

Inle Lake Post-Disaster Environmental Assessment and Rehabilitation Plan



16th~30th September 2024 (Flood)



28th March 2025 (Earthquake)

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Prepared by: E Guard Environmental Services



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LIST OF ABBREVIATIONS

ASEAN	The Association of Southeast Asian Nations
CBOs	Community-Based Organizations
CSOs	Civil Society Organizations
CSR	Corporate Social Responsibility
CT	Current Transformer
DD	Data Deficient
DDM	Department of Disaster Management
DGSE	Department of Geological Survey and Mineral Exploration
DMH	Department of Meteorology and Hydrology
DRR	Department of Risk Reduction and Resettlement
ECD	Environmental Conservation Department
EN	Endangered
FD	Forest Department
Ft	Feet
GAD	General Administration Department
GIS	Geographic Information System
H	Height
Ha	Hectare
ILPMTF	Inle Lake Pollution Monitoring Task Force
ILRA	Inle Lake Rehabilitation Authority
ILDRP	Inle Lake Disaster Rehabilitation Project
INGOs	International Non-governmental Organizations
IUCN	International Union for Conservation of Nature
IWWS	Inle Wetland Wildlife Sanctuary

Kg	Kilogram
KII	Key Informant Interviews
KPIs	Key Performance Indicator
L	Length
LC	Least Concern
LPG	Liquefied petroleum gas
MES	Myanmar Engineering Society
MEL	Monitoring, Evaluation, and Learning
MOECAF	Ministry of Environmental Conservation and Forestry
Mm	Millimeter
MMK	Myanmar Kyat
NE	Not Evaluated
NGOs	Non-Governmental Organization
NT	Nearly threatened
PPP	Public-Private Partnerships
PVC	Polyvinyl Chloride
SDGs	Sustainable Development Goals
SMS	Short Message Service
TDC	Township Development Committee
UN	United Nations
UNDP	United Nations Development Programme
USD	United State Dollar
VU	Vulnerable
W	Width
WLC	Wildlife Conservation

TABLE OF CONTENTS

DISCLAIMER	I
ACKNOWLEDGEMENTS	II
LIST OF ABBREVIATIONS.....	IV
TABLE OF CONTENTS.....	VI
LIST OF TABLES	XII
LIST OF FIGURES	XIII
အစီရင်ခံစာအကျဉ်းချုပ်	1
EXECUTIVE SUMMARY	3
1 INTRODUCTION.....	4
1.1 Overview.....	4
1.1.1 Issues & Problem Description from the Previous Studies	6
1.1.2 The 2024 Flood Disaster.....	7
1.1.3 The 2025 Earthquake Disaster	8
1.1.4 Cumulative Impact.....	8
1.1.5 Rehabilitation for Sustainable Environment.....	9
1.2 Purpose of this report	9
1.3 Method of Assessment.....	10
1.3.1 Damage and Impact Assessment	10
1.3.2 Socio-Economic Assessment.....	11
1.3.3 Environmental Assessment.....	11
1.4 Limitations and Scope of the Assessment	11
2 BACKGROUND INFORMATION AND CONTEXTS OF INLE LAKE REGION	12
2.1 Community Profiles and Demographics.....	12

2.2	Background Context of Inle Lake.....	16
2.2.1	Geology.....	16
2.2.2	Disaster Profile of Inle Lake.....	18
2.2.2.1	Earthquake.....	19
2.2.2.2	Flood.....	19
2.2.2.3	Landslide.....	19
2.2.2.4	Erosion and Deposition.....	19
2.2.2.5	Strong Winds and Tornadoes.....	20
2.2.2.6	Thunderstorms and Hail.....	20
2.2.2.7	Drought and Water Scarcity.....	20
2.2.2.8	Forest and Urban Fires.....	20
2.2.2.9	Other Hazards.....	20
2.3	Environmental Concerns.....	21
2.3.1	Past Environmental Concerns.....	21
2.3.2	Present Environmental Concerns.....	22
2.3.3	Future Environmental Concerns.....	24
3	GROUND SURVEY AND FIELD OBSERVATION.....	25
3.1	Ground Survey.....	25
3.1.1	Key Informant Interview (KII Survey).....	25
3.1.2	Stakeholder’s Engagements.....	27
3.2	Field Observation.....	28
3.2.1	Household and Residential Structures Damage.....	29
3.2.2	Public Building (Schools, Clinics, Religious Sites).....	34
3.2.2.1	Impacts on Religious and Cultural Heritage.....	35
3.2.2.2	Impacts on Social Infrastructure.....	40

3.2.3	Transportation Infrastructure	41
3.2.4	Utilities.....	42
3.2.4.1	Water Supply (Source)	42
3.2.4.2	Sanitation.....	44
3.2.4.3	Electricity.....	45
3.2.5	Biodiversity and Ecosystem of Inle Lake	46
3.2.5.1	Methodology.....	48
3.2.5.2	The Condition of Biodiversity and Ecosystem in Inle Lake during Current Study	48
3.2.5.3	The Condition of Fisheries in Inle Lake Before and After Natural Disaster...	56
3.3	Disaster Impact	59
3.3.1	Humanitarian Impact	59
3.3.1.1	Displacement and Housing Damage.....	59
3.3.1.2	Health Risks.....	61
3.3.1.3	Gender Impact	62
3.3.2	Economic and Livelihoods Impact	64
3.3.2.1	Agriculture.....	64
3.3.2.2	Fishing and Aquatic Farming	65
3.3.2.3	Tourism.....	66
3.3.2.4	Women’s Livelihoods.....	67
3.3.3	Environmental Impact.....	68
3.3.3.1	Waterways	68
3.3.3.2	Aquatic Weed Shortages	69
3.3.3.3	Water Quality	71
3.3.3.4	Demolition Waste Disposal	73

3.3.4	Impact on Biodiversity and Ecosystem.....	75
3.3.4.1	Before Earthquakes and Flooding	75
3.3.4.2	After Earthquakes and Flooding.....	77
3.3.5	Impact on the Fishery.....	78
3.3.5.1	Before Earthquake and Flooding.....	78
3.3.5.2	After Earthquake and Flooding	81
3.4	Loss Inventory	82
3.4.1	Loss Inventory of Building Damage.....	82
3.4.2	Affected People.....	85
3.4.3	Loss Inventory of Fatality.....	87
4	NEEDS ASSESSMENT.....	89
4.1	Urgent Relief Requirements	89
4.2	Infrastructure and Housing Reconstruction Priorities.....	91
4.3	Restoration of Livelihoods and Economic Activities	95
4.4	Social Protection and Psychosocial Support Needs.....	97
5	REHABILITATION AND RECOVERY PLAN	99
5.1	Rehabilitation for Long-term Restoration and Conservation of the Lake	99
5.2	Formation of a Lead Working Group	99
5.3	Specific Action Plan	100
5.4	Recovery Plan	103
5.4.1	Short-Term (0-6 Months).....	103
5.4.2	Long-Term (6 Months-5 Years).....	105
5.4.3	Donor Engagement Strategies.....	107
6	MONITORING AND EVALUATION (M&E) FRAMEWORK.....	110
6.1	Key Performance Indicator (KPIs)	110

6.1.1	Disaster-Resilient Housing and Infrastructure Reconstruction.....	110
6.1.2	Community-Based Disaster Preparedness Programs.....	110
6.1.3	Environmental Rehabilitation of Lake Ecosystem	111
6.1.4	Livelihood Restoration and Vocational Training	111
6.2	Monitoring & Evaluation Framework for Inle Lake Disaster Rehabilitation Plan.....	112
6.3	Stakeholder Roles in Monitoring and Feedback.....	114
6.4	Adaptive Management Strategies	115
7	STAKEHOLDER ENGAGEMENT AND COORDINATION	117
7.1	Role of Local Authorities, Civil Society, NGOs, INGOs.....	117
7.1.1	Local Authorities	117
7.1.2	Civil Society Organizations	117
7.1.3	Community-Based Organizations (CBOs)	118
7.1.4	Non-Governmental Organizations (NGOs)	118
7.1.5	International NGOs (INGOs).....	118
7.2	Coordination with National Disaster Management Agencies.....	119
7.3	Community Participation Mechanisms.....	121
8	CONCLUSION AND RECOMMENDATIONS	123
	ANNEXES	124
	Annex A: Administrative Information of Nyaung Shwe Township	124
	Annex B: Photo Documentation	139
	Annex C: List of Consulted Stakeholders	141
	Annex G: Illustration of Multipurpose Floating Shelters for The Inle Lake	142
	Annex H: Illustration of Floating R.O Water Station for Inle Lake	157
	Annex F: Illustration of Floating Toilet System for The Inle Lake	160
	Annex E: Septic Tank and Sewage Treatment System.....	163

Annex D: Illustration of Working Platform for Construction/Demolition work on the Lake Water	168
Annex I: Survey Tools/ Questionnaires	173
Annex J: Brief Integrated Conservation Strategy for Flood and Earthquake Protection of Ancient Structures	196
REFERENCES	198

LIST OF TABLES

Table 2-1 Hazard Risk Table	21
Table 3-1 Summary of KII.....	26
Table 3-2 Damages and Losses due to the Earthquake in Nyaung Shwe Township.....	33
Table 3-3 Religious Sector.....	37
Table 3-4 Offices/ Department	40
Table 3-5 Basic Education Schools	40
Table 3-6 Health Care Centers.....	41
Table 3-7 Urban Development Sector	42
Table 3-8 Electricity Sector	46
Table 3-9 Recorded Species from the Study Area.....	49
Table 3-10 List of Persons Temporarily Sheltered at Relief Camps	60
Table 3-11 On-Site Water Quality Test Results from ECD (Shan State) Before Earthquake.....	72
Table 3-12 On-Site Water Quality Test Results from ECD (Shan State) After Earthquake	72
Table 3-13 Types of Buildings Damaged due to the Earthquake in Nyaung Shwe Township	83
Table 3-14 Affected People due to the Earthquake in Nyaung Shwe Township.....	85
Table 3-15 Fatalities and Injuries Due to the Earthquake in Nyaung Shwe Township.....	87
Table 5-1 Governance, Planning, and Coordination.....	100
Table 5-2 Disaster Recovery and Resilience	101
Table 5-3 Disaster Risk Reduction and Community Engagement	102
Table 5-4 Environmental Rehabilitation and Monitoring.....	103
Table 6-1 Disaster-Resilient Housing and Infrastructure Reconstruction	113
Table 6-2 Community-based Disaster Preparedness Programs	113
Table 6-3 Environmental Rehabilitation of Lake Ecosystem.....	113
Table 6-4 Livelihood Restoration and Vocational Training	114

LIST OF FIGURES

Figure 2-1: Catchment Area (Drainage Basin) of Inle Lake.....	16
Figure 2-2 Geology Map of Inle Lake and its Watershed	18
Figure 3-1 KII Informant Interview	26
Figure 3-2 Stakeholder’s Engagements	28
Figure 3-3 Field Observation at Earthquake Affected Villages in Inle Lake Region.....	29
Figure 3-4 Household and Residential Structures Damage	34
Figure 3-5 Nga Phel Chaung Monastery	35
Figure 3-6 Inle Phaung Taw Oo Pagoda.....	36
Figure 3-7 Ahlotaw Pauk Pagoda	36
Figure 3-8 Damaged Religious Structures	37
Figure 3-9 Buildings in the Inn Dein Pagoda Area that Collapsed due to Flooding	38
Figure 3-10 Temples Damage by Floods in the Inn Dein Area.....	39
Figure 3-11 Stupas and Temples Damaged by Floods in the Inn Dein Area	39
Figure 3-12 Damaged School	40
Figure 3-13 Damages to Transportation Infrastructures	42
Figure 3-14 Current Domestic Water Usage	43
Figure 3-15 Current Sanitation Systems.....	45
Figure 3-16 Damage to Electricity Supply Systems	46
Figure 3-17 Recorded Species during Current Study	56
Figure 3-18 Interviewing a Local Fishermen.....	57
Figure 3-19 Investigation on Fisheries	58
Figure 3-20 Fishing Practice	58
Figure 3-21 Temporary Shelters	61
Figure 3-22 Temporary Relief Camp.....	62
Figure 3-23 Current Socio-economic Conditions after Natural Disasters	67
Figure 3-24 Current Conditions of Waterway at Inn Dein Creek.....	69
Figure 3-25 Current Condition of Water Quality in Inle Lake near Residential	73
Figure 3-26 Demolition Waste.....	75
Figure 3-27 Land Cover Changes Due to Deforestation	76
Figure 3-28 Eutrophication and the Mass of Death Snail Shell.....	76

Figure 3-29 Erosion and Eutrophication.....	78
Figure 3-30 Invasive Species	80
Figure 3-31 Fishing Gear	80
Figure 3-32 Loss Inventory Map (Buildings) of Inle Lake (Post-Earthquake Assessment)	84
Figure 3-33 Loss Inventory Map (Affected People) of Inle Lake (Post-Earthquake Assessment)	86
Figure 3-34 Loss Inventory Map (Fatality) of Inle Lake (Post-Earthquake Assessment).....	88
Figure 4-1 Tiled Traditional Style Stilt Timber Houses under Restoration Work	89
Figure 4-2 Donor’s Funded Stilt House Newly Built in Place of Collapsed One on Lake Water	91
Figure 4-3 Latrine Waste in contact with Lake Water and Floated Raw Sewage Deposit from Direct Disposal.....	92
Figure 4-4 Floating Garden and Local Transport	95

အစီရင်ခံစာအကျဉ်းချုပ်

အင်းလေးကန်ဒေသသည် မြန်မာနိုင်ငံတွင် အလွန်အရေးပါသော ဂေဟစနစ်နှင့် ယဉ်ကျေးမှုအမွေအနှစ်တစ်ခု ဖြစ်ပြီး ယခုအခါတွင် သဘာဝဘေးအန္တရာယ်ကြီးနှစ်ခုကို ဆက်တိုက် ရင်ဆိုင် ထားရသော ဒေသဖြစ်ပါသည်။ ၂၀၂၄ ခုနှစ်၊ စက်တင်ဘာလတွင် တိုက်ခတ်ခဲ့သည့် အရှိန်အဟုန် ပြင်းထန်သော ရာဂီမုန်တိုင်းကြောင့် အင်းလေးကန်ဒေသ အတွင်း ရေကြီးရေလျှံမှုများ ဖြစ်ပေါ်ခဲ့ပြီး မြေယာများ ရေလွှမ်းခြင်း၊ အိုးအိမ်များ ရေနှစ်မြုပ်၍ ဆုံးရှုံးပျက်စီးခြင်း ၊ စိုက်ပျိုးမြေများ၊ ကျွန်းမြောစိုက်ခင်းများနှင့် အခြေခံအဆောက်အအုံများ ပျက်စီးခြင်းတို့ ဖြစ်ပွားခဲ့ပါသည်။ ရေကြီးမှုဖြစ်ပွားပြီး ခြောက်လခန့်အကြာ ၂၀၂၅ခုနှစ်၊ မတ်လ ၂၈ ရက်နေ့တွင် မန္တလေးတိုင်း ဒေသကြီး၌ ပြင်းအား ၇.၇ ရှိသော ငလျင်တစ်ခုလှုပ်ခတ်ခဲ့သဖြင့် ငလျင်ကြောတစ်လျှောက် အဆောက်အအုံများစွာ ပျက်စီးမှုများ ဖြစ်ပွားခဲ့သည့်အပြင် အဆိုပါငလျင်သည် အင်းလေးကန်နှင့် အနီးတဝိုက်ရှိ ဒေသများကိုလည်း ထပ်မံ၍ ထိခိုက်စေခဲ့ ပါသည်။

ထိုဘေးအန္တရာယ်များ ဖြစ်ပွားပြီးနောက် ထိခိုက်ပျက်စီးမှုများနှင့် ပြန်လည်တည်ဆောက်ရေး လိုအပ်ချက်များ၊ အင်းလေးကန်၏ ဂေဟစနစ် ပြန်လည်ထူထောင်ရေးနှင့် ရေရှည်ထိန်းသိမ်းသွားနိုင်ရေး လိုအပ်ချက်များကို ဦးတည်၍ ဤအစီရင်ခံစာအား ပြုစုရေးသားခဲ့ခြင်း ဖြစ်ပါသည်။ အစီရင်ခံစာတွင် အင်းလေးကန်၏ သဘာဝပတ်ဝန်းကျင် ယိုယွင်းလာမှုများ၊ အခြေခံအဆောက်အအုံ ပျက်စီးမှုများ၊ ရွှေ့ပြောင်းနေထိုင်မှုများ၊ လူထုကျန်းမာရေးအန္တရာယ်များ၊ ရေနှင့်မိလ္လာစနစ်များနှင့် ဆက်စပ်၍ တွေ့ရှိချက် များကို ဖော်ပြထားပါသည်။

တွေ့ရှိသုံးသပ်ချက်များအရ “ဒေသခံ အင်းသူအင်းသားများ ကိုယ်တိုင်ပါဝင်လျက် ပူးပေါင်း ညှိနှိုင်း ဆောင်ရွက်၍” လုံလောက်သော နည်းပညာ၊ လူ့စွမ်းအားအရင်းအမြစ်၊ ပစ္စည်းအင်အား၊ ရင်းနှီးမြှုပ်နှံမှုများ၊ ငွေကြေး ရံပုံငွေနှင့် အတတ်ပညာထောက်ပံ့မှုများ စသည်တို့ဖြင့် အချိန်မီ ဆောင်ရွက်နိုင်ခြင်း မရှိပါက အင်းလေးကန်သည် ရေရှည်တွင် ဂေဟစနစ်ပျက်စီးယိုယွင်းခြင်း၊ စီးပွားရေးကျဆင်းခြင်းနှင့် အင်းလေးဒေသခံများ၏ လူနေမှုအဆင့်အတန်းများ နိမ့်ကျလာနိုင်သည့် အန္တရာယ်ရှိပါသည်။

ဤအစီရင်ခံစာသည် အင်းလေးဒေသတွင် ဖြစ်ပွားခဲ့သော သဘာဝဘေးအန္တရာယ်၏ သက်ရောက်မှုများကို မှတ်တမ်းတင်ရုံသာမက အကြံပြုချက်များကို လက်တွေ့မြေပြင်တွင် အကောင်အထည်ဖော်ဆောင်ရွက်ရန်အတွက် “တိုက်တွန်းနှိုးဆော်ခြင်း”လည်း ဖြစ်ပါသည်။ ထို့ကြောင့် အစီရင်ခံစာမှ လက်တွေ့ကျသော တည်ဆောက် ပြုပြင်ရေးနှင့် ပြန်လည်ထူထောင်ရေး အစီအစဉ်များချမှတ်၍ လမ်းညွှန်မှုများ ချမှတ်ပေးနိုင်ရန် ရည်ရွယ်၍ ရေးသားထားပါသည်။ အင်းလေးကန်ဒေသ၏ လက်ငင်းလိုအပ်ချက်များနှင့် ရေရှည်တည်တံ့နိုင်ရေးအတွက် သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးရာ ကိစ္စရပ်များကို ထိန်းသိမ်းကာကွယ်စောင့်ရှောက်ကာ ဖွံ့ဖြိုးတိုးတက်စေမည့်

“လုပ်ငန်းစဉ်မူဘောင် တစ်ရပ်ကို ချမှတ်ပြဋ္ဌာန်း ဆောင်ရွက်နိုင်ရေး” အတွက် အထောက်အကူ ဖြစ်စေရန် အတွက် လည်း ရည်ရွယ်ပါသည်။

အစီရင်ခံစာတွင်ပါရှိသော အချက်အလက်များနှင့် အကြံပြုချက်များသည် အင်းလေးကန်၏ ဂေဟစနစ်ကို ကာကွယ်နိုင်ပြီး ဒေသခံများ၏ လူမှုစီးပွားရေးကို မြှင့်တင်ပေးနိုင်ကာ ရေရှည်တည်တံ့သော အသက်မွေး ဝမ်းကျောင်းမှုများကို လုပ်ဆောင်နိုင်သည့် ထိရောက်မှုရှိသော “ငွေကြေးထောက်ပံ့မှု ရရှိရေးအစီအစဉ်”များ ရေးဆွဲ ရာတွင် အထောက်အပံ့ဖြစ်စေရန် အတွက်လည်း ရည်ရွယ်ကာတင်ပြပေးထားပါသည်။ သို့ဖြစ်ပါ၍ ဖော်ပြထားသော ပြန်လည်ထူထောင်ရေး လမ်းပြမြေပုံကို အကောင်အထည် ဖော်ရာတွင် ပြည်တွင်း၊ ဒေသတွင်းနှင့် နိုင်ငံတကာ မိတ်ဖက်များ၊ ရင်းနှီးမြှုပ်နှံသူများ၊ အလှူရှင်များအား ပူးပေါင်းပါဝင် ဆောင်ရွက်ရန် ဖိတ်ခေါ် အပ်ပါသည်။

ဤအစီရင်ခံစာတွင် ရေးဆွဲဖော်ပြထားသော အကြံပြုချက်များအား လက်တွေ့အကောင် အထည်ဖော်ဆောင်ရွက် နိုင်ရန် ရင်းနှီးမြှုပ်နှံမှုပြုလုပ်ခြင်းသည် နိုင်ငံတကာ မိတ်ဖက်များ၊ ရင်းနှီးမြှုပ်နှံသူများနှင့် အလှူရှင်များ အနေဖြင့် အင်းလေးဒေသရှိ ဒေသခံများအတွက် ရာသီဥတုပြောင်းလဲမှုဆိုင်ရာ ဒဏ်ခံနိုင်မှု၊ အင်းလေးကန် ဂေဟစနစ် ပြန်လည်ထူထောင်ရေးနှင့် ရေရှည်ထိန်းသိမ်းရေး၊ အင်းသူအင်းသားများ၏ လူမှုစီးပွားရေးဘဝ ဖွံ့ဖြိုးတိုးတက်ရေး၊ သဘာဝဘေးအန္တရာယ် လျော့ချရေးဆိုင်ရာ လုပ်ငန်းများကို အားပေးကူညီရေးနှင့် အရှေ့တောင်အာရှ၏ အထင်ကရ ဖြစ်သော သဘာဝနှင့် ယဉ်ကျေးမှုဆိုင်ရာများထဲမှ အဖိုးတန်အမွေအနှစ် တစ်ခုကို ကာကွယ်စောင့်ရှောက်နိုင်မည့် အခွင့်အရေးများ ရရှိမည်ဖြစ်ပါသည်။

EXECUTIVE SUMMARY

The Inle Lake region, a vital ecological and cultural landmark in Myanmar, has been significantly affected by two major natural disasters in rapid succession. In September 2024, severe flooding caused by intensified *Typhoon Yagi* inundated large swathes of land surrounding the lake, damaging homes, farmlands, and critical infrastructure. Just six months later, on March 28, 2025, a 7.7 magnitude earthquake struck the Mandalay Region, causing widespread structural impacts and compounding the vulnerabilities of already strained communities in and around Inle Lake.

This report, "*Inle Lake Post-Disaster Environmental Assessment and Rehabilitation Plan*" offers a comprehensive evaluation of the damages sustained, the vulnerabilities exposed, and the opportunities for targeted recovery and sustainable development. It presents detailed findings on environmental degradation, infrastructure damage, displacement, public health risks, and disruptions to water and sanitation systems.

The assessment concludes that without swift, coordinated, and adequately resourced interventions, Inle Lake risks long-term ecological decline, economic regression, and a deterioration of living conditions for tens of thousands of residents. However, with the right support, this critical juncture also presents an opportunity to rebuild stronger, greener, and more resilient systems.

This report is not only a documentation of disaster impacts, it is a call to action. It has been developed to guide the formulation of a cohesive and realistic recovery and restoration plan. It seeks to provide an evidence-based framework for action that addresses both the immediate needs and long-term resilience of the Inle Lake region, ensuring that future development is both environmentally sustainable and socially inclusive.

The evidence and recommendations herein are intended to support the design of effective, high-impact donor programs that can protect Inle Lake's unique ecosystem, enhance community resilience, and ensure sustainable livelihoods. We invite local, regional, and international partners to collaborate in implementing the recovery roadmap outlined in this report.

By investing in these integrated solutions, investors donors and international partners have a critical opportunity to support the people of Inle's commitments to climate resilience, sustainable development, and disaster risk reduction while safeguarding one of Southeast Asia's most iconic natural and cultural treasures.

1 INTRODUCTION

1.1 Overview

There have always been earth processes that are hazardous to people. These natural hazards must be recognized and avoided where possible, and their threat to human life and properties must be minimized (Keller, 1979). Natural disasters are common phenomena occurring throughout the planet since the Earth's formation. Based on data from the EM-DAT database, an average of approximately 65,566 disaster-related fatalities occurred annually from 2004 to 2023. According to the disaster risk indices published by Bündnis Entwicklung Hilft, Myanmar ranks as the 6th highest-risk country in the 2024 World Risk Index.

Inle Lake, a highland lake situated in Southern Shan State, is renowned for its unique culture and scenic beauty. In addition to its significance in tourism, it is recognized as a Ramsar Site due to its support for freshwater native species, migratory birds, and waterfowl. It is located in Shan State, eastern Myanmar, at an elevation of approximately 880 meters above sea level. It is the country's second-largest freshwater lake, covering around 116 square kilometers.

Beyond its ecological significance, the lake plays a vital role in Myanmar's water and energy systems. It supplies water to the Moebye Dam and the Lawpita Hydroelectric Power Station. The lake is relatively shallow, with an average depth of 2–3 meters during the dry season and slightly deeper during the rainy season due to increased inflow from twenty-nine creeks, with nine serving as its primary water sources. Water depth varies seasonally, averaging 2 m and reaching up to 5m during the rainy season. Its main outflow is through the Belu creek, which eventually connects to the Thanlwin River system.

The livelihoods of the Inle Lake region's inhabitants are closely intertwined with the lake's ecosystem. Floating agriculture is a defining practice, with villagers cultivating tomatoes, gourds, and cucumbers on floating gardens anchored to the lakebed using bamboo poles. Fishing is another key livelihood, with the Intha people famous for their leg-rowing technique and use of conical nets to catch species such as the Inle carp and other freshwater varieties. Additionally, the region is well-known for its traditional handicrafts, including lotus silk weaving, cigar-making, blacksmithing, and silverwork activities that also serve as important attractions for the area's vibrant tourism industry. Cultural and ecotourism plays a growing role in the local economy, with visitors drawn to the natural beauty, stilted villages, and traditional lifestyles.

The Inle Lake region's utility infrastructure including water, electricity, and sanitation varies considerably among villages, depending on their accessibility, and levels of development. In some villages, people use artesian well water, rainwater storage tanks, earthen small reservoirs, and water from Inle Lake for their daily household needs such as cooking, washing, and cleaning. However, due to the limited access to safe and treated water sources, drinking water is typically obtained from water purification systems installed at local monasteries, which serve as vital community hubs for clean water access. Lake water, widely used for daily needs, is frequently contaminated due to agricultural runoff, household waste, and poor sanitation infrastructure. Electricity access is moderate, with many villages connected to the grid, while others depend on off-grid solar systems and small generators. Sanitation systems are generally basic; most households use pit latrines or septic tanks, and many floating or stilted villages discharge waste directly into the lake, contributing to environmental degradation. Solid waste disposal is with practices like open dumping and burning still prevalent.

The lake and its surrounding watershed are now at the center of an escalating environmental and humanitarian crisis. For decades, the lake has been subjected to unchecked floating garden expansion, widespread deforestation, sedimentation, eutrophication, and lack of sanitation infrastructure. These chronic pressures culminated in a devastating flood by the effect of *Typhoon Yagi* in September 2024, brought on by unprecedented torrential rainfall. During the flood, water levels rose steadily approximately one foot per day eventually reaching depths of up to 20 feet over a period of two months. The situation worsened further with a powerful 7.7 magnitude Mandalay Region earthquake on March 28, 2025, which caused at least 50 deaths and destroyed over 2,000 buildings. Other notable hazards include strong winds and thunderstorms. Less frequent and lower-magnitude events include erosion, sedimentation, forest and urban fires, drought, hail, tornadoes, landslides, and subsidence. Extreme temperatures are not a significant concern, as the lake's waters moderate heat and cold. Although tsunamis are typically not associated with inland lakes, the possibility of a tsunami caused by landslide masses entering the lake exists. However, community surveys indicate no historical experiences of *Tsunamis* in Inle Lake.

