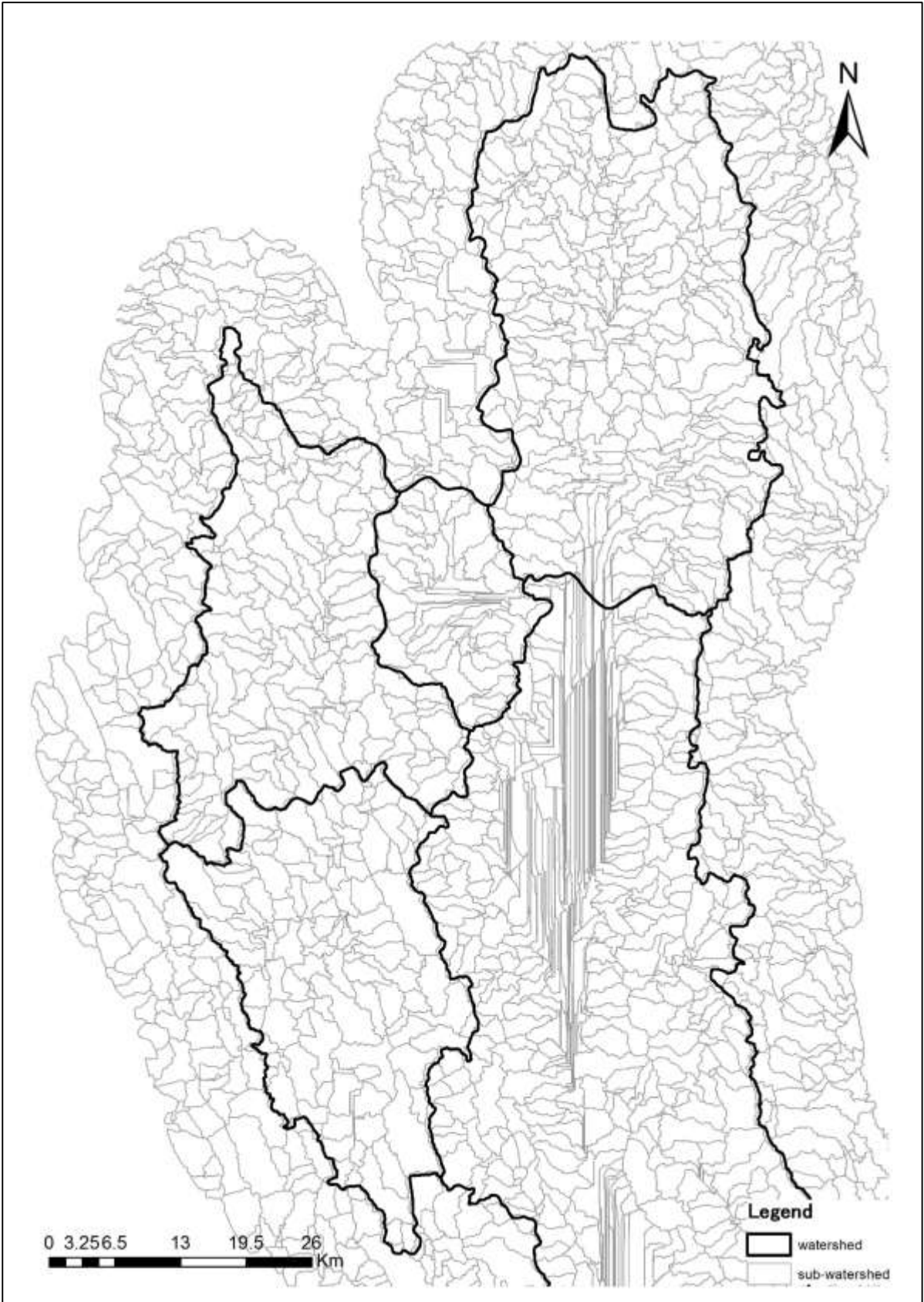


Figure 1 Sub-Watershed and Micro