These back-to-back natural disasters caused widespread devastation, including the collapse and destruction of homes, the loss of essential community infrastructure, and the severe damage to floating gardens, which serve as the backbone of local food production and livelihoods. Additionally, water sources became heavily contaminated with debris, household waste, and

sediment, further exacerbating public health risks. As a result of enduring two consecutive years of natural disasters, many communities around Inle Lake are now facing a deepening economic and humanitarian crisis. The combined impacts have led to widespread displacement, the disruption of agricultural and fishing activities, and heightened food and water insecurity.

This report provides a comprehensive analysis of the causes and effects of these compounded disasters, emphasizing the urgent need for integrated and sustainable environmental management.

1.1.1 Issues & Problem Description from the Previous Studies

Despite the wealth of studies and assessments conducted over the years to identify the key challenges facing Inle Lake, there has been little substantive follow-up in terms of practical interventions or sustained support. These studies have consistently highlighted a wide range of interconnected environmental, social, and institutional problems that have contributed to the ongoing degradation of the lake ecosystem. One of the most pressing issues is the significant reduction in the lake's water storage capacity, primarily due to excessive sedimentation and siltation in its main inflowing perennial streams. This sediment build-up has been further accelerated by widespread deforestation and changes in land use patterns across the lake's watershed, which have destabilized the soil and increased runoff into the lake.

The unchecked expansion of floating gardens, along with the lack of systematic removal of defunct or abandoned gardens, has also led to further encroachment into open water areas, altering the lake's natural hydrology and reducing its ecological resilience. Compounding these physical pressures is the excessive and unregulated use of chemical pesticides and fertilizers in surrounding agricultural practices, which has contributed to nutrient loading and water pollution. This, in turn, has fueled the explosive growth of invasive species such as water hyacinth, which now chokes large sections of the lake, disrupting navigation, water flow, and aquatic life.

Unsuitable farming techniques including the cultivation of paddy on the lake's banks, particularly on the northern and southern fringes have led to further encroachment and destabilization of the shoreline. Meanwhile, the indiscriminate disposal of untreated solid waste and wastewater by nearby villages, businesses, and tourist facilities has severely degraded water quality, contributing to the spread of waterborne diseases and harming aquatic biodiversity. The rapid growth of tourism, while economically beneficial, has brought its own set of environmental challenges,

particularly through the heavy use of motorboats, which results in oil and fuel leakage into the lake.

Institutionally, the absence of a cohesive regulatory framework and weak enforcement of existing policies has allowed these issues to persist unchecked. There is a clear lack of coordination among relevant government departments and agencies, leading to fragmented and inefficient responses. Furthermore, public awareness about the importance of protecting Inle Lake remains low, resulting in limited community engagement in conservation efforts. Altogether, these factors underscore the urgent need for an integrated, well-coordinated restoration and recovery plan that not only addresses these root causes but also ensures sustained institutional and community participation.

1.1.2 The 2024 Flood Disaster

For years, Inle Lake has been under siege from a combination of human activities and climatic changes. The unregulated spread of floating gardens has transformed large portions of the lake's open water into semi-permanent agricultural plots, leading to accelerated sedimentation and wetland formation. Simultaneously, deforestation in the surrounding watershed has destabilized upland soils, increased erosion and contributing to sediment loads that raise the lakebed. Lack of sanitation infrastructure, coupled with nutrient-laden agricultural runoff, has caused widespread eutrophication and water quality decline.

These factors significantly diminished the lake's resilience to extreme weather events. When heavy rains struck in September 2024, the lake already shallower and more constrained was unable to accommodate the deluge. The result was catastrophic flooding that not only displaced hundreds of households but also caused soil erosion, sedimentation in the lake, contamination of water sources, and damage to traditional floating gardens. The disaster served as a clear signal that the environmental carrying capacity of Inle Lake had been severely compromised.

The community revealed that they have never seen such a flood in their lifetime. The event of flood took about two months in lake area because of the combination effect of heavy rain in the whole region of both upland and downstream, plus narrow outlet clog the water to the Lower Belu creek. The buildings, road, bridge and farms are submerged under water about two months and the recovery process necessary to wait for so long.

1.1.3 The 2025 Earthquake Disaster

Barely six months after the flood, on March 28, 2025, a powerful 7.7 magnitude earthquake struck the Inle Lake region. Although the epicenter was some distance from Inle Lake, the seismic event had both immediate and long-term consequences, significantly compounding the environmental, structural, and social challenges already present in the area.

The earthquake caused widespread physical destruction, including structural collapse of homes, bridges, schools, and monasteries, many of which were weakened by the 2024 flood. Based on interviews with local residents, the floating gardens in the affected villages were not significantly damaged by the earthquake. Water and sanitation systems ruptured, spilling sewage and waste directly into the lake.

Long-term impacts include accelerated sedimentation, infrastructure collapse, ecological disruption, and deepened community vulnerability. Changes to the lakebed, increased water turbidity, and the collapse of waste management systems have all compounded the crisis, placing immense stress on already fragile social and ecological systems.

1.1.4 Cumulative Impact

The flood and earthquake disasters happened in September 2024 and March 2025 respectively have exposed the extreme vulnerability of the Inle Lake region. While regular earth processes such as heavy rainfall and tectonic activity cannot be prevented, their disastrous outcomes were made far worse by decades of environmental mismanagement. These dual disasters have not only inflicted immediate physical and economic damage, but also posed long-term threats to the sustainability of Inle Lake's environment and the resilience of its communities. In other words, especially for Inle Lake, the natural disasters are occurring though out the whole history, but the current human activities that impact environment negatively increases loss and damage of their society.

Furthermore, the social systems around the lake are showing signs of collapse. Farmers are losing viable land. Fisherfolk are catching fewer fish in increasingly polluted waters. Children are being pulled from schools due to displacement. Cultural tourism, once a major economic pillar, is in rapid decline. The urgent need for a comprehensive assessment and an integrated rehabilitation strategy has become evident.

1.1.5 Rehabilitation for Sustainable Environment

The convergence of these disasters underscores the need for a coordinated, science-based, and community-driven approach to assess damage and guide recovery. Understanding the cumulative impacts of flood and seismic events is critical for ensuring that rehabilitation efforts contribute to both environmental sustainability and community resilience.

In light of these urgent challenges, this report has been developed to provide a clear, evidence-based foundation for coordinated recovery and sustainable development efforts. It aims to inform and guide both local stakeholders and the international donor community in identifying high-priority interventions that will strengthen disaster resilience, restore critical infrastructure, and protect the environmental integrity of Inle Lake. By delivering reliable impact data and actionable recommendations, this assessment seeks to attract meaningful support and catalyze partnerships that can help build a safer, more sustainable future for the region.

1.2 Purpose of this report

This report aims to conduct a post-disaster impact assessment focused on the September 2024 flood and the March 2025 earthquake, specifically examining their combined effects on the Inle Lake ecosystem, infrastructure, and socio-economic conditions of local populations. The key objectives are:

- To identify and document the extent and nature of environmental, structural, and socio-economic damages in the Inle Lake area;
- To evaluate the short-term and long-term impacts of these disasters on the lake's ecological integrity and the livelihoods dependent on it;
- To propose actionable rehabilitation and restoration measures that promote sustainable environmental management and disaster resilience;
- To inform local and international donors, investors, policy makers, stakeholders, and development partners for coordinated response and recovery efforts aimed.

By integrating scientific assessment with community-based insights, this report intends to serve as a roadmap for sustainable recovery and long-term resilience in the Inle Lake region.

1.3 Method of Assessment

This report employs a multi-disciplinary, mixed-methods approach combining field-based assessments, stakeholder consultations, social media news and secondary data review. The methodology includes the following components:

1.3.1 Damage and Impact Assessment

Rapid Field Surveys: On-site assessments were conducted in selected affected communities around Inle Lake to document physical damages to homes, infrastructure, farmland, and natural habitats. Collect geospatial data using mobile apps for mapping impacted zones. Interview local residents and authorities to gather firsthand accounts of impacts and immediate needs. Document environmental changes with photos and measurements.

Stakeholder Consultation: Organize meetings with local government officers, NGOs, community leaders, and emergency responders to discuss impacts and response gaps. Engage technical experts (e.g., engineers, hydrologist, geoscientist, ecologist) to evaluate structural, hydrological, geological and ecological risks post-event.

Social Media News and Web Based News Agency: Monitor social media platforms like Facebook for real-time posts, images, and videos from affected areas to gauge impact severity and public sentiment. Analyze news articles from reputable web-based agencies for reports on casualties, damages, and response efforts. Cross-reference social media and news data to verify information and identify recurring themes or unaddressed issues.

Secondary Data from Research Paper and Reports: Review academic papers and government reports on past floods/earthquakes in the region to identify patterns and vulnerabilities. Data on rainfall, water levels, soil erosion, and seismic activity were analyzed to understand disaster dynamics and their environmental consequences. Collect data from disaster management department on historical impacts and response strategies. Analyze geological, hydrological, social and ecological studies to understand underlying causes and risk factors. Synthesize findings to benchmark current impacts against historical data and inform mitigation recommendations.

1.3.2 Socio-Economic Assessment

Household and Community Surveys: Key Informant Interviews and focus group discussions were carried out to gather qualitative and quantitative data on disaster impacts, coping mechanisms, and livelihood disruptions.

Institutional Consultations: Meetings were held with local authorities, civil society organizations, and environmental agencies to evaluate response efforts, identify gaps, and explore collaborative solutions.

1.3.3 Environmental Assessment

Biodiversity Monitoring: The status of key aquatic and terrestrial species was assessed to determine ecological stress, habitat loss, and species displacement.

1.4 Limitations and Scope of the Assessment

Assessing the impacts of floods and earthquakes on the buildings and estimating the associated damage costs presents several challenges. Variability in damage due to factors like soil conditions, construction quality, or proximity to fault lines and flood zones further complicates uniform evaluations. Post-disaster conditions, such as debris or restricted access, often hinder thorough inspections.

Similarly, cost estimation of damages faces significant limitations. Incomplete damage inventories often fail to account for indirect losses, such as business interruptions or undocumented properties in informal sectors. Fluctuating costs for labor and materials post-disaster, coupled with subjective valuations of intangible losses like cultural heritage or environmental degradation, introduce inconsistencies.

2 BACKGROUND INFORMATION AND CONTEXTS OF INLE LAKE REGION

2.1 Community Profiles and Demographics

The community profiles and demographics of Nyaung Shwe township around Inle Lake provide crucial insights for post-disaster impact assessment and rehabilitation following flood and earthquake events. The region is home to a diverse population, including ethnic Intha, Shan, and Pa-O communities, who primarily depend on agriculture, traditional floating gardens, fishing, and tourism for their livelihoods. Settlements are typically clustered around the lake’s periphery and along waterways, making them particularly vulnerable to environmental hazards. The population density varies, with higher concentrations in areas such as Nyaung Shwe and the surrounding villages. Demographic characteristics reveal a mix of age groups, with a significant proportion engaged in subsistence activities. Limited infrastructure, inadequate access to healthcare, and low-income levels further increases the community’s vulnerability to disasters. A thorough understanding of these profiles is essential for designing inclusive, sustainable, and culturally appropriate rehabilitation strategies that strengthen resilience and promote long-term environmental stewardship of the Inle Lake region.

(A) Demographic

Total population	189,407*		
Males	94,537		
Females	94,870		
Sex ratio	100 males per 100 females		
Percentage of urban population	8.6%		
Area (km ²)	1,454.0*		
Population density (persons per km ²)	130.3 persons		
Number of wards	8		
Number of village tracts	35		
	Total	Urban	Rural
Population in conventional households	178,457	14,072	164,385
Number of conventional households	42,634	3,059	39,575
Mean household size	4.2 persons ***		

- In Nyaung Shwe Township, there are same ratio for females and males with 100 males per 100 females.
- The majority of the people in the Township live in rural areas with only (8.6%) living in urban areas.
- The population density of Nyaung Shwe Township is 130 persons per square kilometre.
- There are 4.2 persons living in each household in Nyaung Shwe Township. This is lower than the Union average

Sources: Nyaung Shwe Township, 2014 Department of Population

Note:

* Include both household population and institution population.

** Settlement and Land Record Department, Ministry of Agriculture, Livestock and Irrigation, (2014-2015)

*** Calculated based on conventional household population

(B) Age

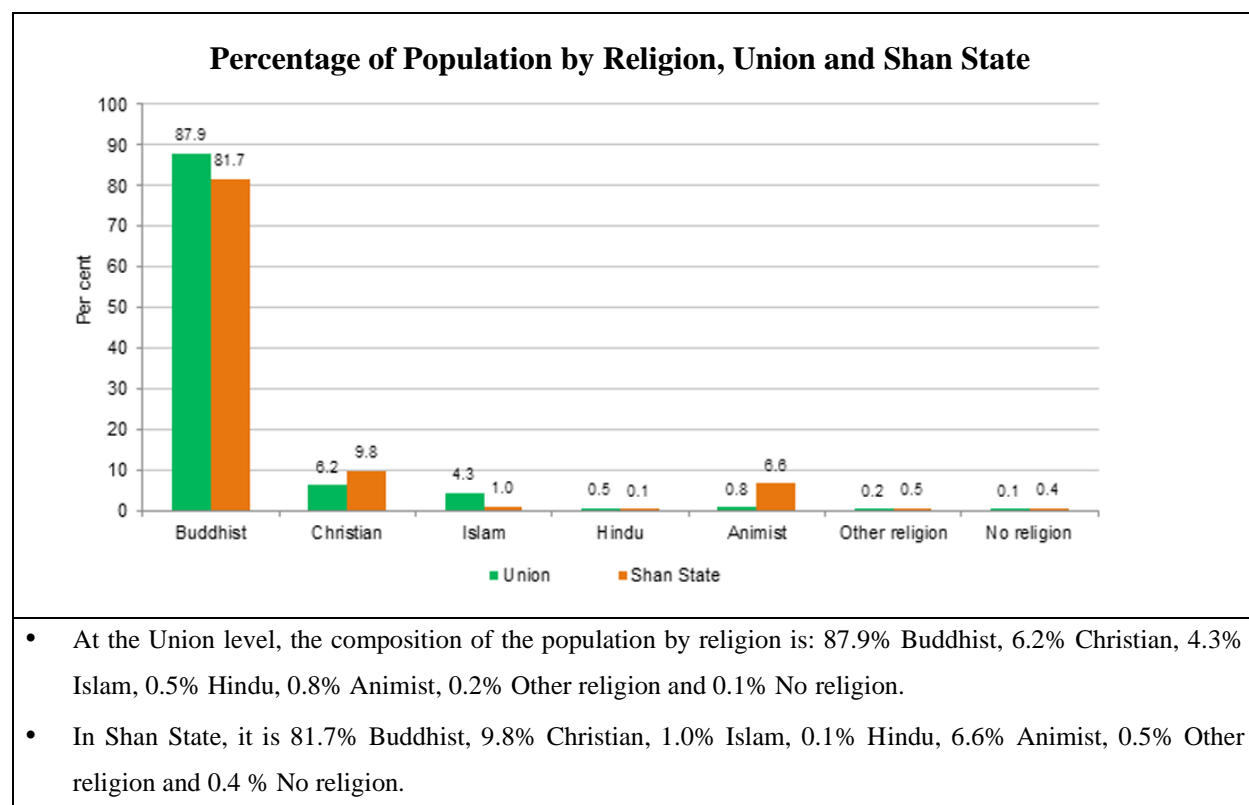
Population by Broad Age Groups, Nyaung Shwe Township	Population by 5-year age groups, Nyaung Shwe Township			
<p>A pie chart illustrating the population distribution in Nyaung Shwe Township across three broad age groups. The largest segment is the 15-64 years group, representing 67.4% of the population (127,715 individuals). The 0-14 years group accounts for 27.8% (52,701 individuals), and the 65 years and over group represents 4.8% (8,991 individuals).</p>	Age groups	Total	Males	Females
	Total	189,407	94,537	94,870
	0 - 4	15,910	8,024	7,886
	5 - 9	17,552	8,915	8,637
	10 - 14	19,239	10,045	9,194
	15 - 19	19,109	9,852	9,257
	20 - 24	17,113	8,585	8,528
	25 - 29	16,537	8,204	8,333
	30 - 34	15,955	8,067	7,888
	35 - 39	14,235	7,159	7,076
	40 - 44	12,935	6,405	6,530
	45 - 49	10,746	5,269	5,477
	50 - 54	8,868	4,309	4,559
	55 - 59	6,731	3,209	3,522
	60 - 64	5,486	2,595	2,891
	65 - 69	3,463	1,605	1,858
	70 - 74	2,310	1,026	1,284
	75 - 79	1,527	608	919
	80 - 84	1,037	406	631
	85 - 89	482	188	294
90 +	172	66	106	

- The proportion of productive working population between 15 to 64 years of age in Nyaung Shwe Township is 67.4 percent.
- The proportion of children aged 14 and below together with the proportion of the elderly aged 65 and over are less than the proportion of the working age group population.

Fewer proportions of children and elderly reduce the dependency of those age groups on the working age population.

Sources: Nyaung Shwe Township, 2014 Department of Population

(C) Religion in the Study Area



Sources: Nyaung Shwe Township, 2014 Department of Population

(D) Conventional Households by Source of Lighting by Urban/Rural

Source of lighting	Total	Urban	Rural
Electricity	37.5	96.5	32.9
Kerosene	5.7	-	6.1
Candle	5.5	2.4	5.7
Battery	15.1	0.3	16.2
Generator (private)	2.1	0.1	2.3
Water mill (private)	3.2	-	3.5
Solar system/energy	30.0	0.3	32.3
Other	0.9	0.4	1.0
Total	Per cent	100.0	100.0
	Number	42,634	39,575

- In Nyaung Shwe Township, 37.5 percent of the households use electricity for lighting. This proportion belongs to the (28-54) group in electricity usage. The percentage of households that use electricity in Shan State is 33.4 percent.
- In rural areas, 32.9 percent of the households use electricity for lighting.

Sources: Nyaung Shwe Township, 2014 Department of Population

(E) Conventional Households by Type of Cooking Fuel by Urban/Rural

Type of cooking fuel		Total	Urban	Rural
Electricity		21.5	53.6	19.1
LPG		*	0.2	*
Kerosene		0.1	-	0.1
BioGas		0.1	0.7	0.1
Firewood		67.9	14.8	71.9
Charcoal		10.1	29.4	8.6
Coal		0.2	0.9	0.1
Other		0.1	0.3	*
Total	Percent	100.0	100.0	100.0
	Number	42,634	3,059	39,575

- In Nyaung Shwe Township, households mainly use wood-related fuels for cooking with 67.9 percent using firewood and 10.1 percent using charcoal.
- About 21.5 percent of households use electricity for cooking.
- About 71.9 percent of households in rural areas use firewood and 8.6 percent use charcoal.

Sources: Nyaung Shwe Township, 2014 Department of Population

Note: * Less than 0.1 percent.

(F) Sources of Drinking Water

Sources of Drinking Water		Shan State
Tap water/ Piped		17.3
Tube well, borehole		23.0
Protected well/ Spring		16.6
Bottled water/ Water purifier		6.7
<i>Total improved drinking water</i>		<i>63.6</i>
Unprotected well/Spring		7.8
Pool/Pond/ Lake		4.6
River/stream/ canal		9.8
Waterfall/ Rain water		13.0
Other		1.2
<i>Total unimproved drinking water</i>		<i>36.4</i>
Total	Percent	100.0
	Number	42,634

- In Nyaung Shwe Township, 63.6 percent of households use improved sources of drinking water (tap water/piped, tube well, borehole, protected well/spring and bottled water/water purifier).
- Nyaung Shwe household belongs to the (57-76) group proportion in use improved sources for drinking water and it is also lower than the Union average (69.5%).
- About 23.0 percent of the households use water from tube well/borehole and 17.3 per cent use water from tap water/piped.
- About 36.4 percent of the households use water from unimproved sources.
- In rural areas, 38.9 percent of the households use water from unimproved sources for drinking water.

Note: * Less than 0.1 percent

2.2 Background Context of Inle Lake

The Inle Lake is fed by multiple rivers and creeks, including Belu, Thandaung, and Kalaw Creeks to the west; Nan Lut Creek to the north; and Nan Pan Creek to the east. It drains to the south via the Belu Creek, which joins the Thanlwin River near Hpsaung in Kayah State. Water levels are maintained through a balance of inflow, outflow, and evaporation. The lake's catchment area spans approximately 3,160 square kilometers, with water sourced from rainfall, springs, and upland runoff.

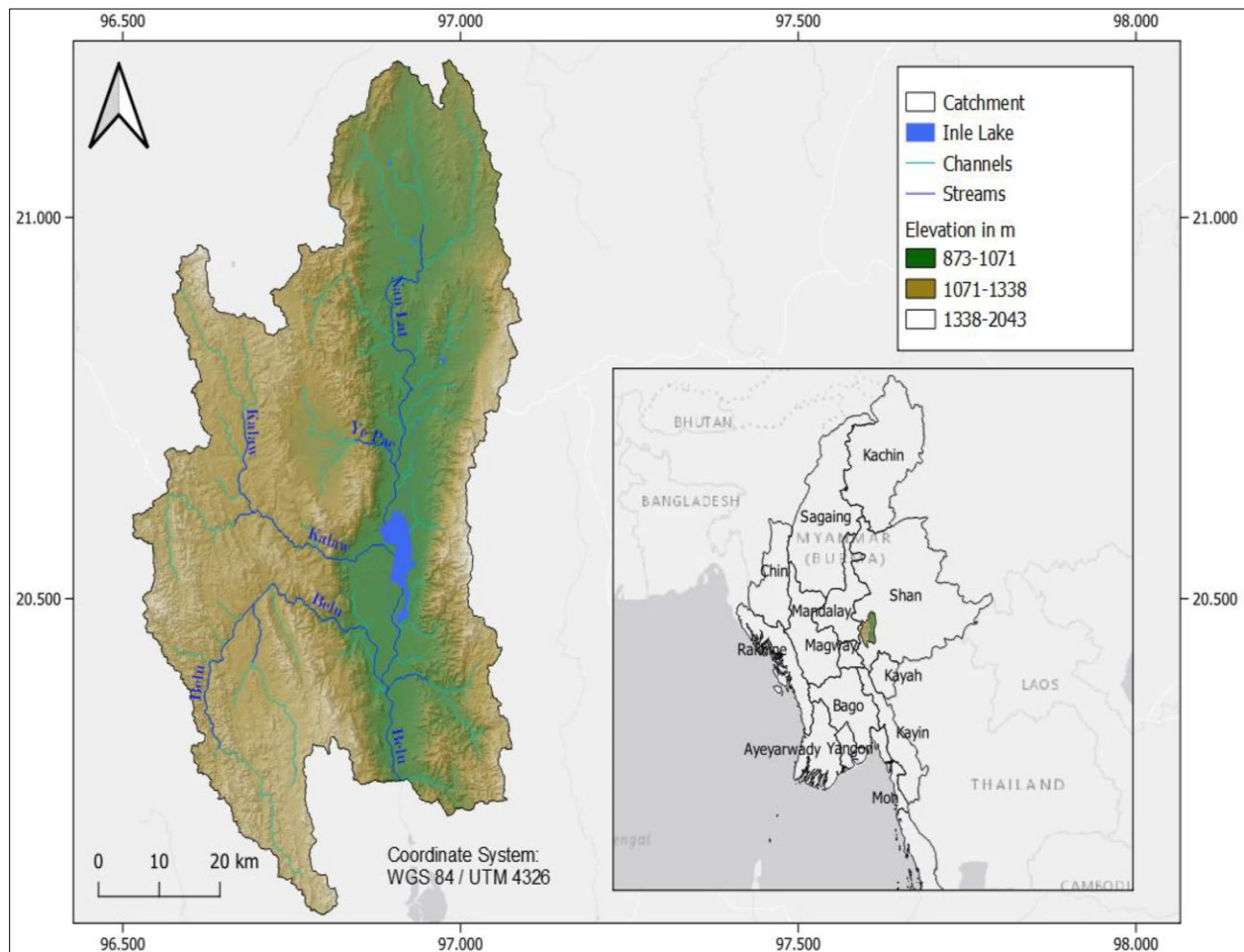


Figure 2-1: Catchment Area (Drainage Basin) of Inle Lake

2.2.1 Geology

Inle Lake is located within the Shan Plateau of the Eastern Highlands, a tectonically active region due to the oblique convergence of the Indian and Eurasian Plates. The area's geology comprises Lower Paleozoic to Tertiary carbonate and clastic sedimentary rocks, overlaid with terra rossa soil

and Tertiary lacustrine sediments (Aung et al., 2019). The eastern highland flank, Sindaung (Sin Range), consists of the Cambrian Molonehein Group, Ordovician Pindaya Group, and Silurian Mibayataung Group. To the west lies Thandaung, a high-relief mountain composed primarily of Permian to Carboniferous Plateau Limestone. The lake itself is filled with Quaternary alluvium, colluvium, and lacustrine deposits of silt, sand, clay, and peat.

Tectonically, Inle Lake is situated between the active Sagaing Fault to the west and Kyaukkyan Fault to the east. These faults generate high-intensity seismic activity. The Inle Basin is believed to be a graben or fault-controlled depression formed during the Cenozoic Era, likely in the Miocene or Pliocene. The surrounding terrain is hilly to mountainous, with elevations exceeding 1,500 meters.

The geomorphology of the Inle watershed includes erosional surfaces, karstic limestone features, and various drainage patterns determined by bedrock and geological structures. Prominent alluvial fans formed by Belu, Thandaung, and Nan Pan Creeks host human settlements and agriculture.

Since the early 21st century, geological processes such as erosion, transportation, and deposition have accelerated due to land use changes, deforestation, population growth, and climate change. Consequences include the loss of settlements and farmland, degradation of water and forest resources, and sedimentation of agricultural and aquaculture areas. Residual soil dominates the watershed slopes, while transported soil is found around the lake and its vicinity.

2.2.2.1 Earthquake

A Richter Scale of 7.7 earthquake occurred on March 28, 2025, with an epicenter near Sagaing Township, approximately 200 kilometers northwest of Inle Lake. The quake, triggered by the Sagaing Fault, resulted in at least 50 fatalities and damaged approximately over 2,000 buildings. Around 13,000 people in Nyaung Shwe Township, primarily residents of the Inle Lake area, were affected. The earthquake exhibited a rare "supershear" rupture, where rupture velocity exceeded shear wave speed, intensifying ground shaking and destruction. Given Inle Lake's position between the Sagaing and Kyaukkyan faults, seismic hazards remain a significant concern. Previous notable earthquakes felt in the area include the 6.8 magnitude Talay Earthquake (March 24, 2011) and the Maymyo Earthquake (2012), which registered approximately 8.0 in magnitude.

2.2.2.2 Flood

In September 2024, *Typhoon Yagi* brought intense rainfall to eastern Myanmar, triggering both flash floods and riverine floods in the Belu Chaung Basin. Flash floods impacted settlements on slopes and at the base of hills, while river flooding affected the lake and areas along the Belu creek. Annual monsoon flooding typically results from intense mountain rainfall, river overflow, and poor watershed management. Floods usually last only a few days, but in 2024, inundation persisted for nearly two months. The prolonged flooding displaced thousands, damaged or destroyed agricultural land and floating gardens, and washed away roads and bridges.

2.2.2.3 Landslide

Rain-induced landslides are common in the mountainous surroundings of Inle Lake. While most landslides are triggered by rainfall and surface runoff, some result from human activities such as infrastructure development, mining, and agriculture. The Ordovician to Carboniferous limestone bedrock generally resists failure, but overburden soil and weathered rock are vulnerable to groundwater changes and erosion. Landslides in the area are typically classified as earth slides, earth avalanches, or debris flows (Varnes, 1986). Impacts include the loss of buildings, farmland, and infrastructures, as well as soil deposition in aquaculture and agricultural zones.

2.2.2.4 Erosion and Deposition

Natural processes of erosion, transportation, and deposition are intensified by geomorphology, geology, deforestation, and climate change. Siltation is a major issue to threatens water storage

capacity, water quality, and aquatic lives. The 2024 floods increased siltation rates dramatically, submerging floating garden plants beneath thick sediment and reducing water depth, as detected by depth sounders. Causes include deforestation, land use changes, extreme weather events, and poor watershed management.

2.2.2.5 Strong Winds and Tornadoes

Although tropical cyclones are rare in the Inle region, strong winds and occasional tornadoes frequently occur, particularly at the beginning and end of the rainy season. A notable incident was the collapse of a sacred barge during the Phaung Daw Oo Pagoda Festival in the 1960s. Community surveys highlight the unpredictability of wind events, which can cause damage to bamboo homes and floating gardens, albeit with limited intensity.

2.2.2.6 Thunderstorms and Hail

Thunderstorms are common during the rainy season and have caused fatalities and property damage due to lightning strikes. Hailstorms occasionally impact the lake and surrounding settlements.

2.2.2.7 Drought and Water Scarcity

Droughts, particularly in El Niño years, lower lake levels, disrupt water transportation, and create shortages of water for domestic use.

2.2.2.8 Forest and Urban Fires

Seasonal forest fires occasionally threaten lakeside settlements, often linked to slash-and-burn agriculture. While not frequent, urban fires sometimes affect wooden homes built on the lakebed. Anecdotal accounts suggest methane gas emissions may contribute to spontaneous fires, given the peat and organic matter deposits in the lakebed.

2.2.2.9 Other Hazards

Ground subsidence, landslide-induced tsunamis, and extreme temperatures are considered potential risks, though no historical events have been recorded in the Inle Lake area.

Table 2-1 Hazard Risk Table

Hazard	Risk Level	Main Cause	Impact Area
Earthquakes	Moderate–High	Nearby fault zones	Regional (including towns)
Flooding	Moderate–High	Monsoon overflow, poor drainage	Lake shore, floating farms
Landslides	Moderate–High	Monsoon rain, deforestation, steep slopes	Hillsides, rural roads
Erosion and Deposition	Moderate	Monsoon rain, cyclones, deforestation	Hillsides, banks, agriculture, villages
Strong Wind and Tornado	Moderate	Climate variation, seasonal transitions	Lake area, villages
Thunderstorm and Hail	Moderate	Climate change, monsoon conditions	Lake area, villages, agriculture
Drought/Water Scarcity	Moderate	Seasonal variability, El Niño events	Lake and surrounding farms
Forest and Urban Fires	Moderate	Dry season, slash-and-burn practices	Entire Inle watershed
Ground Subsidence	Low	Soil compaction, limestone collapse	Entire Inle watershed
Pound Tsunami	Low	Landslides into the lake	Inle Lake banks
Extreme Temperature	Low	Climate and land cover changes	Entire Inle watershed

2.3 Environmental Concerns

Inle Lake, nestled in the Shan Plateau of Myanmar’s Shan State, is a critical ecological and cultural treasure. Recognized as part of the Global 200 ecoregions and a freshwater biodiversity hotspot, it is the second-largest lake in Myanmar after Indawgyi. It is a major hydropower source for southern Myanmar and one of the country’s top 10 tourist destinations. Historically, the lake sustained a delicate balance between human livelihoods and natural ecosystems. Traditional practices such as floating gardens, organic waste management, and fishing were largely harmonious with the environment. However, it faces severe environmental challenges compounded by recent natural disasters, including the September 2024 floods from *Typhoon Yagi* and the March 2025 Earthquake.

2.3.1 Past Environmental Concerns

Historically, Inle Lake was a vibrant ecosystem included 267 bird species (82 wetland birds), 43 freshwater fish species, otters, turtles, and several species listed as critically endangered, vulnerable, or near-threatened by the IUCN.

Over the past century, human activities have significantly degraded the lake:

Shrinking Lake Area: Between 1934 and 2007, the lake's surface area decreased by nearly 40%, from 271 km² to 163.2 km², with only 62.2 km² remaining as open water by 2007, as reported by the Land Records and Settlement Department. Floating gardens and farm plots have replaced much of the open water, reducing it to canals in some areas. Housing development and land use expansion over the lake water are another reason of shrinking lake area.

Deforestation and Resource Overuse: Increased demand for fuelwood for cooking and cottage industries, driven by population growth, led to deforestation in the surrounding watershed, increasing sedimentation and unbalancing the run-in and run-off ration.

Agricultural Practices: The overuse of chemical fertilizers and pesticides in floating farms contaminated the lake, disrupting its natural filtration system and poisoning fish populations.

Tourism Boom: Since 1996, ecotourism promotion attracted 100,000–150,000 visitors annually, straining infrastructure and contributing to pollution and habitat disruption.

Climate Variability: Over the past few decades, the monsoon period shortened by approximately 10 days, altering water inflows and exacerbating seasonal water shortages, as noted in climate data analyses.

These factors initiated a cycle of degradation, reducing the lake's ecological resilience and threatening the livelihoods of the predominantly Inthar population, alongside Shan, Taung Yo, Pa-O, Danu, Kayah, Palaung and Bamar communities.

2.3.2 Present Environmental Concerns

In the present day, Inle Lake faces the cumulative stress of pollution, invasive species, biodiversity loss, and increasing climate variability. The proliferation of water hyacinth, an invasive species, is choking waterways and altering nutrient cycles. Meanwhile, unregulated tourism, excessive use of agrochemicals, lack of public and private sewage treatment system, and poor solid waste management are undermining the lake's ecological resilience. The pressure on local fish populations, including endemic species such as the Intha Carp, has also intensified, threatening food security and local livelihoods. Key concerns include:

Continued Lake Shrinkage and Pollution: The lake's open water area remains critically reduced, with pollution from chemical runoff and untreated waste poisoning fish and rendering

water unsafe for consumption. High rates of diarrhea and dysentery persist in downstream communities, as reported in the 2015 UNDP publication “Inle Lake Conservation and Rehabilitation.”

Invasive Species: Fast-breeding invasive species continue to threaten native flora and fauna, further degrading biodiversity and undermining local livelihoods dependent on fishing and ecotourism.

Population and Tourism Pressures: Rapid population growth and tourism development have intensified resource demands, including fuelwood and water, while contributing to waste and pollution.

Lake Water Pollution: The absence of by-laws governing residential, public, and commercial structures built on Inle Lake has led to inadequate implementation of private and public sewage treatment systems. This regulatory gap, combined with growing population pressures and increasing visitor numbers, is exacerbating water pollution in the lake.

Climate Change Impacts: The shortened monsoon season and unpredictable rainfall patterns have disrupted water inflows, affecting the lake’s depth and ecosystem balance. Rising temperatures may also exacerbate evaporation rates.

Flood by Typhoon Yagi Floods (September 2024): The remnants of *Typhoon Yagi*, Asia’s largest storm of 2024, caused unprecedented flooding in Inle Lake and Nyaung Shwe Township. The lake’s water level rose over 6 meters (20 feet) above normal, inundating homes and displacing people across 171 villages. The floods submerged crops, destroyed farmland, floating farm and killed livestock, leading to severe food shortages and economic losses. Moreover, the sediments from the debris flow deposited onto farmlands and parts of human settlements, causing destruction. Power outages and school closures compounded the crisis, while clean water and medical supplies became scarce.

Mandalay Earthquake (March 28, 2025): A 7.7-magnitude earthquake, the strongest in Myanmar since 1912, struck the Mandalay Region, with significant impacts on Shan State and Inle Lake. The earthquake damaged most residential housing, buildings, monastery and stupa exacerbating the region’s recovery challenges from the prior floods. Infrastructure disruptions, including intermittent phone connections and electricity, hindered aid delivery. Survivors

faced shortages of clean water, food, and fuel, with many relying on monasteries and makeshift shelters on floating islands. Post-earthquake health risks, including diarrhea and skin diseases, surged due to poor sanitation and water scarcity. High winds in late April 2025 further damaged temporary shelters, worsening conditions for those effected by earthquake in the area.

2.3.3 Future Environmental Concerns

Looking ahead, Inle Lake faces a complex array of challenges that threaten its survival as a biodiversity hotspot and livelihood source. Future concerns include:

Ecosystem Collapse: Without intervention, continued shrinkage, pollution, and invasive species could lead to the collapse of the lake's ecosystem, wiping out critically endangered species and native fish stocks essential for local diets and economies.

Climate Change Intensification: Projections suggest worsening climate impacts, including more frequent extreme weather events (e.g., typhoons, floods) and further monsoon variability. These could exacerbate flooding, sedimentation, and water scarcity, reducing the lake's capacity to support hydropower and agriculture.

Post-Disaster Recovery Challenges: The compounded impacts of the 2024 floods and 2025 earthquake will require years of recovery. Rebuilding infrastructure, restoring floating farms, and addressing health risks (e.g., cholera, dengue) will strain limited resources, especially given ongoing conflict and aid restrictions. Food insecurity is likely to persist due to disrupted crop cycles and submerged fields.

Urbanization and Tourism Pressures: If tourism rebounds post-disasters, unchecked development could further degrade the lake through waste, pollution, and habitat loss. Sustainable tourism frameworks will be critical to balance economic benefits with conservation.

Socioeconomic Vulnerabilities: The Inthar and other communities face heightened livelihood risks as fishing yields decline and agricultural lands/floating farms remain damaged.

Health and Sanitation Crises: The risk of waterborne diseases (e.g., cholera, diarrhea) and skin infections, already elevated post-disasters, could worsen with the upcoming monsoon season, particularly if clean water and sanitation remain scarce.

3 GROUND SURVEY AND FIELD OBSERVATION

The Inle Lake, is home to distinctive stilt villages and floating gardens. These homes, typically constructed from bamboo, teak, and thatch, reflect the region's adaptation to the aquatic environment but remain structurally vulnerable to natural disasters. Over time, some residents have transitioned to sturdier materials like brick and zinc, although many buildings still lack proper seismic resilience.

In September 2024 flooding that submerged many homes and destroyed crops. Just months later, in March 2025, an earthquake further devastated the area, toppling structures and displacing families. These consecutive disasters caused extensive damage to homes, floating gardens, and community infrastructure. Water sources became polluted, heightening public health risks. Livelihood activities like farming and fishing were disrupted, leading to economic hardship. Today, the Inle Lake region faces a deepening humanitarian and environmental crisis requiring urgent attention and sustainable recovery efforts.

3.1 Ground Survey

E Guard's assessment team (study team here on after called) conducted a field visit to the earthquake-affected Inle Lake region to evaluate the extent of the disaster's impact. Although the study faced certain limitations such as the short duration of the visit and the inability to access all affected areas the team prioritized gathering firsthand data from the most accessible and significantly impacted villages. The assessment focused on documenting structural damages, household losses, and environmental disruptions. Despite the constraints, the findings provide valuable insight into the immediate needs of the affected communities and serve as a foundation for planning recovery and rehabilitation efforts.

3.1.1 Key Informant Interview (KII Survey)

Key informant interviews are crucial after flooding and earthquake disasters as they provide in-depth, context-specific insights from individuals with firsthand knowledge of the affected communities, such as local leaders, and emergency responders. These interviews help uncover critical information about immediate needs, gaps in response, community perceptions, and the effectiveness of disaster management efforts. By capturing local perspectives, they support a more

accurate assessment of the situation, inform targeted recovery strategies, and guide the development of resilient preparedness plans for future disasters.

E Guard team carried out KII by conducting face to face interview with local people, hotel owner, boat business owner, motorboat operator, leaders of nonprofit and charity organizations in Inle Region on 13rd to 15th April 2025 and used the preconstructed interview form prepared for this report to collect the information about previous flood and recent earthquake disasters.



Source: E Guard Study Team

Figure 3-1 KII Informant Interview

The following table shows the villages that conducted KII interview and the preconstructed KII interview form are attached in Annex B.

Table 3-1 Summary of KII

No.	Village/ Ward	Village Tract	Township	District	State	Date of KII
1.	Nan Pan Kyar Taw Village	Nan Pan	Nyaung Shwe	Kalaw	Shan (South)	13.04.2025
2.	Kyay Sar Kone (North) Village	Min Chaung	Nyaung Shwe	Kalaw	Shan (South)	13.04.2025
3.	Kay Lar Village	Kay Lar	Nyaung Shwe	Kalaw	Shan (South)	13.04.2025
4.	Tha Le U Inn Village	Tha Le U	Nyaung Shwe	Kalaw	Shan (South)	13.04.2025
5.	Floating Garden (from Kyay Sar Kone (North) Village)	Min Chaung	Nyaung Shwe	Kalaw	Shan (South)	14.04.2025
6.	He Yar Ywar Ma Village	He Yar Ywar Ma	Nyaung Shwe	Kalaw	Shan (South)	14.04.2025
7.	Inn Paw Hkon Village	Inn Paw Hkon	Nyaung Shwe	Kalaw	Shan (South)	14.04.2025

No.	Village/ Ward	Village Tract	Township	District	State	Date of KII
8.	Se Khaung Village	Sam Kar	Nyaung Shwe	Kalaw	Shan (South)	14.04.2025
9.	Yae Lel Village	Nan Pan	Nyaung Shwe	Kalaw	Shan (South)	14.04.2025
10.	Inn Dein Village	Inn Dein	Nyaung Shwe	Kalaw	Shan (South)	15.04.2025

3.1.2 Stakeholder’s Engagements

Stakeholders’ engagements were conducted both formally, through scheduled meetings, and informally, through onsite discussions during fieldwork activities. The assessment team engaged with the stakeholders to evaluate the socio-economic through a combination of structured interviews and discussions about affected areas, engineering assessments, soil conditions, infrastructure failure, casualties, water quality, hydrological data and identification of urgent environmental risks.

The assessment team engaged with the following stakeholders:

- **Federation of Myanmar Engineering Society (Fed. MES), Taunggyi:** MES provided technical assessments on previous flood and recent earthquake regarding the structural impacts of the earthquake on critical infrastructure, soil conditions and results of soil measurements and offered preliminary engineering assessments to inform environmental evaluations.
- **Wildlife Conservation, Forest Department (FD):** WLC collaborated in conducting field surveys and supporting the biodiversity team by providing data, with a particular focus on aquatic species and wildlife inhabitants.
- **Department of Risk Reduction and Resettlement (DRR):** DRR supported categorized list of damages by township, detailing building collapses, fatalities, and injuries resulting from earthquake and flood.
- **Environmental Conservation Department (ECD):** ECD provided information of water quality results of Inle Lake and supported the villages rescue and relief and the list of damages, along with other initiatives, to facilitate the implementation of necessary measures.

- **General Administration Department (GAD):** Township information is provided the secondary data from Nyaung Shwe Township Information (2023) and obtained information on flood and earthquake damages from relevant stakeholders.
- **Local Communities:** Direct engagement with local communities was undertaken to capture the experiences of the previous flood and recent earthquake's environmental and social impacts, identify priority needs, and integrate local knowledge into the assessment.



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-2 Stakeholder's Engagements

3.2 Field Observation

Following the devastating earthquake that struck the Inle Lake region in March 2025, a field observation was conducted to assess the damage and challenges faced by one of the most severely affected villages. The purpose of the visit was to gain firsthand insight into the scale of destruction, the living conditions of displaced families, and the broader impacts on housing, livelihoods, infrastructure, and the local environment. The village, located along the lake's edge, is

characterized by stilt houses built over soft, unstable ground, which contributed to the extensive structural damage observed. Many homes were either partially collapsed or rendered uninhabitable, forcing residents to take refuge in temporary shelters such as monasteries or community halls. The earthquake also disrupted essential services, including access to clean water, sanitation, and electricity, further deepening the humanitarian crisis. This field observation aimed to document these conditions and gather information to support recovery planning and future risk reduction efforts.



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-3 Field Observation at Earthquake Affected Villages in Inle Lake Region

3.2.1 Household and Residential Structures Damage

Villages around Inle Lake are renowned for their unique stilt houses built directly over the water or along marshy lake edges. These traditional dwellings are typically constructed using locally available materials such as bamboo, hard wood, and thatch, reflecting the region’s adaptation to

its aquatic environment. In recent years, there has been a gradual shift toward more durable materials, including brick nogging and zinc sheeting, to improve structural strength and longevity. Some homes have evolved into two-story structures, combining timber frames with brick foundations. However, despite these adaptations, many stilt houses remain vulnerable to seismic events due to their construction on soft lakebed soils and the lightweight nature of traditional materials. The combination of flexible wooden joints and limited foundational anchoring increases the risk of structural damage or collapse during earthquakes.

The recent earthquake caused extensive structural damage across all surveyed villages, severely affecting a wide range of housing types. Traditional homes made from bamboo and wood were particularly hard-hit, with many structures either collapsing completely or tilting precariously. These lightweight buildings, while affordable and culturally familiar, lacked the structural integrity to withstand the ground shaking. In several cases, wooden support posts especially in older homes had weakened due to long-term exposure to moisture, resulting in sudden failure during the earthquake. Bamboo houses, often built as single-story dwellings, were frequently destroyed by the combined effects of seismic forces and subsequent ground shifts. In areas where two-story wooden homes existed, signs of instability such as leaning and cracking were common, with some residents resorting to makeshift bamboo supports to temporarily hold up the damaged structures.

One recurring structural flaw identified was the improper configuration of joints and connections in wooden buildings. In some buildings, all structural joints were placed at the same vertical level rather than being staggered, significantly compromising load distribution. This design oversight became a major point of failure during the quake. Additionally, many homes were constructed with shallow or inconsistent foundations sometimes as little as three feet deep which proved inadequate in the face of strong shaking and shifting soil. In some instances, foundations were only added after the house was already built. These practices significantly undermined the resilience of houses, especially those built near rivers, lakes, and soft soils.

The geological conditions of the villages further influenced the scale and pattern of damage. Homes built over water or on reclaimed land were particularly vulnerable; in several cases, houses appeared to have been yanked downward into waterlogged mud, making rescue and recovery efforts more difficult. The direction of tilting in many affected homes was consistently toward the east, indicating a dominant directional force during the earthquake. However, the most affected

villages particularly Kay Lar and Za Yet Gyi experienced homes tilting in multiple directions, with some structures completely submerged, indicating severe ground instability and extensive structural failure. In contrast, hillside homes generally experienced less severe damage, suggesting that soil stability and elevation played a protective role. Some villages with mixed terrain, such as lowlands combined with water bodies, faced both structural and environmental hazards including landslides and erosion which further intensified the destruction.

In several locations, historically significant houses over 100 years old were either heavily damaged or completely destroyed, demonstrating the cumulative toll of repeated environmental stress and the lack of retrofitting or maintenance. However, a few older homes surprisingly remained intact, possibly due to more robust traditional construction methods used in the past. Brick and concrete structures tended to fare better overall, although they too showed damage in the form of wall cracks and collapsed staircases. This indicates that while rigid materials resist collapses better than bamboo or wood, they are still susceptible to seismic stress if not properly designed or maintained.

It was outlined in the Geology and Geomorphology section, buildings in the Inle Lake area are founded on three primary ground conditions: hillslope and its base, alluvial fan, and lakebed deposits. Structures located on hillsides or at the base of mountain ranges are typically built on rock formations, weathered rock, or residual soils. Most large-scale, medium-sized, and small buildings excluding bamboo houses utilize shallow foundations, either isolated or strip footings. These buildings have generally experienced minimal seismic impact, likely due to their placement on firm ground conditions. No major structural damage was recorded in the damage inventory for these buildings, aside from minor issues such as cracks in brick fences and concrete lean floors.

The second category of buildings is constructed on alluvial fan and fluvial deposits, where foundations are either partially submerged under shallow water or situated directly on the ground. Depending on the building type, foundations are typically either shallow footings or timber pile foundations. Preliminary site inspections indicate that timber piles were installed using manual pressure driven into the ground by human force until further penetration was no longer possible. However, there are no standardized guidelines regarding the applied pressure, dimensions of the timber piles, installation depth, or safe bearing capacity. In contrast, shallow footings in these areas are generally founded on loosely filled soil, either at ground level or in shallow water zones. Traditional construction methods often involve building retaining walls with local rock fragments,

followed by soil filling without compaction, and then placing footings at the desired depth of this fill. Field surveys suggest that buildings supported by manually installed timber piles are more vulnerable to structural failure compared to those with shallow footings in similar alluvial and fluvial settings.

The third category of buildings is constructed on lake deposits, specifically within the lake area itself. These deposits consist primarily of peat (organic soil) and other unconsolidated materials, which present challenging ground conditions. In this zone, buildings are predominantly supported by timber pile foundations, installed using the same manual pressing technique described earlier.

Timber piles used in lake deposits typically range from 10 to 15 feet in length, in contrast to those used in alluvial and fluvial deposits, which generally do not exceed 5 feet. Due to the weak and compressible nature of lake deposits, buildings supported by longer timber piles are found to be the most vulnerable to seismic forces, showing reduced bearing capacity to resist ground shaking.

Preliminary investigations indicate that building damage and distortion, in case of foundation failure, during ground shaking may occur through three primary mechanisms. First, the bearing capacity of shallow footings and timber piles may gradually decrease under dynamic stress. Second, ground shaking could potentially induce soil liquefaction, leading to a loss of soil stiffness and, consequently, a reduction in the foundation's load-bearing capacity. Third, structural failure may result from breaks at foundation joints particularly at the connection points between timber piles and columns caused by seismic forces. While multiple modes of failure are possible, signs of liquefaction were not reported during community interviews, suggesting it may not have been a significant factor in this event.

In summary, the earthquake revealed the widespread vulnerability of rural housing in seismically active and environmentally sensitive areas. The damage pattern points to a critical need for improved construction practices, particularly in joint configuration, foundation depth, and material selection. It also highlights the importance of site-specific planning, such as conducting geotechnical assessments before construction in flood-prone or reclaimed land areas. Moving forward, efforts to rebuild should prioritize resilient housing design, technical training for local builders, and community awareness to reduce risk in future disasters.

Table 3-2 Damages and Losses due to the Earthquake in Nyaung Shwe Township

Ward/Village Tract	House		Number of Affected Persons				
	Collapsed	Partially	Number of House	Household	Male	Female	Total
17	2297	595	2892	2903	6568	6815	13383

Source: DDM



Source: E Guard Study Team



Source: Social Media



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: Social Media



Source: Social Media



Source: Social Media



Source: Social Media

Figure 3-4 Household and Residential Structures Damage

3.2.2 Public Building (Schools, Clinics, Religious Sites)

The recent earthquake caused widespread damage to religious, educational, and public infrastructure across the affected region. Many monasteries suffered varying degrees of structural damage, ranging from minor cracks to complete collapse. Most monasteries in the Inle Lake area were constructed on a large scale to serve multiple purposes. Many of the ancient structures were built using timber pile foundations or shallow footings. Investigations indicate that a significant number of these monasteries collapsed or suffered structural distortion due to insufficient bearing capacity to support their large-scale design during ground motion events.

In several locations, religious structures such as pagodas showed signs of instability, including leaning stupas, cracked retaining walls, uplifted floor tiles, and partially collapsed platforms. Some monasteries experienced internal structural failure, including collapsed brick pillars and walls, exacerbated by ongoing aftershocks. In previously flood-affected areas, buildings like ordination halls and bamboo structures had already been weakened, leading to more severe destruction during the earthquake. Multiple monasteries completely collapsed, and several schools were heavily impacted, with reports of collapsed roofs, crumbling walls, and destruction of classrooms and

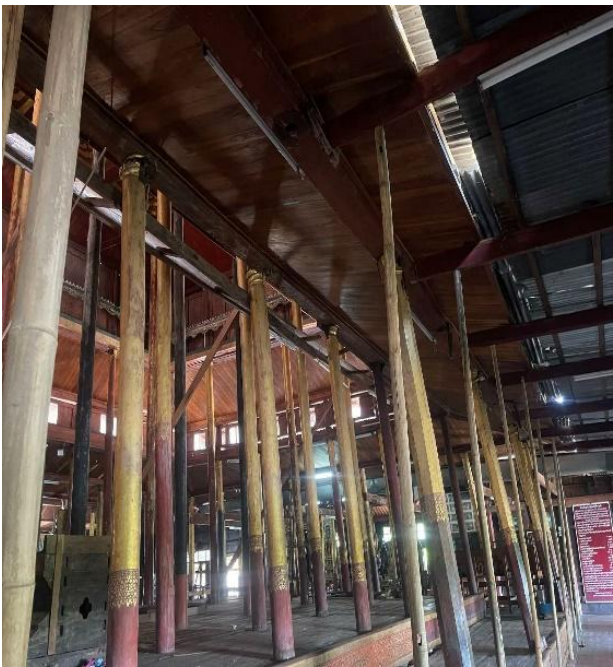
teaching materials. In some cases, healthcare facilities were also affected, including at least one local clinic that suffered total collapse.

Overall, the earthquake highlighted critical vulnerabilities in public and religious infrastructure, especially in aged buildings and those located on unstable terrain or near water bodies.

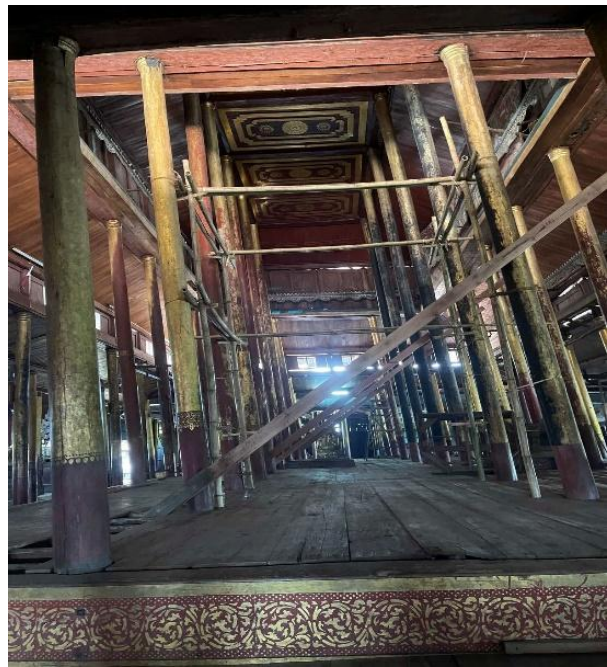
3.2.2.1 Impacts on Religious and Cultural Heritage

(1) Impacts of Recent Earthquake

One culturally significant monastery, Nga Hpe Chaung Monastery, also known as the *Jumping Cat Monetary* “ကြောင်ခုန်ကျောင်း” which is over history spanning over 180 years, is constructed in the southern Shan traditional architectural style, containing rare ancient design features and numerous cultural artifacts. and previously reinforced with concrete footings due to aging, sustained severe damage including tilted support posts, cracked footings, fallen tie beams, and damage to religious sculptures while the monks’ dining hall fully collapsed.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-5 Nga Phel Chaung Monastery

Additional damage was reported at a prominent pagoda, Phaung Daw Oo, where exterior fractures and cracked terrace tiles were clearly visible, alongside unusual water behavior such as temporary receding and re-flooding, likely caused by seismic disturbance.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-6 Inle Phaung Taw Oo Pagoda

Ahlotaw Pauk Pagoda, located in Nampan Village, within Inle Lake, has tilted of its htee (umbrella finial), and some cracks have appeared in the lower base of the front platform.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-7 Ahlotaw Pauk Pagoda

Table 3-3 Religious Sector

Totally Damaged	Partially Damaged					Leaning		Brick Walls		Others
	Pagoda	Buddha Statue	Pagoda	Monastery	Pavilion and Adoration	Other Religious Schools	Pagoda	Monastery	Location	
5		11	33	4		4	25	5	1150	32

Source: DDM



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-8 Damaged Religious Structures

(2) Impacts of Previous Floods

Shwe Inn Dein Pagoda is an ancient religious site containing 403 main pagodas and 1,054 auxiliary pagodas, experienced severe flooding due to continuous heavy rainfall. The floodwaters affected the entire Shwe Inn Dein Pagoda compound and its surrounding infrastructure.

Historical inscriptions and carvings were washed away or heavily eroded and several Buddha statues suffered surface damage and material corrosion. Sacred relic chambers were breached in

at least 12 locations. It is reported that approximate 312 auxiliary pagodas were sustained partial or full structural collapse, 87 main pagodas reported cracks, foundation erosion, and brick disintegration and decorative elements and relic chambers were waterlogged and contaminated.



Source: Social Media



Source: Social Media

Figure 3-9 Buildings in the Inn Dein Pagoda Area that Collapsed due to Flooding



Source: E Guard Study Team



Source: Socail Media



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-10 Temples Damage by Floods in the Inn Dein Area



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-11 Stupas and Temples Damaged by Floods in the Inn Dein Area

3.2.2.2 Impacts on Social Infrastructure

The following table described the damages of offices and departments effected by the earthquake, 2025.