Watershed Map

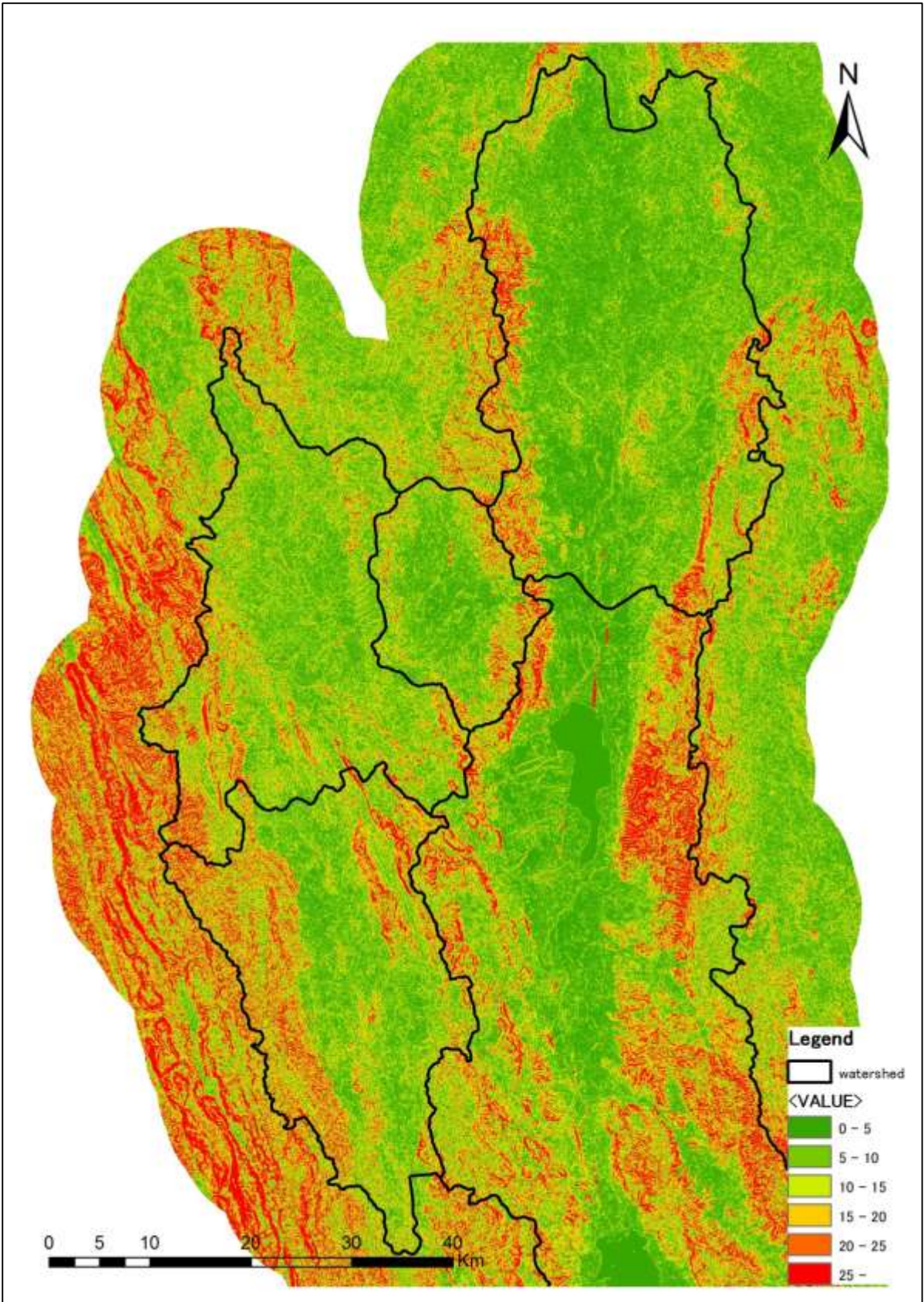


Figure 2 Slope Map