Table 3-4 Offices/ Department

Total Number of Offices/Departments	Offices/ Buildings	Staff Housing	Warehouse	Others	Brick Walls	
	Partially	Partially	Partially		Location	Feet
17	19	7	5	60	12	1855

Source: DDM

Several schools also experienced wall buckling and structural shifts.

Table 3-5 Basic Education Schools

Total Number of Schools/ Offices	Education Officer's Office		Classroom Building		Staff Housing		Brick Walls		Others	
	Totally Damaged	Partially	Totally Damaged	Partially Damaged	Totally Damaged	Partially Damaged	Location	Feet	Totally Damaged	Partially Damaged
51		2	26	35		1	10	3314	198	

Source: DDM



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-12 Damaged School

Table 3-6 Health Care Centers

Total Number of Hospitals/Clinics	Office/ Depart	Hospital	Rural Health Sub-Center		Staff Housing	Brick Walls		Others
	Partially	Partially	Totally Damaged	Partially	Partially	Location	Feet	
18		1	2	6	1	4	620	11

Source: DDM

3.2.3 Transportation Infrastructure

In September 2024, a severe flash flood of Belu Creek, caused by the creek’s sudden overflow, led to significant destruction in Inn Dein Village, which lies along the creek’s banks. The flooding inflicted extensive damage to critical infrastructure, including the iconic gateway to the Inn Dein Pagoda and several houses situated near the waterway. Approximately 20 feet of the village's main roadway was washed away, further isolating the community. The water level rose by an estimated 15 feet and remained high for four consecutive days, exacerbating the damage. Additionally, the collapse of a nearby dam intensified the flooding’s impact and contributed to the widespread inundation of low-lying areas. Notably, two bridges and four jetties were either destroyed or severely impaired, disrupting transportation routes and limiting access to the village’s religious, cultural, and community landmarks. Despite the severity of the flood, there was no significant structural damage reported in Inn Dein Village following the recent earthquake in 2025. The bridges and roads were destroyed not only by erosion of water, but also ruined by deposition of sediments and slope wash materials during flood event in 2024.

The earthquake affected nearby villages, where several small bridges showed signs of tilting and structural weakness. However, some villages experienced minimal damage, with key infrastructure such as roads and bridges remaining intact, reflecting relative resilience. Although the main bridge in Maing Thauk remained intact, numerous secondary routes and footpaths sustained severe damage, limiting access and complicating relief and recovery efforts. A subsequent aftershock later that day further intensified the situation. At Nga Phe Chaung Monastery, cracks developed in the retaining wall near the jetty. These incidents underscore the vulnerability of transportation infrastructure to seismic events, highlighting the need for structural assessments, stabilization measures, and long-term restoration planning.



Source: E Guard Study Team



Source: Social Media

Figure 3-13 Damages to Transportation Infrastructures

Table 3-7 Urban Development Sector

Market				PPP Sector	
Shop Unit		Brik Walls		Trade and Commerce	Service Sector
Totally Damaged	Partially Damaged	Location	Feet		
8	32				

Source: DDM

3.2.4 Utilities

3.2.4.1 Water Supply (Source)

Most villages in the Inle Lake region depend primarily on the lake for domestic water use, including washing, bathing, and cleaning, while drinking water is usually sourced from small-scale purification systems, often located at monasteries. Some communities also collect rainwater or use communal water tanks for cooking. Although practices such as direct use of the lake for household water needs including washing, bathing, and sanitation as well as waste disposal, have been long-standing, the gradual increase in population has led to a rise in waste discharge, which in turn has steadily worsened water pollution in the lake. Over time, this has weakened the lake's natural self-purification capacity, leading to the accumulation of organic waste, pathogens, and harmful contaminants in the water. Even before the recent disaster, communities were already facing related to water quality and hygiene challenges.

The recent earthquake and earlier flooding have exacerbated the situation by disturbing the lakebed and spreading accumulated pollutants, making the water unsafe even for basic non-potable uses. This disruption has sharply increased the risk of waterborne diseases such as diarrhea, skin

infections, and other hygiene-related illnesses. Although a few purification systems remain operational, their limited capacity cannot meet the heightened demand, leading to overcrowding and social tensions within communities particularly in densely populated areas. at water collection points and rising tensions in more populated areas.

Emergency water trucking has been introduced in some locations, but its reach remains inconsistent and unsustainable in the long term due to logistical challenges and damaged road infrastructure. There is an urgent need for comprehensive water quality testing, and the rehabilitation or expansion of existing systems. These interventions are critical to restoring safe and equitable access to water across all affected villages. Without swift and coordinated action, the ongoing water crisis may escalate into a secondary public health emergency and seriously hinder overall recovery efforts in the Inle Lake region.



Source: E Guard Study Team



Source: E Guard Study Team



Source: Social Media



Source: Social Media

Figure 3-14 Current Domestic Water Usage

3.2.4.2 Sanitation

Sanitation infrastructure in the region is basic and varies by housing location. Inland households generally use shallow, stone-lined pit latrines (around 4 feet deep), while stilt houses over the lake often discharge human waste directly into the water, a practice that has long contributed to the lake contamination. The recent earthquake and previous flood caused widespread damage to both inland and floating sanitation systems. Due to the instability or destruction of stilt housing caused by the disaster, the sanitation system was also damaged along with the houses, resulting in uncontrolled waste discharge into the lake, which poses significant risks to public health and further degrading the lake's ecosystem.

This has worsened pre-existing sanitation challenges. With many latrines rendered unusable, households have increasingly resorted to open defecation, especially in areas lacking alternatives. As a result, exposure to fecal matter has intensified, increasing the risk of waterborne diseases such as cholera, diarrhea, and intestinal parasites. The lake, which serves as a primary water source for most residents, is now further contaminated, undermining recovery efforts in water supply and hygiene.

Overcrowded temporary shelters and displacement sites often lack sufficient sanitation facilities, compounding the crisis. Immediate action is needed to provide emergency sanitation support, including safe temporary latrines, desludging services, and hygiene promotion. In the medium to long term, efforts should prioritize rehabilitating damaged systems and developing resilient, environmentally sound sanitation solutions to prevent future contamination and safeguard public health.



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: Social Media



Source: Social Media

Figure 3-15 Current Sanitation Systems

3.2.4.3 Electricity

Electricity in the region is primarily provided by the national grid, with some households relying on solar panels as a supplementary or alternative source. Although the earthquake did not cause uniform damage to electrical infrastructure across all villages, it led to the collapse of numerous electricity poles and localized failures of transmission lines. These damages triggered widespread power outages, even in areas where infrastructure appeared structurally intact, due to the interconnected nature of the grid.

The loss of electricity has had cascading effects on daily life and essential services. Households have faced difficulties with basic energy needs such as cooking, lighting, and phone charging. More critically, the power disruptions have severely impacted the operation of vital services, including water purification systems, health facilities, and communication networks essential components for coordinating emergency response and supporting community resilience.

In displacement sites and temporary shelters, the lack of electricity has heightened protection concerns. The outages have also disrupted education services, as many learning centers and schools rely on electricity for lighting, ventilation, and digital learning tools.

In the short term, there is an urgent need to restore electricity through temporary power solutions such as mobile generators, solar-powered systems, and the rapid repair of damaged poles and lines. In the medium to long term, investments should focus on strengthening the resilience of the power infrastructure by decentralizing supply, expanding solar energy access, and reinforcing the grid to withstand future shocks. Enhancing energy reliability is essential not only for recovery but also for long-term development and disaster preparedness.

Table 3-8 Electricity Sector

Building	Electric Pole		Power Line		Transformer	Electric Meter			
	Zawgyi	Concrete Pole	Wood Pole	11KV (Mile)		400V (Mile)	Domestic Use	CT	Power
		220	1216	3.48	11.05	6	123	2	

Source: DDM



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-16 Damage to Electricity Supply Systems

3.2.5 Biodiversity and Ecosystem of Inle Lake

Inle Lake, Myanmar’s second-largest freshwater inland lake, supports diverse wetland species, including migratory and resident birds, as well as the Inle Carp (locally known as nga-phane). Recognizing its environmental importance, the Forest Department designated it as the Inle Wetland Wildlife Sanctuary (IWWS) in 1985, and in 2004, it was declared an ASEAN Heritage Park.

Designated as a global freshwater biodiversity hotspot, Inle Lake harbors an extraordinary array of wildlife, including 53 bird species and 36 fish species—16 of which are endemic—alongside four threatened bird species and five threatened mammal species (Lwin and Sharma 2012). This ecologically vital sanctuary serves as a critical refuge for internationally endangered species such as the white-rumped vulture (*Gyps bengalensis*), greater spotted eagle (*Clanga clanga*), pallid harrier (*Circus macrourus*), Baer's pochard (*Aythya baeri*), sarus crane (*Grus antigone*), and ferruginous duck (*Aythya nyroca*) (Su and Jassby 2000). Beyond its avian significance, the lake functions as a key breeding ground for fish and a nesting habitat for birds and amphibians (Ma 1967, Su and Jassby 2000). It also supports Red Data Book-listed mammals, endemic fish species (Butkus and Myint 2001), and a rich aquatic ecosystem characterized by dense submerged vegetation and floating macrophytes (Akaishi et al. 2006). As a thriving hub of biodiversity, Inle Lake sustains countless species, including human communities, underscoring its irreplaceable ecological value.

Despite its importance, the lake faces mounting anthropogenic pressures. Local populations rely heavily on its resources (Ma 1996), while escalating tourism has introduced new management complexities (Sett and Liu 2014). These pressures, compounded by pollution (Ma 1997), sedimentation (Su and Jassby 2000), and the lake's shrinking surface area (Sidle et al. 2007), threaten its delicate balance. Furthermore, agricultural expansion—particularly floating gardens—and deforestation in surrounding catchments have altered land cover dynamics (Thiha 2001; Htwe et al. 2015).

Despite the evident environmental transformations occurring in Inle Lake, the fundamental drivers behind these changes and their full ecological implications remain inadequately understood. This study addresses this critical knowledge gap by integrating and analyzing both primary and secondary data sources to provide a systematic, comprehensive assessment of the lake's changing dynamics. Through this approach, the research aims to elucidate the complex interplay of factors contributing to ecological degradation while offering evidence-based insights to inform conservation strategies.

3.2.5.1 Methodology

From 13 to 14 April 2025, the study team conducted a comprehensive assessment of biodiversity and ecological conditions in Inle Lake, Myanmar, in response to recent seismic events. The study aimed to evaluate potential impacts of the earthquake on the lake's freshwater ecosystems.

Transect Line Method: Systematic observations along predetermined paths to document species distribution and habitat changes.

Point Count Method: Fixed-location sampling to quantify avian and aquatic fauna density, with particular attention to endemic and threatened species.

Data collection focused on flora, aquatic fauna, and avian populations, with additional metrics recorded for water quality and sediment stability.

3.2.5.2 The Condition of Biodiversity and Ecosystem in Inle Lake during Current Study

In the present study, direct observations recorded a total of 36 species distributed across 25 families and 21 orders within the study area. The documented taxa included three aquatic plant species, two beetle species (Coleoptera), 14 molluscan and crustacean species (comprising snails, clams, and prawns), six fish species (Pisces), and 11 waterbird species (Aves). A detailed summary of species composition is provided in Table 3-10.

Table 3-9 Recorded Species from the Study Area

No.	Order	Family	Scientific Name	Common Name	Local Name	IUCN Status
Aquatic Plant						
1	Ceratophyllales	Ceratophyllaceae	<i>Ceratophyllum demersum</i>	Hornwort	အမြီးရှည်မြက်	LC
2	Salviniales	Salviniaceae	<i>Eichhornia crassipes</i>	Water hyacinth	ဗေဒါပင်	LC
3	Saxifragales	Haloragaceae	<i>Myriophyllum heterophyllum</i>	Variable-leaved water-milfoil	အမြီးရှည်မြက်	LC
Beetle						
4	Coleoptera	Scarabaeidae	<i>Gymnetis pantherina</i>	Flower beetle	ပန်းလှေးပိုး	NE
5	Hemiptera	Cimicidae	<i>Cimex lectularius</i>	Bed bug	ပိုးတောင်မာ	NE
Fresh water snail, clam and prawn						
6	Architaenioglossa	Viviparoidea	<i>Taia elitoralis</i>	Lake snail	ရေချိုခရု	DD
7	Architaenioglossa	Viviparoidea	<i>Taia noticooides</i>	Piano snail	ခရုပက်ကျိ	NE
8	Architaenioglossa	Viviparoidea	<i>Bellamya bengalensis</i>	Common banded pond snail	ရေချိုခရု	LC
9	Architaenioglossa	Viviparoidea	<i>Bellamya dissmilis</i>	Common banded pond snail	ခရုသင်း	NE
10	Architaenioglossa	Ampullariidae	<i>Pila globosa</i>	Indian apple snail	ခရုချို	LC
11	Architaenioglossa	Ampullariidae	<i>Pila scutata</i>	Apple snail	ခရုချို	LC
12	Hygrophila	Planorbidae	<i>Planorbis rotundatus</i>	Great ramshorn	ခရုကွင်း	LC
13	Littorinimorpha	Bithyniidae	<i>Digoniostoma iravadica</i>	Freshwater snail	ဧရာဝတီ ခရု	NE
14	Sorbeoconcha	Pachychilidae	<i>Bortia costula</i>	Brotia snail	ခရုဖင်ချွန်	NE
15	Unionoida	Unionidae	<i>Parreysia andersoniana</i>	Freshwater mussel	ပုံကောင်	LC
16	Venerida	Cyrenidae	<i>Corbicula striatella</i>	Freshwater mussel	ကမာငယ်	LC
17	Venerida	Cyrenidae	<i>Corbicula iravadica</i>	Freshwater mussel	ကမာငယ်	LC
18	Venerida	Cyrenidae	<i>Villorita corbiculoides</i>	Black clam	ကမာပြား	DD
19	Decapoda	Palaemonidae	<i>Palaemon paucidens</i>	Common prawn	ပုစွန်ဆိတ်	NE
Freshwater fish						
20	Cypriniformes	Cyprinidae	<i>Puntius ornata</i>	Black tail spotted barb	ငါးနိုးမသေး	VU
21	Cypriniformes	Cyprinidae	<i>Garra borneensis</i>	Sand-digger	ကတ္တပိုး	LC

No.	Order	Family	Scientific Name	Common Name	Local Name	IUCN Status
22	Cypriniformes	Cyprinidae	<i>Pethia erythromycter</i>	Lipstick barb	ငါးခုံးမပါးနီ	LC
23	Cypriniformes	Cyprinidae	<i>Cyprinus intha</i>	Inle carp	ငါးဖိန်း	EN
24	Cichliformes	Cichlidae	<i>Tilapia mossambica</i>	Tilapia	တီလာဗီးယား	LC
25	Perciformes	Ambassidae	<i>Ambassis ambassis</i>	Asiatic glassfish	ငါးဇင်လိတ်	LC
Water Birds						
26	Charadriiformes	Charadriidae	<i>Vanellus duvaucelii</i>	Grey -headed lapwing	တစ်တီတူး	NT
27	Charadriiformes	Laridae	<i>Chroicocephalus brunnicephalus</i>	Brown-headed gull	ဇင်ယော်ခေါင်းညို	NE
28	Charadriiformes	Recurvirostridae	<i>Himantopus mexicanus</i>	Black-necked Stilt	ဒေါင်းလန်းခြေထောက်	LC
29	Ciconiiformes	Ciconiidae	<i>Anastomus oscitans</i>	Asian openbill	ခရုတုတ်	LC
30	Gruiformes	Rallidae	<i>Gallinula chloropus</i>	Grey -headed swamphen	မယ်ညို	LC
31	Passeriformes	Acrocephalidae	<i>Acrocephalus orientalis</i>	Oriental Reed Warbler	မြစ်ငှက်	LC
32	Pelecaniformes	Ardeidae	<i>Ardea cinerea</i>	Grey heron	ငဟစ်မွဲ	LC
33	Pelecaniformes	Ardeidae	<i>Botaurus sinensis</i>	Yellow bittern	ခြူးတိုးဗျိုင်းအောက်	NE
34	Pelecaniformes	Ardeidae	<i>Egretta caerulea</i>	Little Heron	ဗျိုင်းအောက်	LC
35	Pelecaniformes	Threskiornithidae	<i>Threskiornis melanocephalus</i>	Black headed ibis	ခရုစုပ်ခေါင်းမဲ	LC
36	Suliformes	Phalacrocoracidae	<i>Microcarbo niger</i>	Little cormorant	အော်ယော်	LC

Source: E Guard Study Team (Biodiversity survey)

Note: EN- Endangered, VU- Vulnerable, NT – Nearly threatened, LC – Least Concern, DD – Data Deficient, NE – Not Evaluated



Ceratophyllum demersum



Eichhornia crassipes



Myriophyllum heterophyllum



Gymnetis pantherina



Cimex lectularius



Palaemon paucidens



Taia elitoralis



Taia noticoidea



Bellamyia bengalensis



Bellamyia dissimilis



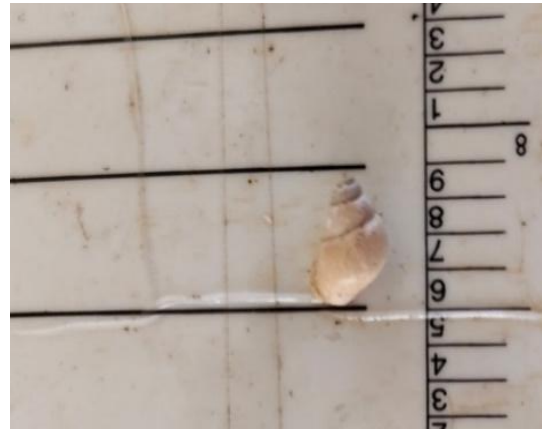
Pila globosa



Pila scutata



Planorbis rotundatus



Digoniostoma iravadica



Bortia costula



Parreysia andersoniana



Corbicula striatella



Corbicula iravadica



Villorita corbiculoides



Ambassis ambassis



Puntius ornata



Garra borneensis



Pethia erythromycter



Cyprinus intha



Tilapia mossambica



Microcarbo niger



Vanellus duvaucelii



Chroicocephalus brunnicephalus



Himantopus mexicanus



Anastomus oscitans



Gallinula chloropus



Acrocephalus orientalis



Ardea cinerea



Botaurus sinensis



Egretta caerulea



Threskiornis melanocephalus

Source: E Guard Study Team

Figure 3-17 Recorded Species during Current Study

3.2.5.3 The Condition of Fisheries in Inle Lake Before and After Natural Disaster (Earthquakes and Flooding)

The study team interviewed with some local fishermen while they still catching the fish in the lake. “I’ve only caught one fish until now,” said U Win Kyaing after six hours of casting his net. “It’s

just too hard to catch fish these days. “At high noon, the stout, wrinkled 50-year-old, black skin man rested on his old boat. He still had five more hours on the water ahead of him.

“When I was 35, fifteen years ago, I would catch nearly 15 viss (54 pounds) of fish—many different species—by noon, and then I’d go home. I didn’t need to fish all day,” he said. “Now, everything has changed.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-18 Interviewing a Local Fishermen

Another fisherman, about 40-year man also said that

“When I was 12, I would catch almost 15 viss (54 pounds of fish) by noon and, I would then go home. I did not need to fish all day,” he said. “It has all changed now”.

Fishermen in Inle Lake report significant declines in fish catches after seismic events, with many stating that they now struggle to catch any fish despite fishing all day. This scarcity has severely disrupted local livelihoods, as one fisherman noted, *“Fifteen years ago, I could catch 15 viss (54 pounds) of fish by noon, but now, even a full day’s effort yields almost nothing.”*



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-19 Investigation on Fisheries

The decline in fish populations extends beyond socioeconomic consequences, affecting broader ecological dynamics. Reduced fish availability has disrupted the lake's food web, leading to cascading effects on dependent species. Notably, populations of piscivorous water birds and migratory birds have declined due to diminished prey availability. This ecological imbalance underscores the interconnectedness of aquatic and terrestrial ecosystems in Inle Lake. "Inle Lake was once brimming with aquatic life, home to nearly 36 species of fish and 53 species water birds, many of them endemic, but the lake's biodiversity has come under threat.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-20 Fishing Practice

These findings underscore the critical necessity for implementing targeted conservation strategies, such as habitat restoration and sustainable fisheries management, to address the long-term ecological consequences of environmental disturbances on both biodiversity and human

populations. However, the recent study remains limited in scope due to temporal constraints, highlighting the need for extended long-term research to comprehensively assess and facilitate the restoration of the lake ecosystem. Further investigations are essential to develop natural-based management approaches that ensure ecological resilience and sustainability.

3.3 Disaster Impact

3.3.1 Humanitarian Impact

The earthquake in the Inle Lake region has triggered a severe humanitarian crisis, displacing hundreds of families and causing widespread disruption to lives, infrastructure, and basic services. Although a comprehensive casualty assessment is still ongoing, numerous injuries and fatalities have been reported across the affected communities. The most vulnerable populations including children, the elderly, and persons with disabilities have been disproportionately impacted, facing heightened risks due to displacement, loss of services, and limited mobility. Immediate humanitarian needs remain critical, with affected populations requiring emergency food supplies, temporary shelter, essential healthcare, clean drinking water, and proper sanitation facilities. The combined loss of homes, livelihoods, and access to public services has placed immense pressure on local coping mechanisms, demanding urgent and coordinated response efforts to prevent further deterioration of conditions on the ground.

3.3.1.1 Displacement and Housing Damage

The recent earthquake has caused widespread destruction to residential structures through partial or complete collapse, resulting in the displacement of hundreds of families in the Inle Lake region. Traditional homes especially those constructed with wood, bamboo, and thatched materials were particularly vulnerable, leading to extensive structural damage and instability. In addition to the immediate displacement, many homes have sustained damage that renders them unsafe for habitation, even if not entirely destroyed. This has left families in a state of uncertainty, unable to return or rebuild without proper technical assessments and resources.

In the immediate aftermath, many displaced persons sought refuge in monasteries, community halls, or with relatives in less-affected areas. However, these informal shelters though vital during the emergency response are not equipped to accommodate large populations for extended periods.

Overcrowding, inadequate facilities, and limited resources are becoming increasingly critical issues, highlighting the urgent need for coordinated and scalable shelter solutions.

The loss of housing has had a cascading impact on social stability. Families have been separated during the evacuation process, and many have lost important personal belongings, documents, and household assets. Additionally, with schools, churches, and other public buildings either damaged or repurposed as emergency shelters, communities have lost key centers for education and social interaction, contributing to a breakdown in daily routines and social cohesion.

In many areas where residences often serve both homes and workspaces, the destruction of housing has had direct economic consequences. Small-scale workshops, farming equipment, stored food supplies, and even livestock have been lost, severely affecting livelihoods, particularly for communities reliant on agriculture, handicrafts, and tourism.

Prolonged displacement is now a growing concern, making it increasingly difficult for families to resume normal life and begin rebuilding. Without immediate support for expanding temporary shelter and planning for transitional or permanent housing reconstruction, recovery will be significantly delayed. There is also concern that informal shelters could evolve into semi-permanent settlements lacking proper infrastructure or land tenure arrangements, complicating future rehabilitation and development efforts.

To address these challenges, immediate actions must include rapid housing damage assessments, the establishment of well-planned temporary shelters, and the initiation of long-term housing recovery programs. These steps are essential to restoring stability, ensuring dignity for displaced populations, and enabling safe, voluntary returns to their communities.

Table 3-10 List of Persons Temporarily Sheltered at Relief Camps

Number of Camps	Household	Male	Female	Total
4	210	397	478	875

Source: DDM



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-21 Temporary Shelters

3.3.1.2 Health Risks

The aftermath of the earthquake in the Inle Lake region has created serious public health concerns, particularly for displaced communities living in overcrowded and poorly equipped temporary shelters. Contaminated water sources and inadequate sanitation have significantly heightened the risk of disease transmission, especially among vulnerable groups such as children, the elderly, pregnant women, and individuals with chronic health conditions.

Many displaced families are relying on untreated lake water for cooking, and washing due to limited access to clean water. This has led to a rise in waterborne illnesses, including diarrhea, dysentery, and potentially cholera posing a serious threat to public health. In addition, the absence of proper waste disposal systems and inadequate latrine facilities within temporary shelters contributes to unsanitary living conditions, increasing the risk of infection.

Overcrowding in emergency shelters exacerbates the spread of communicable diseases such as respiratory infections, skin diseases, and gastrointestinal illnesses. The lack of proper ventilation, insufficient bedding, and minimal personal hygiene items further compound these risks. Malnutrition is also emerging as a growing concern, particularly for children and pregnant women, as food supplies are inconsistent and often lack nutritional value.

Moreover, access to healthcare services has been disrupted. Many local health clinics have been damaged or overwhelmed, and mobile medical units remain insufficient to meet the growing needs. The lack of medical personnel, essential medicines, and mental health support services further endangers the well-being of the affected population.

To prevent a public health crisis, immediate interventions are urgently needed. Priorities should include:

- Provision of safe and treated drinking water;
- Installation of emergency latrines and sanitation facilities;
- Distribution of hygiene kits and essential medicines;
- Implementation of nutrition support programs for vulnerable groups;
- Public awareness campaigns on disease prevention and hygiene practices.



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-22 Temporary Relief Camp

3.3.1.3 Gender Impact

The burden of post-disaster survival has fallen disproportionately on women and girls. In the aftermath of the earthquake, traditional gender roles such as caregiving, water collection, food

preparation, and household management have become significantly more demanding due to limited access to essential services, displacement, and the loss of livelihood resources.

Women, particularly those heading households especially in the absence of male support or stable income are facing intensified workloads under highly stressful and resource-constrained conditions. Many are simultaneously responsible for the care of children, the elderly, and people with disabilities, further compounding their physical and emotional strain.

The collapse of infrastructure has disrupted access to critical maternal and reproductive healthcare services, placing women and adolescent girls at increased risk. Overcrowded shelters, combined with a lack of privacy and security, have also heightened the vulnerability of women and girls to gender-based violence, harassment, and exploitation often with limited or no access to protection services or support mechanisms.

The economic impact on women has been severe. In many affected communities, women who previously relied on informal income-generating activities such as weaving, food vending, or tourism-related work have lost their means of livelihood. Widows, single mothers, and elderly women face compounded challenges due to reduced access to social safety nets, financial resources, and recovery support.

Moreover, the exclusion of women from decision-making processes in relief and recovery efforts has led to service gaps and the inadequate consideration of gender-specific needs. Female-headed households, in particular, are at risk of being overlooked in the distribution of aid and housing support.

To address these gendered impacts, it is essential to adopt a gender-sensitive and inclusive recovery approach. Priority actions should include:

- Ensuring the safety, dignity, and privacy of women and girls in temporary shelters;
- Re-establishing access to sexual and reproductive health services;
- Preventing and responding to gender-based violence through protection services, reporting mechanisms, and community awareness programs;
- Supporting women's active participation in recovery planning, leadership roles, and community decision-making;

- Providing targeted livelihood restoration programs, vocational training, and access to financial resources to economically empower women.

Recognizing and addressing the distinct challenges faced by women and girls is essential to ensuring a just, inclusive, and resilient recovery process that leaves no one behind.

3.3.2 Economic and Livelihoods Impact

The recent earthquake has severely disrupted local economies and traditional livelihoods in the Inle Lake region. Agriculture, fishing, and tourism sectors that form the backbone of the regional economy have been critically affected. These disruptions not only undermine the economic resilience of households but also threaten long-term recovery and development in the region. The informal nature of many income-generating activities and the region's dependence on natural resources have exacerbated vulnerabilities, especially among marginalized groups such as women, elderly persons, and ethnic minorities.

3.3.2.1 Agriculture

Agriculture, particularly tomato cultivation on Inle Lake's traditional floating gardens has suffered severe destruction due to the combined impacts of the recent earthquake and earlier flooding. About one-third of floating farms in the region were damaged by the earthquake, following an earlier flood that had affected nearly half. These unique agricultural systems made from layers of aquatic vegetation and lakebed mud were torn apart by seismic shocks and rendered unusable by sedimentation, contamination, and structural collapse. Many gardens were displaced, submerged, or fractured, while bamboo poles that anchor them were uprooted, making cultivation and access extremely difficult for farmers.

The loss of these floating gardens has had a direct and immediate effect on household income, as tomatoes are a vital cash crop for thousands of smallholder farmers. Many households reported losing entire harvests, leaving them without earnings for the season and unable to repay agricultural loans or afford daily expenses. Market disruptions and supply shortages have triggered price hikes, affecting not only producers but also consumers and traders in surrounding areas. Additionally, the broader food system has been strained, as floating gardens also support a variety of vegetables used for both commercial and household consumption.

Recovery in this sector requires urgent and coordinated efforts. Farmers need technical guidance to restore the floating beds and improve their resilience against future shocks. Essential support should include the provision of agricultural inputs such as seeds, compost, and tools, along with rehabilitation of boats and small irrigation equipment. In the longer term, strategies like crop diversification, climate-adaptive farming methods, and disaster-resilient infrastructure must be introduced to safeguard both food security and livelihoods in the region.

3.3.2.2 Fishing and Aquatic Farming

Fishing and aquatic farming, long-standing livelihoods for communities around Inle Lake, have been seriously disrupted by the ecological consequences of the recent earthquake. The seismic activity triggered large-scale sediment displacement, water contamination, and changes to the aquatic environment. As a result, water clarity and oxygen levels have declined, while debris and pollutants from collapsed structures have further degraded the lake's ecological balance. This has disrupted fish breeding grounds and significantly reduced fish populations and other aquatic organisms.

These changes have had a direct impact on local livelihoods. Many households that rely on small-scale fishing or aquaculture for daily income and subsistence now face reduced catches and increased difficulty in maintaining fish stocks. Fish cages and ponds have been damaged or swept away, while fishing gear such as nets and boats have been lost or rendered unusable. For families who engage in fishing as a supplementary source of income particularly in times of agricultural downturn this additional loss deepens their economic vulnerability and threatens food security.

Recovery efforts must prioritize both environmental and economic restoration. Immediate needs include the replacement of lost fishing equipment, rehabilitation of fish cages and ponds, and clean-up of debris in the lake. In the medium to long term, restoring aquatic habitats, improving water quality, and introducing sustainable fishery practices will be vital to reviving fish populations. Support for community-based resource management, technical training in eco-friendly aquaculture, and access to microcredit for rebuilding operations can help fishing-dependent households recover their livelihoods and build greater resilience against future disruptions.

3.3.2.3 Tourism

Tourism, one of the most vital economic pillars of the Inle Lake region, has been heavily affected by the recent earthquake, compounding the earlier disruptions caused by previous flooding. Inle Lake is internationally recognized for its natural beauty, floating villages, traditional leg-rowing fishermen, cultural heritage sites, and handicraft markets. However, the earthquake damaged key infrastructure including hotels, guesthouses, boat docks, walkways, pagodas, and roads, making many tourist areas unsafe or inaccessible. Flooding prior to the earthquake had already disrupted transport and access to lakeside attractions, leading to a significant decline in tourist arrivals even before the seismic event.

The combined disasters have triggered widespread booking cancellations and temporary closures of businesses that cater to tourists, such as boat tour operators, local guides, souvenir sellers, restaurants, and homestays. Small businesses, many of which are family-run and lack formal insurance or financial reserves, are among the hardest hit. With the tourism sector largely informal, many workers now face a sudden loss of income and employment, especially women and youth who depended on tourism for seasonal or part-time work. The decline in tourist activity has also reduced demand for local products, including handicrafts and traditional foods, further weakening the economic ecosystem tied to the sector.

Recovery of the tourism industry will require a phased and coordinated approach. In the short term, safety assessments, infrastructure repairs, and clear communication to rebuild traveler confidence are essential. Local authorities and tourism associations must work together to rehabilitate key tourist routes and public facilities, while providing temporary support to affected businesses and workers. In the longer term, efforts should focus on diversifying tourism offerings such as promoting eco-tourism and cultural heritage tours and investing in community-based tourism models that prioritize resilience, sustainability, and equitable benefit-sharing among local communities.



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-23 Current Socio-economic Conditions after Natural Disasters

3.3.2.4 Women's Livelihoods

Women in the Inle Lake region play a critical role in the local economy, particularly through their engagement in the informal sector. Many women are involved in the collection, processing, and sale of agricultural produce especially tomatoes as well as in fish processing, weaving, food vending, and running small shops catering to tourists. However, the combined effects of the recent earthquake and previous flooding have severely disrupted these livelihood activities. The destruction of floating gardens, decline in fishing yields, and collapse of local markets have left many women without reliable income, increasing economic insecurity across female-headed households.

This sudden loss of income has not only weakened women's financial independence but also disrupted household stability. In many families, women manage the majority of caregiving and food preparation responsibilities. With livelihoods lost and food prices rising, women face

increased burdens in meeting daily household needs. Widows, single mothers, and elderly women are particularly vulnerable, often lacking access to formal safety nets, credit, or ownership of productive assets. Moreover, because most women operate outside of the formal economy, they are often excluded from mainstream aid and recovery programs, despite being disproportionately affected by the crisis.

Restoring women's livelihoods is essential for inclusive and resilient recovery. Recovery efforts must prioritize gender-sensitive support that includes financial assistance, vocational training, and re-establishment of women's cooperatives. Women should be actively involved in recovery planning, market re-entry strategies, and local leadership roles. Supporting women-led businesses, reviving handicraft value chains, and improving access to childcare and public services will not only rebuild incomes but also strengthen social cohesion and community resilience in the long term.

3.3.3 Environmental Impact

The combined impact of the earthquake and preceding flooding has resulted in significant environmental degradation across the Inle Lake region. The region's delicate lake ecosystem, which supports agriculture, fishing, tourism, and biodiversity, has been severely disrupted. Key environmental concerns include sedimentation of waterways, shortage of aquatic vegetation, deterioration of water quality, and the improper disposal of demolition waste. These environmental issues have not only harmed natural systems but also deepened the socio-economic impacts of the disaster.

3.3.3.1 Waterways

The recent earthquake, combined with prior episodes of seasonal flooding, has led to significant sedimentation in the waterways and canals of the Inle Lake region. The tremors triggered widespread soil displacement from surrounding hillsides, riverbanks, and disturbed lakebeds, while floodwaters carried silt, organic debris, and eroded materials into the lake's network of channels. These waterways are critical to the daily functioning of the region's floating villages and serve as the primary transportation routes for goods, agricultural products, and people. The sudden and dense accumulation of sediment has clogged these passages, severely disrupting water flow and contributing to stagnant, shallow water conditions.

Environmentally, the sedimentation has altered the hydrological balance of the lake. Reduced water circulation has created localized stagnation, diminishing oxygen levels in the water and increasing the risk of algal blooms. Fish breeding areas, especially those in shallow and vegetated zones, have been smothered by silt, affecting reproductive cycles and reducing fish populations. Aquatic biodiversity is under pressure, as sensitive species struggle to adapt to changing water quality and habitat loss.

The long-term impacts of sedimentation could be severe if not addressed. Prolonged disruption of water flows may contribute to shrinking lake area, shoreline erosion, and further ecological imbalance. Moreover, the physical disconnection of water bodies through sediment-filled channels can fragment habitats and limit nutrient exchange between sections of the lake. Restoring waterway connectivity should therefore be a key priority in environmental recovery efforts. This will require a coordinated sediment dredging program, reforestation of degraded catchment areas to reduce future runoff, and the establishment of sediment traps or retention ponds to prevent further inflow of debris into critical lake areas. Involving local communities in monitoring and maintenance of the waterways can also enhance sustainability and ownership of restoration processes.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-24 Current Conditions of Waterway at Inn Dein Creek

3.3.3.2 Aquatic Weed Shortages

Aquatic vegetation particularly floating weeds plays a vital role in the agricultural ecosystem of the Inle Lake region. These weeds are fundamental to the construction and maintenance of floating gardens, a traditional and ecologically sensitive farming method used by generations of local

farmers. In addition to their use as the structural foundation for crops, aquatic weeds are harvested for use as organic compost, and even as supplemental livestock feed, making them a multi-functional natural resource in this unique agroecosystem.

The earthquake, compounded by prior flooding, has caused extensive ecological disturbance, leading to a severe shortage of these critical aquatic plants. Submerged or contaminated weeds were destroyed during the disaster, while others were swept away by strong water currents or buried under layers of sediment. Additionally, many of the shallow wetland zones that typically support dense aquatic vegetation were disrupted, further reducing natural regrowth capacity. In the immediate aftermath, farmers desperate to restart agricultural activities engaged in intensive and unregulated harvesting of remaining aquatic plants, unintentionally contributing to over-extraction and ecosystem stress.

This shortage has created a serious bottleneck in the recovery of agricultural production systems. Without sufficient aquatic vegetation, farmers are unable to reconstruct or stabilize their floating gardens, which serve as the base for growing tomatoes and other vegetables central to both household consumption and market sales. The lack of composting material also compromises soil fertility, which may affect crop yields even after the physical restoration of the gardens. Livestock feeding has become more difficult and costly, as many households depended on readily available aquatic weeds as a low-cost feed source for cattle, buffaloes, and pigs.

If the aquatic weed shortage persists, it could threaten long-term food security and reduce the economic resilience of entire communities. The dependency on these natural materials, without effective replenishment strategies or alternative resources, exposes the local agricultural system to significant risk. Targeted interventions are urgently needed to address this challenge. These should include the protection and rehabilitation of weed-rich wetland zones, replanting or propagation of fast-growing aquatic species, and the regulation of harvesting practices to prevent overuse. Furthermore, research into sustainable alternatives such as coir fiber, aquatic mats, or biodegradable planting substrates could provide supplementary options for floating garden reconstruction and help diversify input sources.

Community education, technical training, and institutional support must be integrated into the recovery process to promote sustainable weed harvesting, improve water management, and build resilience in the face of future environmental shocks. Strengthening local environmental

stewardship and encouraging farmer-led monitoring of aquatic vegetation can also contribute to the sustainable regeneration of this critical natural resource.

3.3.3.3 Water Quality

The water quality of Inle Lake has sharply deteriorated in the aftermath of the recent earthquake, exacerbating the already stressed environmental conditions caused by previous flooding. The lake, which supports the livelihoods of thousands and serves as the primary source of water for domestic use, agriculture, and aquaculture, is now facing a serious pollution crisis. Large volumes of debris, decaying vegetation, and solid waste from damaged homes and infrastructure have entered the lake, accompanied by runoff containing fertilizers, pesticides, and other chemicals from surrounding agricultural plots.

One of the most concerning developments is the widespread discharge of untreated human waste directly into the lake. With many sanitation facilities damaged or destroyed by the earthquake, households and temporary shelters along the lake's edge have been forced to dispose of waste directly into the water. The collapse of pit latrines, toilets, and septic tanks has compounded the problem, resulting in the spread of pathogens and elevated levels of organic pollution. As a result, the lake exhibits visible signs of contamination, including greenish discoloration, strong odors, algal growth, and floating debris. These indicators signal deteriorating water quality, oxygen depletion, and a risk of eutrophication.

The consequences for public health are severe. Communities living in stilt houses or along the lake's perimeter rely on the lake for cooking, washing, and even bathing. With the degradation of water quality, these residents face increased exposure to waterborne diseases such as diarrhea, dysentery, cholera, and skin infections. Children, the elderly, and people with weakened immune systems are especially at risk. The pollution has also impacted fish populations and aquatic ecosystems, threatening food security, biodiversity, and the viability of the lake's fishing industry. The tourism sector, too, is affected, as environmental quality is closely linked to the region's attractiveness to visitors.

Table 3-11 On-Site Water Quality Test Results from ECD (Shan State) Before Earthquake

ပြည်နယ်ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန၏ အင်းလေးကန်အတွင်းရှိ ရေအရည်အသွေး OnSite (U53G) တိုင်းတာမှုရလဒ်များ ၂၀၂၅ ခုနှစ်၊ မတ်လ												
စဉ်	တိုင်းတာသည့် Parameter	Unit	NSWQS (Class V)	ညောင်ရွှေလှေဆိပ် 21°28'29.64"N 96°53'22.99"E	ဖောင်တော်ဦးလှေဆိပ် 20°38'55.58"N 96°55'21.99"E	ရေလယ်ဖိုလ်တံ (20°34'37.80"N ,96°55'2.40"E)	ဓရင်ကြီး (20°29'15.02"N, 96°54'36.60"E)	အင်းပေါ်နိဗ္ဗာ (20°26'48.22"N, 96°53'53.82"E)	ဟံသာရွာမ (20°29'46.09"N 96°53'33.05"E,)	ခေါင်တိုင် 20°35'34.24"N 96°53'0.78"E	မိုင်းဆောက် 20°34'51.91"N 96°56'4.47"E	ဦးသန်းလွင် (ညောင်ဆေးဆိုးလုပ်ငန်း) 20.4468704 N, 96.9038280 E
1.	pH	S.U	5-9	8.06	7.41	8.90	8.67	7.42	8.52	7.96	6.79	7.86
2.	pH (mV)	mV	-	-107	-141	-118	-102	-92	-121	-131	-90	-87
3.	Oxidation Reduction Potential	mV	-	99	124	100	116	135	79	124	134	138
4.	Electrical Conductivity	dS/m	6	0.542	0.557	0.269	0.317	1.23	0.429	1.33	0.851	0.99
5.	Turbidity	NTU	100	385	298	17.8	17.8	105	310	58.7	5.67	10.8
6.	Dissolved Oxygen	mg/l	>2	18.99	12.11	9.34	8.24	5.92	11.87	6.82	9.62	9.91
7.	Total Dissolved Solids	mg/l	2000	345	337	160	175	276	379	218	198	427
8.	Salinity	ppt	35	0.4	0.3	0.4	0.6	0.4	0.2	0.7	0.6	0.6
9.	Water Depth	m	-	0.56	0.59	1.36	1.25	1.35	1.00	1.07	0.87	0.81
10.	Temperature	°C	-	23.17	23.79	28.21	26.27	23.22	23.26	21.22	22.63	22.12

Source: ECD (Shan State)

Table 3-12 On-Site Water Quality Test Results from ECD (Shan State) After Earthquake

ပြည်နယ်ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန၏ အင်းလေးကန်အတွင်းရှိ ရေအရည်အသွေး OnSite (U53G) တိုင်းတာမှုရလဒ်များ ၂၀၂၅ ခုနှစ်၊ ဧပြီလ													
စဉ်	တိုင်းတာသည့် Parameter	Unit	NSWQS (Class V)	ညောင်ရွှေလှေဆိပ် 21°28'29.64"N 96°53'22.99"E	ဖောင်တော်ဦးလှေဆိပ် 20°38'55.58"N 96°55'21.99"E	ကောလာရွာ (20°30'12"N ,96°54'11"E)	ရေလယ်ဖိုလ်တံ (20°34'37.80"N ,96°55'2.40"E)	ဓရင်ကြီး (20°29'15.02"N, 96°54'36.60"E)	အင်းပေါ်နိဗ္ဗာ (20°26'48.22"N, 96°53'53.82"E)	ဟံသာရွာမ (20°29'46.09"N 96°53'33.05"E,)	ခေါင်တိုင် 20°35'34.24"N 96°53'0.78"E	မိုင်းဆောက် 20°34'51.91"N 96°56'4.47"E	ဦးသန်းလွင် (ညောင်ဆေးဆိုးလုပ်ငန်း) 20.4468704 N, 96.9038280 E
1.	pH	S.U	5-9	7.61	7.18	7.35	7.59	6.72	6.97	7.48	7.73	6.66	7.05
2.	pH (mV)	mV	-	-131	-105	-116	-129	-78	-93	-123	-138	-89	-97
3.	Oxidation Reduction Potential	mV	-	129	103	191	126	68	147	87	96	100	124
4.	Electrical Conductivity	dS/m	6	1.77	1.35	1.03	1.05	1.65	1.24	0.003	0.002	0.561	0.907
5.	Turbidity	NTU	100	600	249	22.2	6.04	13.0	82.1	592	4.87	6.04	56.5
6.	Dissolved Oxygen	mg/l	>2	6.90	4.61	9.63	11.00	2.75	7.24	10.26	10.93	10.12	7.84
7.	Total Dissolved Solids	mg/l	2000	1130	861	621	651	1060	790	2	1	250	556
8.	Salinity	ppt	35	0.9	0.7	0.5	0.5	0.8	0.6	0.0	0.0	0.5	0.4
9.	Water Depth	m	-	0.75	0.80	1.20	1.35	1.05	1.15	0.60	0.65	0.95	0.90
10.	Temperature	°C	-	24.27	24.09	23.42	24.03	25.17	24.84	22.87	24.18	24.65	24.89

Source: ECD (Shan State)

According to the results of on-site measurement by ECD (Shan State), the turbidity levels of Inle Lake and surrounding water bodies showed a significant increase after the earthquake when

compared to the levels recorded before the event. Prior to the earthquake, turbidity values with a maximum of 385 NTU, with only a few locations exceeding the National Standards for Water Quality Guideline (NSWQG) Class V threshold of 100 NTU. However, after the earthquake, the turbidity levels escalated sharply, reaching up to 600 NTU in some monitoring sites. Multiple locations showed values well above the standard, such as 592 NTU and 249 NTU. This substantial rise in turbidity is likely attributed to sediment disruption, soil erosion, and increased runoff caused by seismic activity. The post-earthquake data clearly indicate a decline in water clarity, posing potential risks to aquatic ecosystems and water usability in the region.

To address this growing crisis, a coordinated and multi-pronged response is urgently needed. Temporary sanitation facilities should be installed to prevent further contamination, and urgent repairs to damaged sewage systems must be prioritized. In the medium to long term, investments should be directed toward the development of climate-resilient water and sanitation infrastructure, environmental monitoring systems, and public education campaigns on hygiene and safe water use. Rehabilitation of the lake's ecosystem through wetland restoration, biological filtration zones, and community-led waste management will be essential to restoring water quality and preserving the ecological integrity of Inle Lake for future generations.



Source: Social Media



Source: E Guard Study Team

Figure 3-25 Current Condition of Water Quality in Inle Lake near Residential

3.3.3.4 Demolition Waste Disposal

The earthquake in the Inle Lake region has generated large volumes of demolition debris, including materials from collapsed homes and public buildings such as wood, bamboo, tin sheets, roofing tiles, bricks, plastics, and broken household items. In many of the hardest-hit villages, this rubble remains scattered across residential areas, roads, public spaces, and lakeside walkways. The lack

of adequate equipment, manpower, and waste disposal systems has hindered efforts to clear these materials, leaving communities to manage the debris on their own, often without safe disposal options.

The unmanaged waste poses multiple risks. Piles of debris obstruct movement and complicate access for emergency services, humanitarian aid, and reconstruction teams. In densely populated areas, it increases the risk of injuries, especially for children, elderly persons, and those navigating unstable ground. The materials also harbor insects and vermin, contributing to unhygienic conditions. In an attempt to deal with the waste, some residents have resorted to burning debris or dumping it in or near the lake and canals. These practices have led to further air and water pollution, contributing to the ongoing deterioration of water quality and placing additional strain on the already fragile environment.

Addressing this issue requires the urgent establishment of safe, systematic, and environmentally responsible demolition waste management mechanisms. Immediate actions should include the deployment of local cleanup teams, supported by municipal authorities or humanitarian actors, to remove debris from critical zones. Designated temporary waste collection and sorting sites must be established with clear protocols for hazardous materials and recyclable components. Community involvement will be key: awareness campaigns on safe disposal practices, combined with training for local waste handlers, can foster shared responsibility and ensure sustainability. In the long term, investing in localized waste recycling infrastructure, introducing green building materials, and incorporating disaster-resilient urban planning can help reduce the environmental footprint of future disasters and contribute to more sustainable reconstruction.



Source: Social Media



Source: E Guard Study Team



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-26 Demolition Waste

3.3.4 Impact on Biodiversity and Ecosystem

Today, lakes worldwide are suffering from severe environmental degradation, including Climate change such as flooding and earthquake, sedimentation, pollution, eutrophication, declining water levels, and deteriorating water quality, disrupting the lake's delicate aquatic and terrestrial ecosystems, leading to long-term ecological consequences. Inle Lake is no exception. A study comparing 1935/1937 topographic maps with 2000 Landsat satellite imagery revealed that 93% of the lake's 22.41 km² loss of open water over 65 years was due to floating garden expansion and the displacement of degraded garden debris to the lake's edges (Sidle et al., 2007).

These environmental changes have serious consequences for local communities, disrupting traditional livelihoods and threatening the lake's delicate ecosystem. If systematic observation and research activities on Inle Lake are not conducted, the ongoing environmental degradation could escalate, exacerbating adverse impacts on both biodiversity and the local communities reliant on the lake's resources for their livelihoods and survival.

3.3.4.1 Before Earthquakes and Flooding

a. Large-Scale Deforestation

Deforestation in the Inle catchment area has been a major driver of ecological decline. The removal of natural vegetation for agriculture, fuelwood, and settlements has reduced forest cover, exacerbating soil erosion and sedimentation in the lake.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-27 Land Cover Changes Due to Deforestation

b. Loss of Habitat and Shelter for Wildlife

The destruction of wetlands and surrounding forests has diminished critical habitats for endemic and migratory species. Key species such as the Inle carp (*Cyprinus intha*) and the Sarus crane (*Antigone antigone*) have faced population declines due to habitat loss.

c. Drying Up of Water Bodies and Springs

Reduced forest cover and unsustainable water use have led to the drying up of natural springs and feeder streams, decreasing water inflow into the lake and affecting its hydrological balance.

d. Soil Erosion and Sedimentation

Shifting cultivation and improper land-use practices have intensified soil erosion, particularly in sloping areas. The eroded sediments flow into the lake, increasing siltation and reducing water depth, which disrupts aquatic vegetation and fish breeding grounds.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-28 Eutrophication and the Mass of Death Snail Shell

e. Eutrophication and Water Quality Deterioration

Agricultural runoff containing fertilizers and pesticides, along with untreated wastewater, has increased nutrient loading in the lake. This has led to algal blooms, oxygen depletion, and the decline of native aquatic species.

f. Invasive Species and Ecological Imbalance

The introduction of invasive species such as water hyacinth (*Eichhornia crassipes*) and Tilapia has disrupted native ecosystems. These species outcompete indigenous flora and fauna, altering food webs and reducing biodiversity.

3.3.4.2 After Earthquakes and Flooding

Natural disasters such as earthquakes and flooding have further aggravated the degradation of Inle Lake, compounding existing environmental stresses.

a. Increased Sedimentation and Siltation

Earthquakes is a kind of triggering factor for landslides. However, the prolonged intense precipitation during *Typhoon Yagi* caused numerous landslides at the hillside of Inle Lake, especially in deforested areas. Simultaneously, the runoff washes large amounts of slope wash materials into the lake and deposited at low land and mostly to the lake bed. This accelerates siltation, further shrinking the lake's area and reducing its water-holding capacity.

b. Disruption of Aquatic Ecosystems

Flooding can introduce pollutants, debris, and invasive species into the lake, worsening water quality. Sudden inflows of muddy water can smother aquatic plants and fish habitats, leading to mass die-offs.

c. Habitat Destruction and Biodiversity Loss

Earthquakes may alter the lake's topography, destroying nesting and breeding sites for birds and fish. Flooding can submerge wetlands, displacing species that rely on these ecosystems for survival.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-29 Erosion and Eutrophication

d. Water Quality Decline Due to Contaminant Influx

Post-flooding, the lake may experience increased contamination from agricultural chemicals, sewage, and industrial waste washed in from surrounding areas. This worsens eutrophication and poses health risks to both wildlife and local communities.

e. Long-Term Ecological Consequences

The combined effects of sanitation problem, (traditional habit), deforestation, erosion, earthquakes, and flooding lead to irreversible changes in the lake’s ecosystem. Native species may face extinction, while invasive species could dominate, permanently altering the ecological balance.

3.3.5 Impact on the Fishery

3.3.5.1 Before Earthquake and Flooding

a. Historical and Ecological Changes in Inle Lake: Impacts on Fish Habitat

Prior to the major earthquake and flooding that occurred over a century ago, the water levels in Inle Lake were significantly higher. Current studies indicate that the average depth of the lake has since declined to approximately 3 meters, creating suboptimal conditions for fish habitats. From a biological perspective, many fish species prefer deeper waters over expansive shallow areas due to their limited tolerance to strong vibrations. The otoliths (ear stones) within a fish’s skull are highly sensitive to disturbances, and the reduced water depth exacerbates their exposure to environmental vibrations by motor boat engine. This physiological stress, in turn, negatively

affects reproductive success, leading to potential declines in fish populations. The lake has a unique diversity as regards its fish population.

b. Eutrophication and Its Ecological Impacts on Inle Lake

The decline in water levels, coupled with inadequate sanitation practices (rooted in traditional habits), excessive use of inorganic chemical compounds in floating gardens, and the expansion of agricultural areas within Inle Lake, has accelerated eutrophication. This process has led to severe oxygen depletion (hypoxia) in the water body. From a biological perspective, most fish species are highly intolerant of prolonged hypoxia and increased water pollution. Consequently, these deteriorating environmental conditions have contributed to a significant decline in fish populations.

c. Invasive Species and Their Ecological Impacts on Inle Lake

A growing concern in wetland management is the proliferation of aquaculture within natural water bodies. In Inle Lake, fish ponds constructed along the northern and western shores have exacerbated water diversion, leading to reduced lake levels and degraded biodiversity. Notably, non-native species such as Tilapia (*Oreochromis niloticus*), introduced for aquaculture despite its African origin, have infiltrated the lake ecosystem. Tilapia now dominates approximately two-thirds of fish catches, outcompeting endemic species due to its rapid reproduction and ecological adaptability. Originally introduced by the Fisheries Department a decade ago, Tilapia continues to spread via overflow from private ponds during seasonal floods, further threatening native fish populations. Similarly, the illegal cage breeding of African catfish (*Clarias gariepinus*) within the lake exposed by researchers poses additional risks to endemic biodiversity. These invasive species compete aggressively for resources, potentially driving local extinctions.



Source: E Guard Study Team



Source: E Guard Study Team

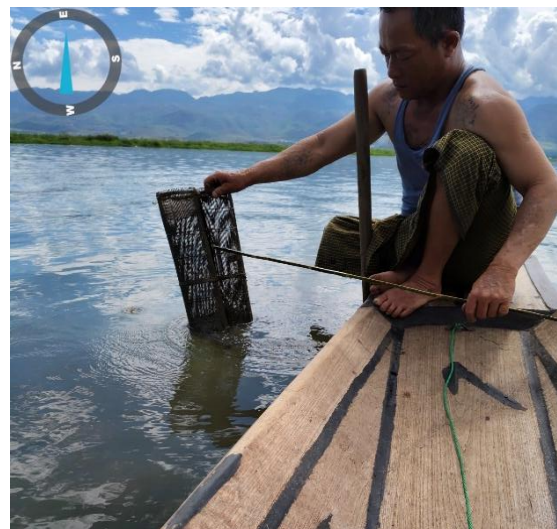
Figure 3-30 Invasive Species

d. Ecological Impacts of Unregulated Fishing Practices on Lake Ecosystems

The absence of seasonal fishing bans during critical breeding periods prevents stock recovery, abandoned fishing gear continues to trap aquatic organisms ("ghost fishing"), and the strategic placement of traps in spawning grounds directly impairs reproductive success. Particularly destructive is the widespread use of electrofishing, which not only depletes target species but also eradicates vital microorganisms, disrupting trophic dynamics and compromising water quality. These cumulative impacts lead to declining fish populations, degraded habitat integrity, and altered ecosystem functioning.



Source: E Guard Study Team



Source: E Guard Study Team

Figure 3-31 Fishing Gear

3.3.5.2 After Earthquake and Flooding

a. Ecological Impacts of Earthquakes and Flooding on Fish Populations in Inle Lake

The substantial accumulation of deceased snail shells following the earthquake indicates a prolonged decline in the water quality of Inle Lake, suggesting that adverse ecological conditions have persisted for an extended period prior to the seismic event. The combined effects of seismic activity and flooding have significantly altered the ecological integrity of Inle Lake, with pronounced impacts on its Ichthyofauna. Earthquakes induce structural changes to benthic habitats through sediment displacement and shoreline collapse, while subsequent floods exacerbate these disturbances by introducing terrestrial debris, nutrient loads, and invasive species from adjacent aquaculture ponds.