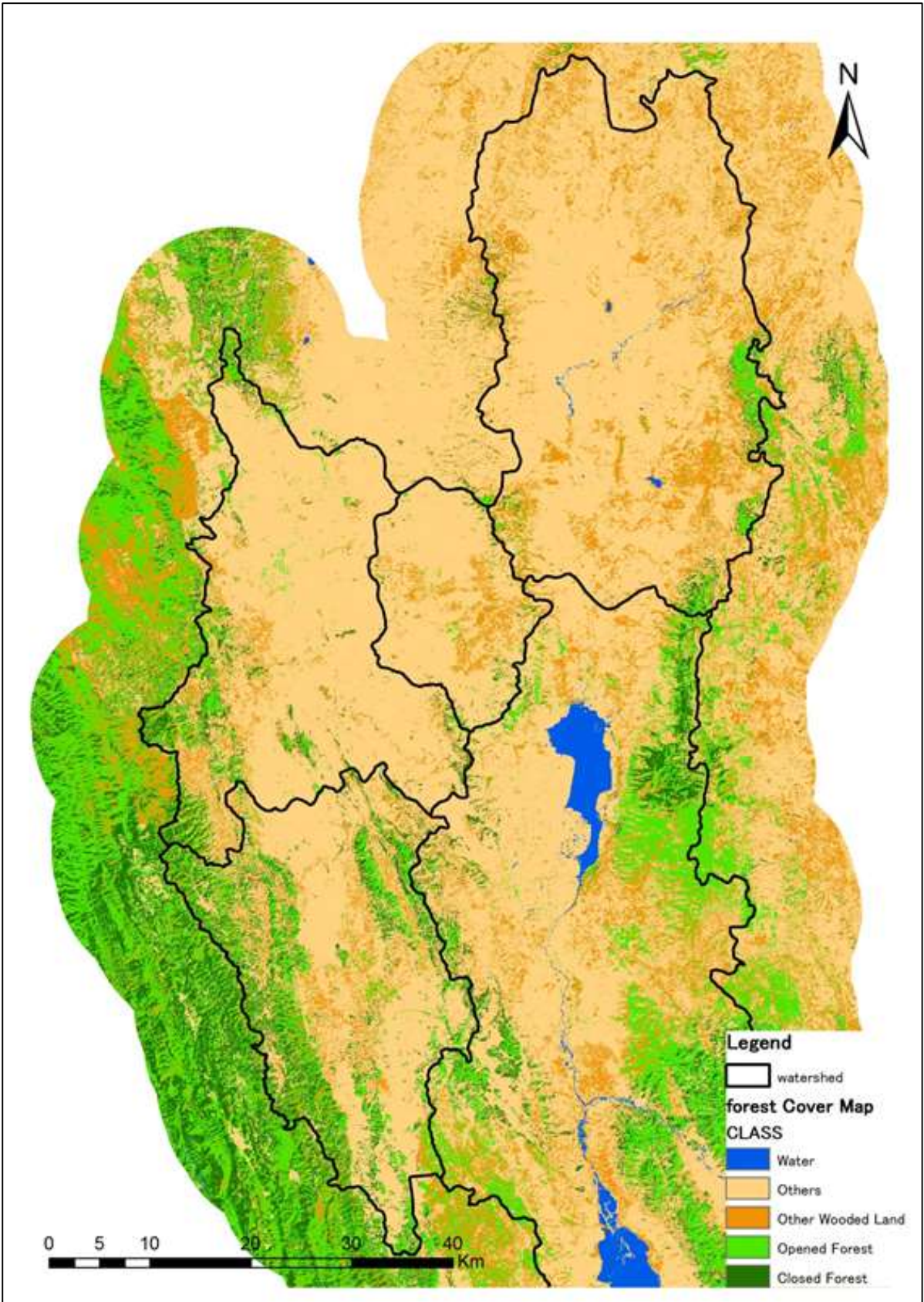


Figure 3 Forest and Land Cover Map