These perturbations have led to: (1) destruction of critical spawning grounds due to siltation, (2) hypoxic conditions from organic matter decomposition, and (3) physiological stress in fish populations as evidenced by aberrant otolith morphologies. Particularly vulnerable are endemic species with narrow environmental tolerances (e.g., *Inleocypris auropurpureus* and *Cyprinus intha*), whose populations have declined markedly due to impaired reproductive success and competition with flood-dispersed invasive like *Oreochromis niloticus*. Hydrological modeling reveals these events have reduced the lake's effective fish habitat by approximately 40% since 2010, with recovery hindered by the synergistic effects of climate change and ongoing anthropogenic pressures (Khurtsia 2015).

The degradation of Inle Lake is a result of both human activities and natural disasters. While deforestation, agricultural runoff, and invasive species have long threatened the lake, earthquakes and flooding exacerbate these issues by increasing sedimentation, habitat loss, and water pollution. Sustainable land-use practices, reforestation, and disaster-resilient conservation strategies are urgently needed to restore and protect this critical ecosystem.

These findings highlight the urgent need for targeted conservation strategies, including habitat restoration and sustainable fisheries management, to mitigate the long-term impacts of environmental disturbances on both biodiversity and human communities.

3.4 Loss Inventory

The 2025 Mandalay Earthquake resulted in significant human and infrastructural losses across the affected region. This section provides a detailed inventory of the earthquake's impact, including recorded fatalities, the number of people injured or displaced, and the extent of damage to buildings and critical infrastructure. Compiled from official assessments and field reports, the data presented here aims to offer a comprehensive overview of the human toll and physical destruction caused by the seismic event. Understanding these losses is essential for guiding recovery efforts, informing risk reduction strategies, and strengthening resilience in future disaster scenarios.

3.4.1 Loss Inventory of Building Damage

This section outlines the structural damage caused by the 2024 Inle Lake Flood and the 2025 Mandalay Earthquake, highlighting the scale and nature of destruction to buildings and infrastructure. During the Inle Lake flood, a total of 13 buildings were reported damaged, alongside approximately 30,000 feet of roadway. In addition, numerous electricity and telecommunication towers were affected, leading to disruptions in essential services.

In contrast, the Mandalay Earthquake in 2025 resulted in far more extensive destruction. An estimated over 2,000 buildings, including residential homes, public facilities, monasteries, and temples, suffered varying degrees of damage. The earthquake also caused the collapse of a major bridge, further impacting mobility and emergency response in the region.

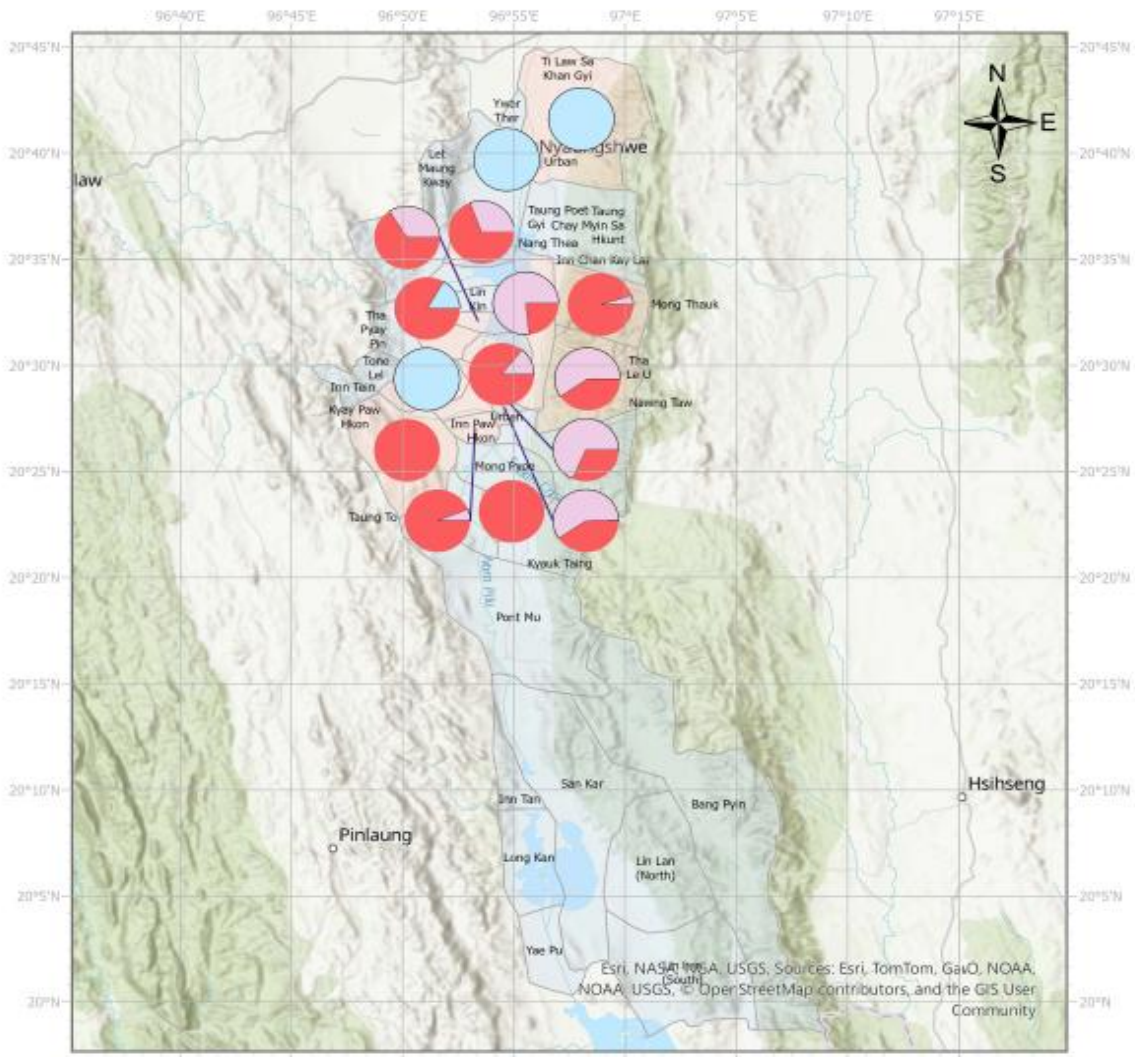
The following figures illustrate the loss inventory of private house in village tract level and the detail are described in the following table.

Table 3-13 Types of Buildings Damaged due to the Earthquake in Nyaung Shwe Township

No.	Name of Ward/ Village Tract	Housing	Collapse				Total
			Reinforced Concrete Building	Timber-Framed Houses		Bamboo Houses	
				Large	Small		
1	Inn Chan/ Kay Lar	828		319	316	193	828
2	Nan Pan	430	1	123	132	174	430
3	Nang Thae	394			121	273	394
4	Min Chaung	217			74	143	217
5	Thale Oo	153		8	83	62	153
6	Mine Thouk	105			5	100	105
7	Inn Paw Khone	65			4	61	65
8	He Yar Ywar Ma	57			39	18	57
9	Inn Ya/ Kyaing Kham	15				15	15
10	Nge Phel Chaung	14			2	12	14
11	Kyun Gyi	6	1			5	6
12	Inn Dein	10	10				10
13	Nanda Wunn Ward	1	1				1
14	Ti Law	1	1				1
15	Kyay Paw Khone	1				1	1
Total		2297	14	450	776	1057	2297

Source: social media

Loss Inventory Map (Buildings) of Inle Lake (Post-Earthquake Assessment)



Loss inventory data is provided by community and government officials
The village location and village tract boundaries are supported



Legend

Damage / Collapse House

- Reinforced Concrete House
- Timber-framed House
- Bamboo House

Affected Village Tract

- Not affected
- Affected

Figure 3-32 Loss Inventory Map (Buildings) of Inle Lake (Post-Earthquake Assessment)

3.4.2 Affected People

This section provides an overview of the human impact caused by the 2024 Inle Lake Flood and the 2025 Mandalay Earthquake, focusing on the number of people affected by each disaster. The flood event in the Inle Lake region had a particularly widespread effect, with approximately 100,000 individuals impacted due to displacement, loss of property, and disruption of livelihoods and essential services.

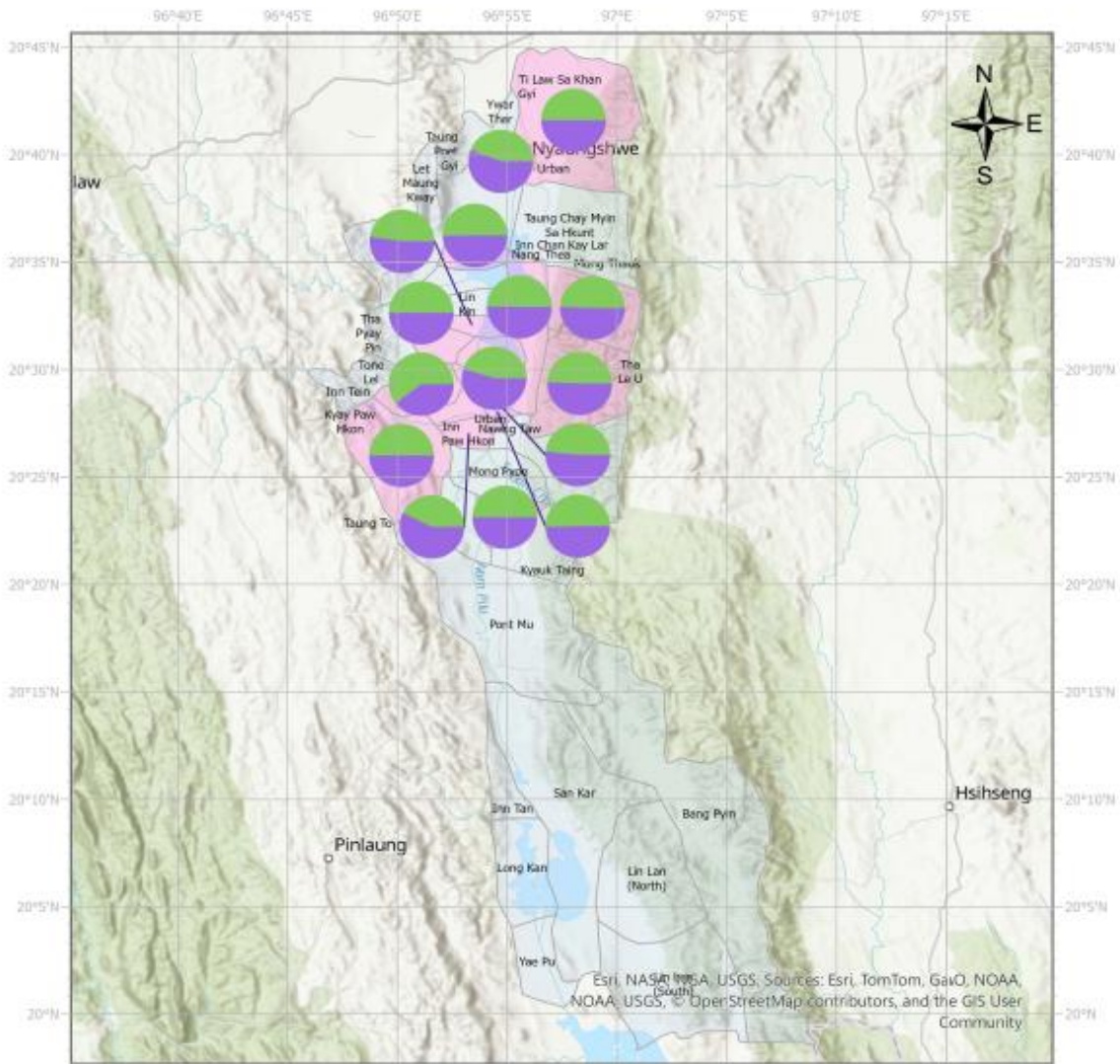
In comparison, the 2025 Mandalay Earthquake currently reported 13,347 affected people, many of whom faced injuries, temporary displacement, and damage to homes and community infrastructure. The following figure represents the affected people during Mandalay Earthquake 2025 in village tract level and the table shows in detail.

Table 3-14 Affected People due to the Earthquake in Nyaung Shwe Township

No.	Name of Ward/ Village Tract	Housing	Total Number of Affected Persons		
			Male	Female	Total
1	Inn Chan/ Kay Lar	828	2618	2637	5255
2	Nan Pan	430	757	745	1502
3	Nang Thae	394	1046	1034	2080
4	Min Chaung	217	608	665	1273
5	Thale Oo	153	571	587	1158
6	Mine Thouk	105	227	232	459
7	Inn Paw Khone	65	490	656	1146
8	He Yar Ywar Ma	57	113	121	234
9	Inn Ya/ Kyaing Kham	15	27	27	54
10	Nge Phel Chaung	14	29	35	64
11	Kyun Gyi	6	13	13	26
12	Inn Dein	10	32	21	53
13	Nanda Wunn Ward	1	11	14	25
14	Ti Law	1	7	7	14
15	Kyay Paw Khone	1	2	2	4
Total		2297	6551	6796	13347

Source: social media

Loss Inventory Map (Affected People) of Inle Lake (Post-Earthquake Assessment)



0 2.5 5 10 15 20 Miles

Loss inventory data is provided by community and government officials
The village location and village tract boundaries are supported



Legend	
Affected People	Affected Village Tract
Affected People_Male	Not affected
Affected People_Female	Affected

Figure 3-33 Loss Inventory Map (Affected People) of Inle Lake (Post-Earthquake Assessment)

3.4.3 Loss Inventory of Fatality

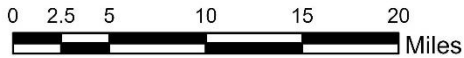
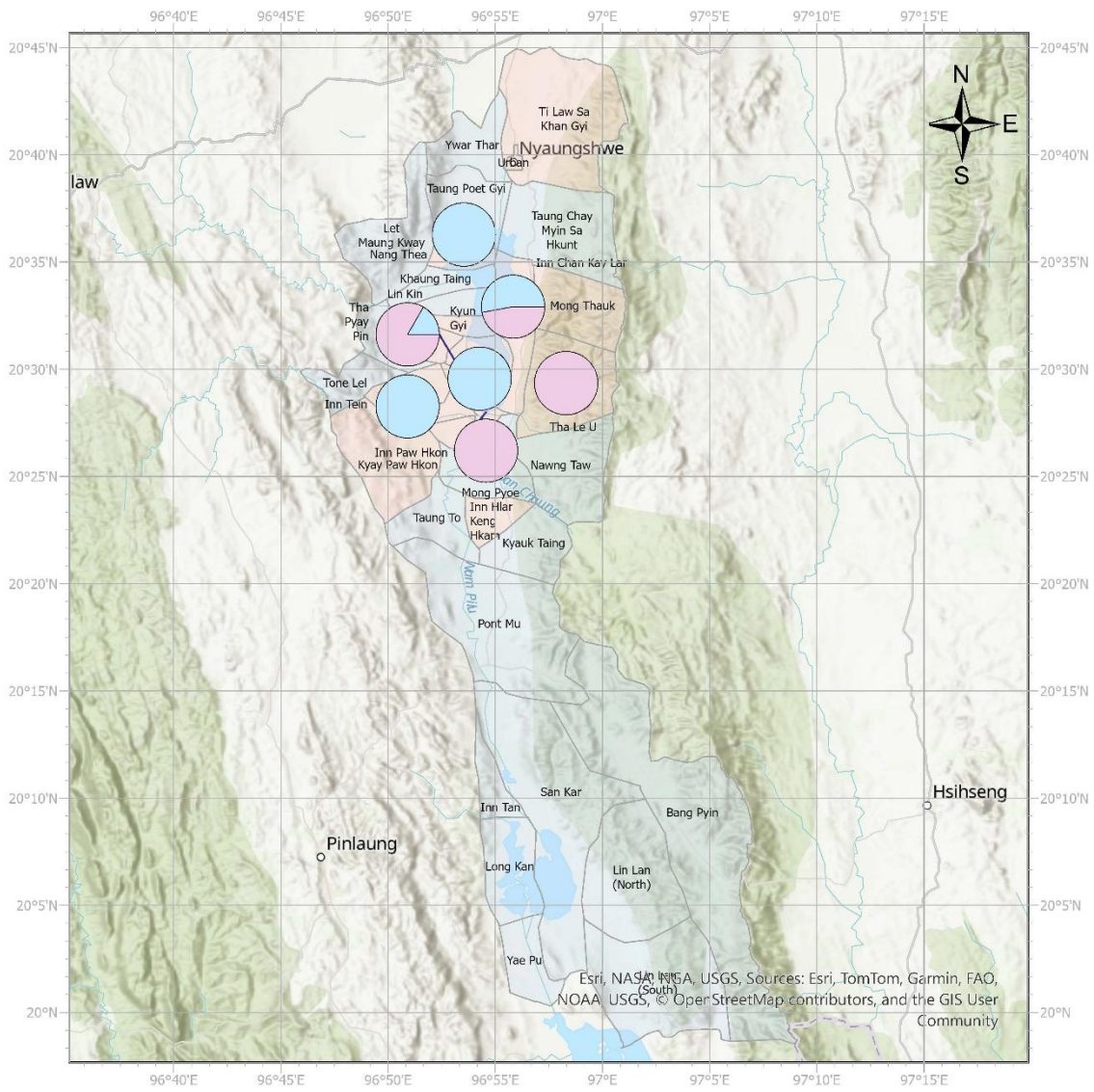
This section presents a summary of human fatalities resulting from two major natural disasters in recent years: the 2024 flood event in the Inle Lake region and the 2025 Mandalay Earthquake. The Inle Lake flood claimed the lives of 10 individuals, primarily due to sudden inundation and limited early warning coverage. In comparison, the Mandalay Earthquake of 2025 had a significantly higher human toll, with 50 fatalities reported as a result of building collapses and related hazards. These figures underscore the urgent need for enhanced disaster preparedness and response mechanisms in vulnerable areas. The following figures represent the fatality list of village tract level during earthquake and the detail are listed in table.

Table 3-15 Fatalities and Injuries Due to the Earthquake in Nyaung Shwe Township

Fatalities							
Male			Female			Grand Total	Remark
Above 18 Years old	Under 18 Years old	Total	Above 18 Years old	Under 18 Years old	Total		
13	7	20	19	11	30	50	
Injuries							
18	5	23	26	1	27	50	

Source: DDM

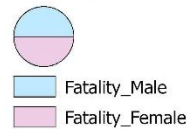
Loss Inventory Map (Fatality) of Inle Lake (Post-Earthquake Assessment)



Loss inventory data is provided by community and government officials
The village location and village tract boundaries are supported

Legend

Fatality



Affected Village Tract

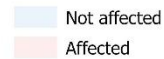


Figure 3-34 Loss Inventory Map (Fatality) of Inle Lake (Post-Earthquake Assessment)

4 NEEDS ASSESSMENT

4.1 Urgent Relief Requirements

In the aftermath of the twin disasters, the immediate humanitarian and environmental needs are substantial and urgent. These events severely disrupted the lives of local communities, destroyed critical infrastructure, and accelerated the ecological degradation of the lake and its surrounding watershed. A rapid and well-coordinated emergency response is essential to stabilize the region and prevent further loss of life, displacement, and environmental damage.



Source: Social media



Source: Social media



Source: Social media



Source: Social media

Figure 4-1 Tiled Traditional Style Stilt Timber Houses under Restoration Work

One of the most pressing needs is the provision of emergency shelter for displaced families. Hundreds of households have lost their homes due to floodwaters and structural collapse from the earthquake. Temporary shelters must be rapidly established, with particular attention to accessibility, sanitation, and safety, especially for vulnerable groups such as the elderly, children, and persons with disabilities.

Equally critical is the restoration of access to clean water and sanitation. Both disasters caused significant water and sanitation problems, leading to the contamination of water sources with untreated sewage, sediment, and waste. This poses an immediate public health risk, with the potential for outbreaks of waterborne diseases. Emergency water purification units, temporary latrines, and hygiene kits are urgently required, along with mobile health clinics to provide medical support and disease surveillance.

Food security is another immediate concern. Emergency food distributions are necessary, prioritizing high-protein, non-perishable supplies to meet basic nutritional needs until local supply chains can be restored.

Infrastructure repair is also essential for short-term recovery. Temporary access routes and rapid repair operations must be implemented to re-establish mobility and supply lines across the lake and surrounding areas.

In addition to physical needs, psychological first aid and community support services are urgently needed. The compounded trauma from back-to-back disasters has left many residents in a state of anxiety and distress. Immediate mental health support, including counseling and community outreach, should be made available through local health facilities and trained volunteers.

Lastly, emergency environmental mitigation measures are required to prevent further degradation of the lake. These include the urgent removal of earthquake debris and flood waste from the lake and streams, clearing blocked drainage channels, and stabilizing landslide-prone areas with erosion control materials. Without these immediate interventions, there is a high risk of further ecological collapse and prolonged displacement of local communities.

Together, these urgent relief requirements form the foundation for a broader, phased recovery and rehabilitation strategy that must follow swiftly to restore the resilience of the Inle Lake region and its people.

4.2 Infrastructure and Housing Reconstruction Priorities

The dual disasters of the 2024 flood and the 2025 earthquake have laid bare the critical vulnerabilities of Inle Lake’s infrastructure and housing systems. Many of the affected communities particularly those with homes and public buildings located on or near the lake suffered catastrophic damage due to both structural weaknesses and environmental degradation. As part of the broader recovery and restoration strategy, urgent and strategic reconstruction of infrastructure and housing must be prioritized to enhance community resilience and support long-term sustainability.



Source: Social media



Source: Social media

Figure 4-2 Donor’s Funded Stilt House Newly Built in Place of Collapsed One on Lake Water

A central priority is the reconstruction of disaster-resilient housing. Many traditional stilted houses, floating homes, and community structures collapsed or were irreparably damaged during the flood and earthquake, either due to direct impact or because they had been weakened over time by poor construction practices and environmental stressors. Rebuilding must go beyond replacing what was lost. New housing should be designed to withstand future floods, seismic events, and strong winds, incorporating elevation benchmarks based on historical and recent maximum flood levels. Technical guidelines, design standards, and community training in resilient construction practices must be urgently developed and disseminated. Incentive-based support schemes should be introduced to assist low-income households in upgrading their homes to meet these new standards.

Public infrastructure is another area in critical need of reconstruction. Many schools, monasteries, health clinics, bridges, and access roads sustained serious damage, disrupting essential services and cutting off vulnerable communities. These facilities must be rebuilt with integrated disaster risk reduction features such as reinforced foundations, elevated platforms, floating shelters, and seismic dampening technologies while also serving as multipurpose community assets during future emergencies. Special emphasis must be placed on rebuilding rural access roads and bridges to reconnect remote villages to markets, schools, and healthcare services.



Source: Social media



Source: Social media

Figure 4-3 Latrine Waste in contact with Lake Water and Floated Raw Sewage Deposit from Direct Disposal

During the reconstruction of houses and public buildings, geological investigations are essential to ensure both safety and long-term sustainability. Comprehensive geological, engineering geological, and geomorphological mapping should be carried out across the entire lake and watershed area. In addition, detailed reports on the geohydrology and hydrology of Inle Lake are recommended to support sustainable infrastructure and development projects.

Geotechnical investigations should be conducted prior to any construction activities to ensure structural stability. For human settlement areas, building codes particularly those related to appropriate foundation design should be clearly defined and strictly enforced.

Inle Lake is renowned not only for its scenic beauty and rich biodiversity but also for its ancient structures and cultural heritage, which are key attractions for tourism. Therefore, rebuilding efforts must strike a balance between safety, disaster resilience, and the preservation of cultural identity. While modern reinforced concrete (RC) buildings may offer greater resistance to natural disasters, they risk erasing the region's architectural heritage potentially leading to a loss in tourism value and associated economic opportunities.

In cases of tilted and distorted houses and buildings constructed on timber pile foundations, some structures may be temporarily stabilized by erecting with the aid of counterweights or additional loads. However, most of them cannot be effectively restored using this method. This is primarily due to the loss or reduction of the timber piles' bearing capacity, caused by dynamic external forces such as ground shaking during earthquakes and fluctuations of water levels during unusual flood events. In particular, large-scale buildings like monasteries are especially difficult to stabilize through load adjustments alone. Their foundations are more vulnerable due to not only dynamic loading but also the cumulative effects associated with group pile behavior, leading to a gradual loss of bearing capacity during disaster events.

Over the past decade, Inle Lake has experienced multiple natural disasters, affecting hundreds of thousands of people living in the surrounding areas. In some cases, relocation and the establishment of resettlement zones have become necessary. However, the development of new urban or resettlement areas is a sensitive issue, as both population and land use have increased significantly during this period. This growth has also led to greater losses, caused by natural disasters, which are closely linked to the expanding population and land use. Therefore, any extension of urbanization or human settlement should be carried out through systematic investigation and well-planned design processes.

Since Inle Lake is threatened by various environmental challenges, it is recommended to develop a comprehensive master plan for environmental management. This should include the preparation of environmental potential maps and disaster risk reduction strategies.

Water and sanitation systems must also be urgently restored and upgraded. The earthquake ruptured many existing latrines, while floodwaters contaminated open wells and surface water sources. This has severely impacted public health and access to safe drinking water. Reconstruction should prioritize decentralized, climate-resilient water and sanitation system such as rainwater harvesting systems, and sealed septic systems. All sanitation infrastructure must be designed to prevent the release of untreated waste into the lake, supported by clear regulations, monitoring systems, and community engagement in waste management practices.

The rehabilitation of the local transportation network, including water-based mobility systems, is equally essential. Many piers, floating walkways, and mooring stations were damaged or destroyed, disrupting livelihoods dependent on lake transport. Reconstruction efforts should improve the durability of these structures while also regulating the use of motorboats to reduce environmental pollution. The drainage system is another important factor for infrastructure resilient during multiple natural disasters.

Recommending disaster-resilient structural designs for flood and earthquake rehabilitation is constrained by challenges related to design criteria and conceptual design development. Establishing appropriate design criteria is often limited by insufficient local data on hazard risks, such as precise flood levels or seismic fault activity, which can lead to overly generic or inadequate standards. The variability in regional environmental conditions and construction practices further complicates the formulation of universally applicable criteria. Conceptual design development faces hurdles due to the high costs of integrating advanced resilient features, such as floating shelters, base isolators or elevated foundations, which may be unaffordable for low-income communities. Additionally, a lack of local expertise in disaster-resilient engineering can result in designs that fail to address site-specific risks effectively. Stakeholder resistance, driven by unfamiliarity with new technologies or cultural preferences for traditional building styles, may also impede the adoption of innovative designs. These limitations highlight the importance of tailoring design criteria to local contexts, investing in capacity-building for engineers, and engaging communities to ensure that rehabilitation efforts are both resilient and feasible.



Source: E Guard Study Team



Source: Social media

Figure 4-4 Floating Garden and Local Transport

Finally, reconstruction must be guided by zoning regulations that discourage unsafe development in high-risk zones such as residential area, transformed land, wetland, floating garden, central lake and commercial area. A coordinated land-use planning framework, supported by local and national authorities, is essential to prevent reconstruction in vulnerable areas and to encourage relocation to safer zones where necessary.

In sum, infrastructure and housing reconstruction in the Inle Lake region must be pursued as an integrated, forward-looking process. It should not only restore what has been lost but lay the foundation for a more resilient, inclusive, and ecologically sustainable future for the region and its communities.

4.3 Restoration of Livelihoods and Economic Activities

The combined impact of long-term environmental degradation, the 2024 flood disaster, and the 2025 earthquake has devastated the economic foundations of communities in the Inle Lake region. Traditional livelihoods such as agriculture, fisheries, weaving, handicrafts, and tourism closely tied to the lake's ecological health have been disrupted or entirely lost for many households. As a result, restoring and revitalizing livelihoods must be a central pillar of the recovery plan, not only to support immediate economic stability but also to foster long-term resilience and sustainable development.

Agriculture, particularly the cultivation of floating gardens, suffered extensive damage during both disasters. Many floating gardens were destroyed or rendered unusable due to sedimentation, water contamination, and structural collapse. Restoration efforts must focus on rehabilitating viable floating gardens through environmentally responsible methods, including removal of defunct

plots, dredging of clogged areas, and the introduction of sustainable organic farming practices. Technical support and access to climate-resilient crop varieties, as well as training on pesticide and fertilizer alternatives, will be essential to ensure productivity while reducing ecological harm. Fisheries, another vital livelihood source, were equally affected. Water pollution, sediment buildup, and invasive species such as water hyacinth have drastically reduced fish populations and disrupted breeding cycles. In response, targeted interventions must be made to restore fish habitats, control invasive species, and introduce community-based fishery management systems. Support for alternative aquaculture techniques, such as cage farming in designated clean zones, can help diversify income and reduce pressure on declining natural stocks.

Weaving and handicraft production, primarily driven by local women were also severely impacted by the destruction of homes, loss of looms and materials, and collapse of market access due to damaged infrastructure. Revival of these industries requires a two-pronged approach: immediate provision of materials and equipment to affected households, and the establishment of cooperative production hubs with improved access to national and international markets. Financial assistance, vocational training, and the promotion of women-led microenterprises will be critical in rebuilding these income-generating activities.

Tourism, once a major economic engine for the Inle Lake area, has come to a standstill. Infrastructure damage, environmental degradation, and safety concerns have all contributed to a sharp decline in tourist arrivals. The recovery plan must therefore prioritize not only the rehabilitation of tourism-related infrastructure (such as piers, guesthouses, and cultural sites) but also the promotion of eco-tourism models that highlight the lake's restoration and community participation. Efforts should be made to train local youth in hospitality, environmental education, and guiding services, ensuring that tourism returns in a more sustainable and community-inclusive form.

Cross-cutting these efforts is the need for financial inclusion and access to recovery capital. Many households affected by the disasters have lost their savings and productive assets. Microfinance services, low-interest recovery loans, and grant-based seed funding must be made available to help restart economic activities. These should be coupled with financial literacy training and business development support to ensure long-term viability.

In conclusion, the restoration of livelihoods in the Inle Lake region must be rooted in environmentally sustainable, socially inclusive, and economically viable approaches. It is not enough to rebuild what was lost the opportunity must be seized to transform local economies in ways that strengthen resilience to future disasters while preserving the lake's unique ecological and cultural heritage.

4.4 Social Protection and Psychosocial Support Needs

The successive disasters of the 2024 flood and the 2025 earthquake have inflicted not only environmental and economic devastation on the Inle Lake region, but also deep and lasting social trauma. Entire communities have experienced displacement, loss of homes and livelihoods, family separation, and damage to critical social institutions such as schools, monasteries, and community centers. These overlapping crises have profoundly affected the mental health and social well-being of affected populations, particularly vulnerable groups such as women, children, the elderly, and persons with disabilities.

The compounded stress from environmental degradation, economic insecurity, and physical loss has contributed to rising levels of psychological distress across communities. Individuals have reported symptoms of anxiety, grief, and trauma, exacerbated by the sudden collapse of support networks and the absence of reliable institutional assistance. Children, in particular, have been affected by disrupted education, the loss of familiar environments, and exposure to traumatic events such as the destruction of homes and schools. These experiences, if left unaddressed, could have long-term consequences for cognitive development and social cohesion.

A comprehensive restoration and recovery strategy must therefore prioritize social protection mechanisms and psychosocial support services. Immediate interventions are needed to provide trauma counseling, mental health first aid, and community-based psychosocial care. These services should be accessible and culturally sensitive, integrating local traditions of vipassana meditation, the involvement of religious and community leaders, and training for local volunteers and teachers in basic psychosocial support techniques.

Simultaneously, long-term social protection systems must be strengthened to ensure inclusive recovery and build resilience against future shocks. Cash transfer programs, food security initiatives, and housing subsidies will be critical for supporting the most affected households.

Special attention must be given to displaced populations, female-headed households, and marginalized ethnic or social groups who may face systemic barriers to recovery.

Restoring social infrastructures such as schools, clinics, community centers, and monasteries are also essential for rebuilding the social fabric. These spaces not only provide essential services but also serve as hubs for community engagement, psychosocial support, and the dissemination of recovery-related information. Investments in rebuilding these institutions must be accompanied by capacity building for local service providers, including training in trauma-informed care and disaster-responsive social work.

Moreover, fostering community participation in the recovery process is key to restoring agency and rebuilding trust. Involvement of affected individuals in the planning and implementation of recovery activities promotes a sense of ownership and collective resilience. Establishing community support groups, women's networks, and youth forums can serve as platforms for social reintegration, mutual assistance, and the co-creation of culturally appropriate coping strategies.

In conclusion, social protection and psychosocial support are not ancillary components of the Inle Lake recovery plan, they are foundational pillars for sustainable and equitable rehabilitation. Without addressing the emotional wounds, social vulnerabilities, and institutional gaps exposed by the disasters, efforts to rebuild infrastructure and livelihoods will fall short of achieving true resilience and recovery. A people-centered approach that heals, protects, and empowers must therefore be at the core of the region's restoration strategy.

5 REHABILITATION AND RECOVERY PLAN

5.1 Rehabilitation for Long-term Restoration and Conservation of the Lake

In 2011, at the request of the Ministry of Environmental Conservation and Forestry (MoECAAF), UN-Habitat initiated the drafting of a Long-Term Restoration and Conservation Plan for Inle Lake. This plan adopted a community-based approach to resource management, recognizing that sustainable outcomes are only achievable when local communities are empowered to take ownership, lead decision-making, and actively participate in implementation.

In the context of disaster rehabilitation and the ongoing restoration of the lake's fragile ecosystem, the active involvement of local communities is essential from the outset. Effective coordination with local authorities and government departments is also necessary to ensure smooth implementation through legal enforcement, institutional support, and technical guidance. Empowered community members, civil society organizations (CSOs), and community-based organizations (CBOs) must be guided by clear visions and missions for shaping the future of Inle Lake. They should assess current conditions, determine actions they can undertake themselves, and identify the forms of assistance required from regional authorities and donor agencies to achieve long-term recovery and conservation goals.

5.2 Formation of a Lead Working Group

As an initial step in the post-disaster rehabilitation process, with a focus on the long-term restoration and conservation of Inle Lake, a lead working group will be established to oversee strategic planning and coordination. This body, to be formally known as the Inle Lake Rehabilitation Authority (ILRA), will serve as the central decision-making and implementation unit for Inle Lake Disaster Rehabilitation Project (ILDRP).

The ILRA will be composed of representatives from lake and surrounding villages, members of various community and civil society groups, officials from the Shan State Government, and township and village-level general administration departments. It will also include officers from key departments such as the Environmental Conservation Department, Irrigation and Water Resources Department, Forest Department, Agricultural Department, Disaster Relief Department, and Nyaung Shwe City Development Committee. Other Ministerial Departments, Banks, Health, Education, Cottage Industries etc: will be called upon as and when necessary. Additionally,

technical expertise will be provided by representatives from the Myanmar Engineering Society in Nyaung Shwe and Taunggyi.

A vital component will be the local communities (Owners of the Lake), CBOs and CSOs. NGOs, INGOs, domestic and international professionals (individuals / organizations) will be invited according to their expertise and capabilities as and when required.

The ILRA will be led by an appointed Chairperson, supported by a Deputy Chairperson, Secretary, Treasurer, and a team of committed working members. Each departmental officer will be paired with a counterpart from the local community to ensure collaboration, transparency, and grassroots participation in all aspects of planning and implementation.

The ILRA will engage local consultants and subject-matter experts to develop a strategic rehabilitation framework. These professionals will be contracted to formulate and initiate the framework based on a specific action plan below, to be implemented within the short-term recovery period beginning in the third quarter of 2025. ILRA will then form committees and subcommittees to implement the specific action plan with elected working members.

5.3 Specific Action Plan

Table 5-1 Governance, Planning, and Coordination

Action	Responsible Agencies	Timeline	Resources Needed
<p>Establish a lead organization with local community leaders, mentors and advisors.</p> <p>This organization is named as Inle Lake Rehabilitation Authority (ILRA) to implement the specific action plan.</p>	<p>Representative from Local Community, CSOs, CBOs, Township/village GAD, Representative from Shan State Government, Nyaung Shwe TDC, Representative from Departmental Concerned, Myanmar Engineering Society (MES)</p>	<p>Immediate, Q3 2025</p>	<p>Permanent office, Permanent staff, Meeting venues, Office equipment</p>
<p>Introduce and enforce the Inle Lake Pollution Protection Law to prohibit direct discharge of latrine waste into the lake and mandate the proper construction and regulation of sewage tanks to prevent contamination of lake water.</p>	<p>Local Community, CSOs, CBOs, Township/village GAD, Environmental Conservation Department (ECD), Nyaung Shwe TDC</p>	<p>Q3 2025 Onwards</p>	<p>Consultant, Community Consultations,</p>

Action	Responsible Agencies	Timeline	Resources Needed
Establish a Lake Pollution Monitoring Task Force (ILPMTF)	Environmental Conservation Department (ECD), CSOs, CBOs	Q2 2026	Inle Lake Pollution Protection Law, established. Pollution control expert/officer, Portable Laboratory,
Integrate disaster resilience into regional development plans and zoning regulations.	Shan State Government, Environmental Conservation Department (ECD), Nyaung Shwe TDC, Departmental Concerned, Local Community, CSOs, CBOs	Q1 2026	Planning Consultants, Community Consultations,
Establish infrastructure resilient consultancy services	Shan State Government, Ministry of construction, Ministry of border area development, Federation of Myanmar Engineering Societies (Fed. MES), Local community, CBOs, CSOs	Q3 2025	Structural experts, geotechnical experts, geodynamic experts, building codes
Establish a committee of Inle Area Disaster Risk Reduction and Early Warning System	Shan State Government, Department of Meteorology and Hydrology, Department Disaster Risk Reduction, Department of Planning, Departemnt of Irrigation, Environment Conservation Department, Department of Public Construction.	Q3 2025	DRR expert, guidelines for disaster risk reduction, educator of DRR for communities. Early warning establishment, weather stations.

Table 5-2 Disaster Recovery and Resilience

Action	Responsible Agencies	Timeline	Resources Needed
Conduct structural assessments and retrofitting of building and infrastructures.	Local Community, CSOs, CBOs, Township/Village GAD, Nyaung Shwe TDC, Myanmar, Engineering Society (MES),	Q3 2025– Q2 2026	Civil Engineers, Design Criteria for Building on Lake Water, Structural Assessment Guidelines
Introduce flood/earthquake disaster resilient building design, water supply system and sanitation system through Local Builder/Service Provider Training Programs.	Local Community, CSOs, CBOs, Township/Village GAD, Nyaung Shwe TDC, Myanmar Engineering Society (MES),	Q3 2025–2026	Consultants, Civil Engineer, Technical Manuals, Product Suppliers, Trainers, Community Outreach.
Voluntary Adaptation of Sealed Septic Tank and	Local Community, CSOs, CBOs, Township/Village GAD,	Q4 2025–2026	Recorded list of voluntary Households and

Action	Responsible Agencies	Timeline	Resources Needed
Disposal of Septic Tank Effluent.	Nyaung Shwe TDC, Myanmar Engineering Society (MES),		Commercial entities by Field Survey.
Construction of Secondary Treatment Facility of septic tank effluents at the bank of the lake. Adaptation of septic tank and effluent treatment by enforcement. To train locals to involve in the Waste Management Services.	Local Community, Township/Village GAD, Nyaung Shwe TDC, Myanmar, Environmental Conservation Department (ECD), Engineering Society (MES),	Q4 2025 Onward	Wastewater Engineer, Civil Engineer, Design Criteria for the Treatment Plant and Operation Procedure of Septic Effluent Handling. Acquisition of Treatment Facility Site Location.
Establish Community Based Solid Waste Management System. (Waste collection system and regular clearing of floating debris on the surface of the lake.)	Local Community, CSOs, CBOs, Township/Village GAD, Nyaung Shwe TDC,	Q3 2025 Onward	Final Disposal Site, Waste Collection Services Implementation to follow the 2014 MOECAF Long-Term Restoration and Conservation

Table 5-3 Disaster Risk Reduction and Community Engagement

Action	Responsible Agencies	Timeline	Resources Needed
To construct a Floating Disaster Resilient Shelter complete with sanitation facility to use as a multipurpose function building. Shelter owner will collect revenue from the users at normal period.	Local Community, CSOs, CBOs, Nyaung Shwe TDC, Myanmar Engineering Society (MES), Department of Disaster Management (DDM), Shan State Government, Township/Village GAD	Immediate, Q3 2025	Design and Location Donors, Investors, Contractor, Supplier for Utilities and Waste Management Facility,
Develop community-based early Flood Warning Systems using SMS alerts, sirens and apps. To seek funding from development agency	Shan State Government, Department of Meteorology and Hydrology (DMH), Department of Disaster Management (DDM), Township/Village GAD	Q4 2025	Early Warning Systems, Acquisition of Locations for Installation of Equipment, Communication Systems, Data Center, Equipment Suppliers Training Sessions,
Train village disaster response teams in evacuation planning, first aid, and search & rescue.	Local Community, CSOs, CBOs, Department of Disaster Management (DDM), Myanmar Red Cross Society, Township and Village GADs,	Q3 2025 Onward	NGOs, INGOs, Training Materials, Facilitators, Team Members, Equipment

Table 5-4 Environmental Rehabilitation and Monitoring

Action	Responsible Agencies	Timeline	Resources Needed
Restoration of upland watershed area, Launch a lake-wide reforestation and riparian buffer zone restoration program.	Forest Department (FD), Environmental Conservation Department (ECD)	Q3 2025–Q4 2027	Implementation to follow the 2014 MOECAF Long-Term Restoration and Conservation Plan
Install Ozonation and Aeration System in the lake to improve lake water quality	Local Community, Township GAD, Village GAD, Environmental Conservation Department (ECD)	Q4 2025 Onward	Implementation to follow the 2014 MOECAF Long-Term Restoration and Conservation Plan
Install Water Quality Monitoring Stations at strategic locations across Inle Lake to continuously track key parameters, including indicators of dissolved peat deposits and effects of geothermal alterations in addition to environmental parameters.	Local Community, Township GAD, Village GAD, Environmental Conservation Department (ECD)	Q4 2025 Onward	Water Quality Expert, Water Testing Kits, On-site Sampling and Lab Analysis Capacity, Floating Water Quality Station, Equipment Suppliers
Conduct Comprehensive Geological Investigations of the lakebed to assess the potential impact of geothermal alterations and the presence of organic peat deposits on lake stability and water quality.	Township/Village GAD, Department of Geological Survey and Mineral Exploration (DGSE),	Q4 2025 Onward	Competent Engineering Geologists, Research Scholar, Research Institutes, Site Investigation
Ecological Conservation	Environmental Conservation Department, CSOs, CBOs, NGOs, INGOs,	Q4 2025 Onward	Implement by following the 2014 MOECAF Long-Term Restoration and Conservation
Regular Dredging sediment, Regular Maintenance Clearing of Water Hyacinth	Water Resources Utilization Department	Q4 2025 Onward	Dredging Equipment, Water Hyacinth Clearing Equipment

5.4 Recovery Plan

5.4.1 Short-Term (0-6 Months)

Flood disasters has been recovered by individual supporters, donors and social support organizations. More than six months have passed since the flood disaster; therefore, the short-term rehabilitation plan intended for implementation within that period will no longer be pursued. Below is the short-term rehabilitation and recovery plan for earthquake destruction in Inle Lake.

(1) Temporary Shelters and Relief Distribution

In the immediate aftermath of the disaster around Inle Lake, the rehabilitation and recovery plan prioritize the provision of temporary shelters, along with access to clean water, food, and sanitation to support displaced and affected communities. Urgent efforts are needed to rebuild and repair houses and buildings that have collapsed or sustained damage. Additionally, restoring critical infrastructure including electricity gridlines, public buildings, schools, and hospitals are essential to ensure the continuity of essential services and support the return to normalcy for the affected population.

(2) Community Engagement and Emergency Services

Community involvement is central to the success of both short- and long-term rehabilitation efforts in the Inle Lake region. Public education initiatives should be carried out to raise awareness about the importance of active community participation in recovery and rebuilding processes.

An emergency response plan should be developed and disseminated to enhance preparedness for future disasters. In parallel, programs need to be implemented to promote the conservation of Inle Lake's ecosystem services, while also preserving the traditional livelihoods of the Inthar people and safeguarding the unique cultural heritage of the Inlay region.

(3) Community Empowerment

Empowering Inle Lake's flood- and earthquake-affected communities involves strengthening local leadership, restoring livelihoods, enhancing disaster preparedness, improving access to services, empowering women, cultural sensitivity, sustainable recovery, and supporting psychosocial recovery.

(4) Accessibility of International Aid

Advocate for impartial humanitarian access and support civil society recommendations for ethical aid delivery. There are international aid program designs and funding strategies for support the flood- and earthquake-affected people of Inle Lake, Shan State, Myanmar.

5.4.2 Long-Term (6 Months-5 Years)

(1) Disaster-Resilient Housing and Infrastructure Reconstruction

As part of the long-term disaster rehabilitation and recovery plan for the Inle Lake region, efforts will focus on rebuilding and restoring houses and public structures situated on or near the lake to be resilient to flooding, earthquakes, and strong winds.

As Inle Lake is a heritage-listed area, buildings should not only be stable and resilient but also culturally unique, environmentally friendly, and sustainable.

Each village will be equipped with water level benchmarks to record minimum, average, and maximum flood levels, providing critical reference points for future planning and construction.

To address rising bed levels in Inle Lake caused by accelerated sedimentation from both natural and human-induced activities, regulations and education programs will be implemented to ensure that buildings are designed and constructed above the historical maximum flood level. Furthermore, guidelines and technical support will be provided to promote flood- and earthquake-resilient housing designs.

To control lake pollution, a decentralized approach to wastewater management will be encouraged through education, regulation, and the introduction of appropriate septic tank designs, with financial support mechanisms in place to assist local communities in implementation. Secondary treatment facility will be constructed on nearest bank of the lake to treat effluents collected by fee-based collection service operated by locals. License will be issued by Inle Lake Rehabilitation Authority for installation of septic tanks, operation of secondary treatment facility and effluent collection services.

(2) Community-based Disaster Preparedness Programs

As part of the rehabilitation strategy, a floating, disaster-resilient multipurpose shelter will be constructed on the lake. This structure will be equipped with proper sanitation facilities and designed to serve multiple functions: as an emergency shelter during disasters, a venue for community gatherings, training and a rest point and viewing platform for tourists and visitors. Its floating design will ensure adaptability to fluctuating water levels while supporting both resilience and sustainable lake-based development.

To enhance long-term disaster resilience in the Inle Lake region, community-based disaster preparedness programs will be established with strong local participation. Meteorological stations will be installed across the four major catchment areas, along with hydrologic gauging stations at the region's main streams and automatic water level gauging systems within the lake. These installations will support the creation of a centralized data center to monitor weather and hydrological conditions in real time.

Multi disaster warning system will be developed based on this data, enabling early alerts and timely response actions. Disaster warning system for floods and earthquakes will be established to protect communities and loss of lives and properties.

Community engagement is central to these efforts, with local residents actively involved in the operation, maintenance, and interpretation of these systems, ensuring both local ownership and effective risk communication.

(3) Environmental Rehabilitation of Lake Ecosystem

The long-term environmental rehabilitation of the Inle Lake ecosystem will be established following the Ministry of Conservation and Forestry's (MOCAF) 2014 Inle Lake Long-term Restoration and Conservation Plan prioritizing reforestation, invasive species control, and reducing chemical runoff through organic farming practices

Key actions include monitoring sedimentation rates in the lake's four major inflowing streams to address siltation and manage sediment loads. Water quality monitoring stations will be installed to continuously assess environmental parameters, including specific indicators to detect geothermal leakages and underlying peat deposits.

Authorities to implement stricter zoning regulations to restrict new settlements, commercial buildings and floating garden expansions in sensitive wetland and open water zones, prioritizing areas already impacted by human activity for sustainable development. Comprehensive surveys will be conducted to map and evaluate floating gardens, including inactive or dysfunctional ones, as well as wetlands, agricultural lands, and overall water surface area.

To support sustainable lake management, the plan will also involve evaluating the ecosystem services provided by the lake through biodiversity assessments of aquatic flora and fauna, ensuring informed decision-making for future conservation and development strategies.

(4) Livelihood Restoration and Vocational Training

As part of the long-term rehabilitation strategy for the Inle Lake region, efforts will focus on restoring livelihoods through sustainable and adaptive practices. Traditional floating gardening will be gradually transitioned to more resilient and environmentally friendly methods such as organic farming and hydroponic agriculture, better suited to the changing lake conditions. Additionally, innovative approaches will be introduced to utilize water hyacinth waste collected from routine lake surface maintenance, turning it into value-added products or materials.

The tourism sector will also be revitalized by promoting not only the region's rich cultural heritage but also new, resource-based services that offer unique experiences while generating alternative income opportunities for local communities. Develop eco-friendly tourism policies and enforce waste management to reduce environmental strain. Vocational training and community capacity-building programs will support these initiatives, ensuring long-term sustainability and resilience.

(5) Land Use Planning in Lake Area and the Entire Watershed Area

Proper land use planning, supported by effective law enforcement, is essential for the sustainable management of Inle Lake. The lake's long-term sustainability is largely influenced by current land use patterns and ongoing land cover changes. Rapid increases in population, housing, infrastructure development, and agricultural activities have led to significant ecological disruption, contributing to pollution, pressure on navigation systems, and degradation of natural habitats. The conversion of natural vegetation in upland areas has exposed more soil surfaces, accelerating geomorphic processes such as erosion, sediment transport, and deposition. This rapid sedimentation poses a serious threat to the stability and ecological balance of the lake. Therefore, comprehensive land use planning addressing both the lake and its surrounding watershed is critically important to ensure the resilience and sustainability of Inle Lake.

5.4.3 Donor Engagement Strategies

To ensure the successful implementation and sustainability of the ILDRP Project, a comprehensive donor engagement strategy is essential to be employed. This strategy aims to attract diverse funding sources, foster long-term partnerships, and align donor priorities with local needs and national development goals.

1. Integrated Funding Framework

The project will adopt a multi-tiered funding model that leverages contributions from bilateral and multilateral donors, international financial institutions, philanthropic foundations, and corporate social responsibility (CSR) programs. Investment packages will be tailored to align with the strategic priorities of donors, such as climate resilience, community empowerment, biodiversity conservation, and sustainable livelihoods.

2. Donor Coordination Mechanisms

A Donor Coordination Platform will be established under the oversight of the Inle Lake Rehabilitation Authority to harmonize efforts, reduce duplication, and promote transparency. Regular coordination meetings, joint monitoring missions, and shared reporting frameworks will facilitate information exchange and ensure alignment with the overall rehabilitation roadmap.

3. Transparent Reporting and Accountability

A robust financial and impact reporting system will be instituted, offering donors access to real-time project updates, independent audits, and performance evaluations. Results-based financing mechanisms will be promoted, linking donor contributions to measurable outcomes such as the number of flood-resilient homes built, hectares of reforested land, or households benefitting from wastewater treatment services.

4. Thematic Investment Portfolios

Donors will be invited to support specific thematic portfolios based on their areas of interest, including:

- *Disaster-resilient infrastructure development*
- *Community-based disaster preparedness*
- *Ecological restoration and water quality improvement*
- *Vocational training and sustainable livelihoods*
- *Eco-tourism and cultural heritage promotion*

5. Public-Private Partnerships (PPP)

Opportunities for PPPs will be actively pursued to mobilize additional resources and technical expertise. Corporate donors may engage in areas such as green construction, eco-friendly tourism,

or the development of decentralized wastewater technologies, creating shared value while supporting community development.

6. Incentives for Long-Term Donor Engagement

Multi-year engagement agreements will be encouraged, offering naming rights for infrastructure components (e.g., training centers or shelters), public recognition in national media and project publications, and access to co-branding opportunities for donor-supported initiatives.

7. Alignment with Global and National Frameworks

The ILDRP project will be framed within key international and national commitments, including the Sendai Framework for Disaster Risk Reduction, the UN Sustainable Development Goals (SDGs), and Myanmar's National Adaptation Plan. This alignment will enhance credibility, attract mission-aligned donors, and position the project as a model for climate-adaptive, community-driven recovery.

8. Local Success Showcasing and Donor Missions

Donors will be invited to participate in field visits, community forums, and stakeholder dialogues to witness project impacts firsthand, interact with beneficiaries, and contribute to ongoing learning and adaptation processes.

Through this strategy, the ILDRP project seeks to cultivate a network of committed, collaborative, and accountable donor partners whose support will enable transformative, inclusive, and lasting recovery in the region.

6 MONITORING AND EVALUATION (M&E) FRAMEWORK

6.1 Key Performance Indicator (KPIs)

Key Performance Indicators (KPIs) are essential for the success of the Inle Lake rehabilitation project implementation tasks because they provide measurable benchmarks to track progress, ensure accountability, and guide decision-making. Given the environmental, economic, and social complexities of restoring Inle Lake, KPIs help clearly define objectives, such as water quality improvement, biodiversity restoration, or sustainable tourism development, and monitor whether specific activities are achieving the desired outcomes. By regularly evaluating KPIs, project managers can identify problems early, allocate resources more effectively, and adjust strategies as needed to stay aligned with long-term conservation goals. Ultimately, KPIs foster transparency among stakeholders and build trust by demonstrating tangible progress toward rehabilitating this critical ecosystem.

6.1.1 Disaster-Resilient Housing and Infrastructure Reconstruction

- ✓ Percent of damaged buildings reconstructed with flood/earthquake/wind resilience design
- ✓ Numbers of villages equipped with flood level benchmark markers
- ✓ Percent of new construction built above historical maximum flood level
- ✓ Numbers of households trained in resilient building techniques
- ✓ Numbers of septic tanks installed following approved designs or suggested criteria
- ✓ Percent of effluent safely collected and treated through licensed services
- ✓ Numbers of secondary treatment facilities constructed and operational
- ✓ Numbers of licenses issued for septic systems and treatment facilities

6.1.2 Community-Based Disaster Preparedness Programs

- ✓ Numbers of floating multipurpose disaster shelters constructed
- ✓ Numbers of meteorological stations installed across catchment areas
- ✓ Numbers of hydrologic and water level gauging stations operational

- ✓ Numbers of communities covered by early warning systems for floods and earthquakes
- ✓ Response time between warning issuance and community notification
- ✓ Percent of local residents trained in emergency preparedness and response protocols
- ✓ Numbers of community members involved in operation/maintenance of monitoring systems

6.1.3 Environmental Rehabilitation of Lake Ecosystem

- ✓ Numbers of trees planted at watershed area
- ✓ Percentage of villages with an operational waste collection system
- ✓ Percentage of households actively participating in the waste collection program.
- ✓ Numbers of aerators installed
- ✓ Numbers of ozonation station installed
- ✓ Cubic meters or weight of floating debris removed per month
- ✓ Number of lake-surface clean-up operations conducted per month
- ✓ Numbers of sediment monitoring points installed and reporting
- ✓ Numbers of water quality monitoring stations operational
- ✓ Frequency of environmental parameter reporting (monthly/quarterly)
- ✓ Numbers of geothermal and peat deposit indicators monitored
- ✓ Percent reduction in unauthorized floating garden expansions
- ✓ Area (ha) of wetlands and floating gardens surveyed and mapped
- ✓ Numbers of biodiversity assessments conducted per year
- ✓ Numbers of new zoning regulations enforced and monitored

6.1.4 Livelihood Restoration and Vocational Training

- ✓ Percent of floating garden farmers transitioned to organic/hydroponic methods
- ✓ Numbers of community members trained in alternative farming and income-generating activities

- ✓ Numbers of new products developed using water hyacinth
- ✓ Numbers of Capacity Building Trainings Conducted for Eco-Tourism Stakeholders
- ✓ Numbers of Eco-Tourism services developed and operation
- ✓ Percent increase in tourism-related income due to Eco-Tourism initiatives
- ✓ Numbers of Eco-Tourism services developed and operational
- ✓ Numbers of vocational training programs conducted
- ✓ Numbers of beneficiaries completing training programs
- ✓ Percent of trained individuals employed or engaged in sustainable livelihoods

Each KPI can be tied to baseline assessments and reviewed periodically to monitor progress, measure impact, and adjust implementation strategies.

6.2 Monitoring & Evaluation Framework for Inle Lake Disaster Rehabilitation Plan

The rehabilitation of Inle Lake involves complex, multi-sectoral interventions, including environmental restoration, community engagement, and disaster risk reduction, which require coordinated efforts and clear measurement tools. A Monitoring & Evaluation (M&E) Framework for the Inle Lake Disaster Rehabilitation Plan is crucial for the successful implementation of the project because it provides a structured approach to track progress, assess effectiveness, and ensure accountability. An M&E framework enables project managers and stakeholders to systematically collect and analyze data, identify gaps or inefficiencies, and make informed decisions to adapt strategies in real-time. It also ensures transparency, supports learning from past actions, and helps demonstrate results to donors and the public, thereby increasing the credibility and sustainability of the rehabilitation efforts.

Table 6-1 Disaster-Resilient Housing and Infrastructure Reconstruction

Indicators	Means of Verification	Frequency
Number of flood- and earthquake-resilient houses reconstructed	Construction records, site inspections	Quarterly
Number of villages with installed water level benchmarks	Benchmark installation logs	Quarterly
Number of buildings constructed above historical flood level	Building permits and elevation data	Quarterly
Number of decentralized septic systems installed and licensed	License records and inspection reports	Quarterly
Volume of effluent treated at secondary treatment facilities	Treatment facility operation reports	Quarterly

Table 6-2 Community-based Disaster Preparedness Programs

Indicators	Means of Verification	Frequency
Number of meteorological and hydrological stations installed	Technical installation reports	Semi-Annually
Functionality of early warning systems	System functionality tests and logs	Semi-Annually
Number of community training sessions conducted	Training attendance and feedback reports	Semi-Annually
Level of community engagement in preparedness activities	Community feedback and participation records	Semi-Annually

Table 6-3 Environmental Rehabilitation of Lake Ecosystem

Indicators	Means of Verification	Frequency
Waste collection coverage	Field reports, GPS tracking of collection routs	Monthly
Household participation in waste management system	Spot checks, community survey	Quarterly
Installation of aerators and ozonation station	Technical installation reports	Quarterly
Volume of waste collected	Weight tickets/logs from waste collector	Weekly
Floating debris removal	Lake patrol logs, before/after photos	Biweekly
Water quality parameters tracked and reported	Water quality station data logs	Annually
Area of wetlands and floating gardens mapped	GIS and satellite imagery analysis	Annually
Number of biodiversity and ecosystem service evaluations conducted	Biodiversity assessment reports	Annually

Table 6-4 Livelihood Restoration and Vocational Training

Indicators	Means of Verification	Frequency
Number of farmers transitioned to organic/hydroponic agriculture	Agricultural extension reports	Annually
Volume of water hyacinth reused in productive ways	Waste reuse project documentation	Annually
Increase in eco-tourism visitor numbers and services	Tourism department statistics	Annually
Number of individuals trained in new vocations	Training attendance and certification logs	Annually

6.3 Stakeholder Roles in Monitoring and Feedback

The success of the ILDRP project relies heavily on the active participation and clearly defined roles of diverse stakeholders in ongoing monitoring and feedback. The Inle Lake Rehabilitation Authority (ILRA) will serve as the central coordinating body, issuing licenses for septic system installations, overseeing construction compliance, and ensuring quality assurance across housing and infrastructure reconstruction. It will also regulate effluent collection services and the operation of secondary wastewater treatment facilities.

Local communities, including individuals, community-based organizations (CBOs), and civil society organizations (CSOs), will play a key role in grassroots-level data collection, reporting, and maintenance of infrastructure such as water level benchmarks, septic systems, and emergency shelters. Their involvement will help ensure that monitoring systems, including meteorological and hydrological stations, function efficiently and that flood warning systems are locally relevant and responsive.

Line ministries and departments such as the Environmental Conservation Department, Irrigation and Water Utilization Department, and the Forest Department will provide technical guidance, regulatory oversight, and capacity-building support for community members. Their responsibilities include regular environmental monitoring, enforcement of zoning and construction codes, and assessment of ecosystem health and biodiversity.

Academic institutions and local consultants will assist in evaluating sedimentation rates, water quality, and the effectiveness of ecological restoration efforts. Tourism authorities and vocational training centers will monitor the uptake of livelihood restoration initiatives and provide feedback on program effectiveness to ensure adaptability.

Feedback mechanisms such as participatory village meetings, public reporting dashboards, and digital communication platforms will be established to ensure two-way information flow, enabling all stakeholders to contribute to and benefit from transparent, evidence-based decision-making throughout the rehabilitation and recovery process.

6.4 Adaptive Management Strategies

The ILDRP project employs an adaptive management approach to ensure resilience, flexibility, and sustainability in response to evolving environmental, social, and climatic conditions. This approach emphasizes continuous learning, stakeholder involvement, and iterative improvements based on real-time monitoring and feedback.

Key adaptive strategies include the installation of water level benchmarks in each village to capture historical and current flood trends. These data points will inform future infrastructure designs, ensuring housing and public buildings are constructed above projected flood levels. Periodic reviews and updates to construction guidelines will allow communities to adapt to changing sedimentation patterns and environmental risks.

In response to rising sedimentation in the lake, adaptive regulations and community education initiatives will be implemented to minimize anthropogenic contributions. A decentralized wastewater management strategy, paired with locally operated effluent collection and treatment services, allows for flexible implementation based on village capacity and environmental conditions. The introduction of licensed septic tanks and community-managed secondary treatment systems will be adjusted as needed, with technical and financial support evolving alongside community needs.

Community-based disaster preparedness will be guided by real-time data from meteorological and hydrological stations and automatic water level gauges, which feed into a centralized data center. These systems support an evolving flood and earthquake early warning system, updated continuously as new data and technologies emerge. Local residents are trained to operate and maintain these systems, ensuring long-term viability and enabling locally informed adjustments. Emergency response plans for multiple types of disasters should be established and regularly practiced through drills with well-trained rescue teams. These disaster response teams should be formed at the community level in each village and equipped to communicate effectively with neighboring communities. A comprehensive disaster information system should be developed

across the entire lake region to facilitate timely coordination and response. In addition, regular community discussions and educational programs are essential to raise awareness and strengthen preparedness.

Environmental rehabilitation efforts, including sediment and water quality monitoring, are designed for adaptive intervention. As indicators reveal new risks such as geothermal leakages or shifts in peat deposit behavior conservation strategies will be recalibrated. Biodiversity assessments and ecosystem service evaluations will guide ongoing adjustments to land-use regulations and conservation priorities, ensuring sustainable resource management.

Livelihood restoration is structured to promote flexible and innovative responses to socio-economic and environmental shifts. Transitioning from traditional to organic or hydroponic farming will be phased and community-led, with results evaluated continuously. Vocational training programs will be modified based on market trends and ecological constraints, while water hyacinth reuse initiatives will adapt to technological developments and community uptake.

The project's adaptive management framework ensures that recovery and development strategies remain dynamic, evidence-based, and inclusive capable of adjusting to feedback, lessons learned, and environmental shifts, thereby safeguarding the long-term resilience of the Inle Lake region.

After submitting the main report to the stakeholders, the study team will prepare and submit a Monitoring and Evaluation (M&E) report six months later, based on on-site visits and stakeholder feedback. This M&E report will not only follow up on the restoration and conservation efforts outlined in the main report but will also assess both improvements and any signs of deterioration in the condition of Inle Lake.

7 STAKEHOLDER ENGAGEMENT AND COORDINATION

7.1 Role of Local Authorities, Civil Society, NGOs, INGOs

In the implementation of the ILDRP project, the collaboration between ILRA local authorities, civil society, community-based organizations (CBOs), non-governmental organizations (NGOs), and international NGOs (INGOs) is critical to ensuring community ownership, inclusiveness, and sustainability. Each stakeholder group has distinct yet complementary roles in supporting the project's success across all thematic areas:

7.1.1 Local Authorities

- *Planning & Regulation:* Develop and enforce construction regulations and zoning laws to ensure disaster-resilient infrastructure and environmentally sustainable land use in sensitive lake zones.
- *Licensing & Oversight:* Issue licenses for septic tank installations, effluent collection services, and operation of secondary treatment facilities under the Inle Lake Rehabilitation Authority.
- *Data Management:* Lead the establishment and maintenance of centralized data systems for hydrological and meteorological monitoring, and support the deployment of early warning systems.
- *Policy Implementation:* Facilitate the implementation of the Ministry of Conservation and Forestry's long-term conservation plans and align them with regional development objectives.
- *Resource Mobilization:* Allocate public funds and mobilize support from state-level institutions for infrastructure, shelters, and training centers.

7.1.2 Civil Society Organizations

- *Awareness & Advocacy:* Promote public awareness on disaster risks, climate change impacts, and environmental stewardship through campaigns and community dialogues.
- *Social Accountability:* Monitor the transparency, equity, and effectiveness of rehabilitation measures, particularly regarding the fair distribution of financial support and housing.

- *Feedback Channels:* Serve as intermediaries between communities and authorities to gather, validate, and report community feedback on project implementation and challenges.
- *Inclusivity:* Advocate for gender-sensitive, youth-inclusive, and socially equitable approaches across all recovery activities.

7.1.3 Community-Based Organizations (CBOs)

- *Local Implementation Partners:* Act as direct implementers of localized activities such as installing water level benchmarks, managing shelters, and overseeing wastewater infrastructure at the village level.
- *Monitoring & Maintenance:* Participate in the operation and routine maintenance of flood monitoring systems, septic tanks, and local treatment units.
- *Capacity Building:* Facilitate community-led training in organic farming, disaster preparedness, and alternative livelihoods in collaboration with NGOs.
- *Behavioral Change Agents:* Promote the adoption of sustainable practices like eco-tourism, waste reduction, and conservation farming through peer networks.

7.1.4 Non-Governmental Organizations (NGOs)

- *Technical Assistance:* Provide expertise in resilient housing design, environmental monitoring, disaster risk reduction, and early warning systems.
- *Program Support:* Co-develop and implement community training programs, livelihood initiatives, and disaster preparedness activities in coordination with government and CBOs.
- *Innovation & Pilots:* Introduce and scale innovative solutions such as hydroponic agriculture, water hyacinth repurposing, and floating infrastructure.
- *Monitoring & Evaluation:* Support the development of M&E frameworks and indicators, and independently assess project impacts for learning and improvement.

7.1.5 International NGOs (INGOs)

- *Funding & Strategic Guidance:* Mobilize international funding and provide strategic direction aligned with global best practices in climate resilience, ecosystem restoration, and sustainable livelihoods.

- *Cross-Learning & Knowledge Transfer*: Facilitate knowledge exchange through case studies, policy dialogues, and technical cooperation with other countries or lake regions.
- *Capacity Enhancement*: Support long-term institutional development through training of local authorities and civil society actors in project management, compliance, and adaptive governance.
- *Advocacy at International Forums*: Elevate local success stories and challenges to global platforms to attract sustained support and encourage policy coherence at regional and international levels.

Together, these stakeholders form a coordinated, multi-level governance system essential for the effective implementation, monitoring, and adaptation of the Inle Lake recovery and rehabilitation initiatives. Their joint efforts will enable an inclusive, resilient, and ecologically balanced future for the lake and its surrounding communities.

7.2 Coordination with National Disaster Management Agencies

Effective coordination with national disaster management agencies is critical to the success of the ILDRP project. These agencies bring technical expertise, regulatory authority, and institutional frameworks essential for aligning local recovery initiatives with national disaster risk reduction (DRR) strategies.

1. Integration with the Department of Disaster Management (DDM)

The Inle Lake Rehabilitation Authority (ILRA) will work in close partnership with the Department of Disaster Management under the Ministry of Social Welfare, Relief and Resettlement. This collaboration will ensure that reconstruction efforts comply with national disaster resilience standards and benefit from DDM's expertise in hazard mapping, building codes, and emergency response planning.

2. Joint Planning and Risk Assessment

National disaster management agencies will co-lead multi-hazard risk assessments and vulnerability analyses in the region. These assessments will guide the planning of disaster-resilient housing, infrastructure, and early warning systems. Regular joint review meetings will be held to update plans based on evolving risk profiles and hydrological data.

3. Alignment with the Myanmar National Framework for Disaster Risk Reduction

All project components will be developed in accordance with Myanmar's National Framework for DRR and the Sendai Framework for Disaster Risk Reduction. This alignment ensures strategic coherence, helps leverage national resources, and enhances eligibility for international funding and technical assistance.

4. Data Sharing and System Integration

The centralized data center for hydrometeorological monitoring at Inle Lake will be linked with national early warning and information systems operated by DDM and the Department of Meteorology and Hydrology (DMH). This integration will allow real-time data exchange, enabling synchronized alerts and broader disaster preparedness coverage.

5. Capacity Building and Technical Support

National agencies will provide training and technical support to local authorities and communities on disaster risk reduction, emergency response, and climate-resilient infrastructure development. This will include workshops, simulation exercises, and technical manuals tailored to local needs.

6. Emergency Preparedness and Response Coordination

The floating multipurpose shelter and local emergency plans will be incorporated into the national emergency preparedness framework. Coordination protocols will be developed to ensure rapid response and efficient resource mobilization during disasters, including the pre-positioning of relief supplies and the deployment of national response teams.

7. Regulatory Oversight and Quality Assurance

All major construction and infrastructure components will be subject to oversight by national disaster and urban development authorities to ensure structural integrity, environmental compliance, and adherence to safety standards. Joint inspection and certification mechanisms will be implemented to maintain accountability.

8. Monitoring, Evaluation, and Learning (MEL)

A national-local MEL framework will be established with the involvement of DDM and other relevant agencies. This system will track project progress, assess impact, and capture lessons

learned to inform future policy and program design across similar ecological and disaster-prone regions in Myanmar.

By fostering strong collaboration with national disaster management institutions, the project will enhance coherence, build local resilience, and establish Inle Lake as a model of integrated, community-driven disaster recovery and environmental sustainability.

7.3 Community Participation Mechanisms

Effective community participation is a cornerstone of the ILDRP project, ensuring that the voices, knowledge, and needs of local residents shape and sustain recovery efforts. The project adopts inclusive and participatory approaches across all program components, reinforcing local ownership, social equity, and long-term resilience.

1. Village-Level Recovery Committees

Dedicated recovery committees will be established in each village to serve as the primary platform for planning, coordination, and monitoring of housing reconstruction, infrastructure upgrades, and livelihood restoration. These committees will include representatives from diverse social groups, including women, youth, ethnic minorities, and vulnerable households, ensuring inclusive decision-making.

2. Participatory Design and Monitoring

Community members will be directly involved in designing resilient housing models, selecting appropriate sanitation technologies, and identifying suitable sites for secondary treatment facilities. Regular consultations and feedback sessions will be held to assess progress, adapt designs to local needs, and monitor implementation outcomes.

3. Community-based Data Collection and Benchmarking

Local volunteers, trained and supported by technical experts and NGOs, will participate in setting and maintaining water level benchmarks, contributing to a shared understanding of flood risks. Community-generated data will be integrated into centralized monitoring systems and used to inform early warning alerts and future construction guidelines.

4. Community Management of Infrastructure

Residents will be engaged in the operation, maintenance, and oversight of key infrastructure, such as floating shelters, decentralized wastewater systems, meteorological and gauging stations. Community ownership models, supported by training and maintenance funds, will ensure functionality and sustainability.

5. Participatory Environmental Governance

Communities will play an active role in environmental monitoring, reforestation activities, floating garden mapping, and organic farming initiatives. Citizen science programs and co-management frameworks will empower residents to protect the lake ecosystem while benefiting from its services.

6. Local Livelihood Innovation Platforms

Innovation hubs and vocational training centers will be co-managed by local organizations and community members to co-develop alternative livelihood solutions, such as water hyacinth-based products, ecotourism services, and climate-resilient farming practices. These platforms will foster local entrepreneurship and knowledge sharing.

7. Public Hearings and Social Audits

Transparent mechanisms such as public hearings, grievance redress systems, and social audits will be institutionalized to build trust, ensure accountability, and continuously improve project activities based on community feedback.

8. Partnership with Local Schools and Youth Groups

Awareness campaigns, school-based activities, and youth-led initiatives will be integrated into the recovery strategy to promote long-term behavioral change and community-wide disaster preparedness and environmental responsibility.

Through these mechanisms, the ILDRP project will transform affected communities from passive recipients of aid into active agents of recovery, resilience, and sustainable development.

8 CONCLUSION AND RECOMMENDATIONS

Inle Lake's environmental crisis, rooted in decades of degradation, has been dramatically worsened by the 2024 *Typhoon Yagi* floods and the 2025 Mandalay Earthquake. These disasters have intensified the lake's ecological decline, disrupted livelihoods, and exposed systemic vulnerabilities tied to conflict and climate change. Immediate humanitarian action, coupled with long-term conservation and climate adaptation strategies, is critical to preserve Inle Lake as a biodiversity hotspot and cultural lifeline. International support must prioritize local voices and equitable aid to ensure a sustainable future for the lake and its communities.

Looking to the future, there are growing concerns that without decisive and coordinated action, **Inle Lake could undergo irreversible ecological collapse.** Continued sedimentation, compounded by climate change-induced shifts in rainfall and temperature, may drastically reduce the lake's surface area and water volume. These changes, in turn, could impair agricultural productivity, limit access to clean water, and undermine the cultural identity and economic stability of the communities who depend on the lake.

To address these concerns, a comprehensive and integrated environmental management strategy is required. Restoration of natural vegetation buffers and wetlands must be prioritized to reduce erosion and filter runoff. Wastewater infrastructure needs to be built using disaster-resilient and environmentally friendly technologies. In the wake of the recent disasters, sediment management through dredging and upstream land stabilization is now more urgent than ever. It is equally critical to support sustainable agricultural practices and community education programs that reduce chemical dependency and promote organic farming. Such efforts will require strong collaboration among government agencies, civil society, and international donors to ensure the long-term ecological and socio-economic sustainability of Inle Lake.

ANNEXES

Annex A: Administrative Information of Nyaung Shwe Township

Physical Environment

Climate

Myanmar has a tropical to subtropical monsoon climate with three seasons: the hot dry inter-monsoonal season (mid-February to mid-May), the rainy southwest monsoon (mid-May to late October), and the cool, relatively dry northeast monsoon (late October to mid-February). The coast and country's southern regions in and around the Ayeyarwady Delta and around the Rakhine, Mon, and Tanintharyi coastlines experience a climate typical of Southeast Asia. The coastal regions and the western and southeastern ranges receive more than 200 inches (5,000 mm) of precipitation annually, while the delta regions receive about 100 inches (2,500 mm). According to Nyaung Shwe township GAD Data, the climate temperate and the highest temperature is 46.6°C and the lowest temperature is 15.5°C. The following table shows the annual rainfall and temperature of Nyaung Shwe township.

Annual Rainfall and Temperature of Nyaung Shwe Township

No.	Year	Temperature		Annual Rainfall (Inch)
		Highest (°C)	Lowest (°C)	
1.	2018	35.0	5.0	32.17
2.	2029	37.8	6.0	37.40
3.	2020	36.6	4.5	32.20
4.	2021	34.5	6.4	34.06
5.	2022	30.4	10.2	47.80
6.	2023	33.3	6.8	1.26

Source: *Nyaung Shwe Township Information (GAD, 2023)*

Structural Geology

(a) Location

Nyaung Shwe township is located North Latitude between 19° 58' to 20° 45' and East Longitude between 97° 46' to 97° 55'. It is 7 miles from east to west and 36 miles from south to north. It is bordered by Kalaw and Pinlaung township in the west, Pekon township in the south, Taunggyi and Hsihseng township in the east and Taunggyi township in the north of Nyaung Shwe. Nyaung Shwe township is located 2950 feet (899.16 meters) above sea level. The following table shows the area of Nyaung Shwe township.

Areas of Nyaung Shwe Township

No.	Name of Town	Area of town (square miles)	Area of village tract11 (square miles)	Township area (square miles)
1.	Kan Thar Ward	0.115		0.115
2.	Myo Lel Ward	0.04		0.04
3.	Thar Si Ward	0.112		0.112
4.	Nan Da Wun Ward	0.831		0.831
5.	Mong Li Ward	0.089		0.089
6.	Win Ward	0.064		0.064
7.	Nan Pan Ward	0.061		0.061
8.	Min Ga Lar Ward	0.063		0.063
9.	No (1) Ward, Nan Pan Town	0.354		0.354
10.	No (2) Ward, Nan Pan Town	0.703		0.703
11.	No (3) Ward, Nan Pan Town	0.359		0.359
12.	No (4) Ward, Nan Pan Town	1.035		1.035
13.	Ywar Thar		7.659	7.659
14.	Ti Law		40.389	40.389
15.	Taung Poet Gyi		11.884	11.884
16.	Nan Thea		8.037	8.037
17.	Taung Chay		23.988	23.988
18.	Let Maung Kway		17.531	17.531
19.	Khaung Taing		6.150	6.150
20.	Lin Kin		12.976	12.976
21.	Min Chaung		6.034	6.034
22.	Kyun Gyi		1.917	1.917
23.	Tha Pyay Pin		4.913	4.913
24.	Nga Hpei Chaung		3.342	3.342
25.	Mong Thauk		32.006	32.006
26.	Tha Le U		40.915	40.915
27.	Ywar Ma		0.435	0.435
28.	Inn Chan Kay Lar		3.632	3.632
29.	Inn Dein		3.996	3.996
30.	Naung Taw Thar Lay		3.293	3.293
31.	Inn Paw Hkon		4.214	4.214
32.	Tone Lel		24.081	24.081
33.	Kyay Paw Hkon		28.875	28.875
34.	Mong Pyoe		6.376	6.376
35.	Inn Hlar		5.817	5.817
36.	Taung To		27.237	27.237

No.	Name of Town	Area of town (square miles)	Area of village tract ¹¹ (square miles)	Township area (square miles)
37.	Nawng Taw		11.234	11.234
38.	Kyauk Taing		9.292	9.292
39.	Pont Mu		22.801	22.801
40.	Inn Tan		13.323	13.323
41.	San Kar		43.154	43.154
42.	Bang Pyin		71.821	71.821
43.	Long Kan		10.589	10.589
44.	Yae Pu		12.215	12.215
45.	Lin Lan (South)		17.511	17.511
46.	Lin Lan (North)		19.917	19.917
Total	3.826	5575.564	561.40	

Source: Nyaung Shwe Township Information (GAD, 2023)

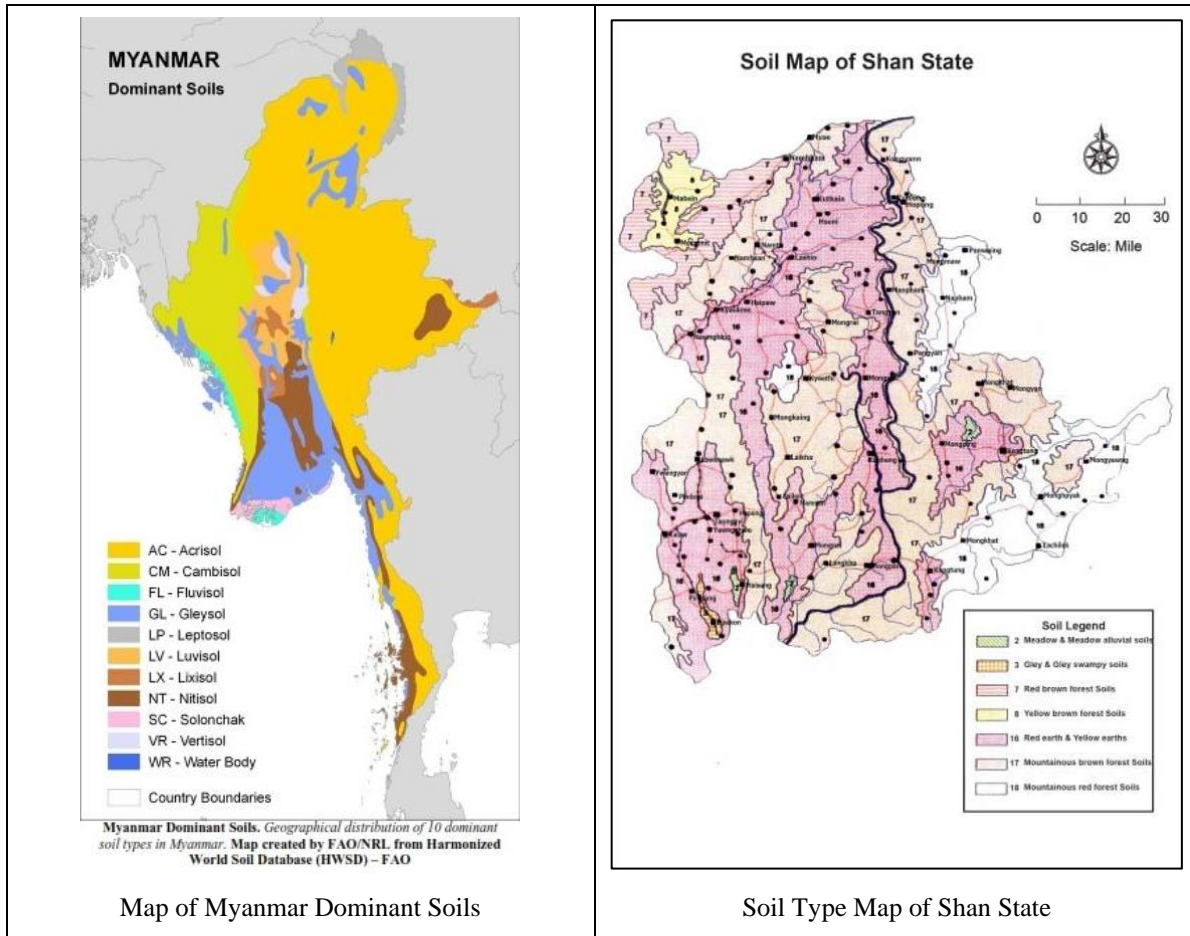
Boundary

Nyaung Shwe township is bordered by Kalaw and Pinlaung township in the west, Pekon township in the south, Taunggyi and Hsihseng township in the east and Taunggyi township in the north of Nyaung Shwe. Nyaung Shwe township is located 2950 feet (899.16 meters) above sea level. The following table shows the area of Nyaung Shwe township.

Topography and Soil

Nyaung Shwe township is bordered by mountain ranges on the east and west sides, with two prominent mountain ridges extending from south to north, 7 miles from east to west and 36 miles from south to north. It covers an area of 359,300 acres (561.40 square miles). The dominant soils of Shan State are Acrisol, Nitisol, and Lixisol. In Nyaung Shwe township, Acrisol soil is the dominant soil and the soil type of is red earths and yellow earths soils. The red earths soils are the most dominating soils of Shan Plateau and of the northern mountainous region at the elevation of more than 3000 feet above sea level. The Shan Plateau is about completely covered with these soils. The yellow earths occur on the lower slopes in the Shan Plateau. They occupy a relatively small area, changing the Red Earths down the slopes. The Red Earths have a very deep profile having the texture varying sandy and silty to silty clay loam and with good structure. They are well drained and easy to plough. The soil reaction is slightly acid to neutral with pH ranging from 6 to 7. However, the yellow earths soils are more acidic and have more clay percentage. Iron and aluminum contents are also very high. The humus contents of yellow earths are more than that of

the red earths. The soils are deficient in nitrogen and phosphorus. The content of potassium is high in the red earths. The red earth is the typical soils for agriculture in Shan State. They are well drained, having good structure and easy to plough so they are very suitable for cultivation of seasonal and perennial crops. However, due to relief and slopes, erosion control measures are required. The Yellow Earths soils can only be utilized for gardens, flowers and forests.



Source: Myanmar Dominant Soils, Soil Types and Characteristics of Myanmar

Soil Map of Shan State

Hydrology/Hydrogeology

In Taungyi District, the Inle Lake watershed area covers 2169.3 square miles. The total area of Nyaung Shwe township is 562.41 square miles. The entire Nyaung Shwe township area located within the Inle Lake watershed area with the total area of 25.23 square miles. There are 29 streams flow into Inle Lake; 16 from the east, 12 from the west and 1 from the north. All the watersheds of the 15 streams flowing from the east of Inle Lake are located within Nyaung Shwe township, covering the total area of 141 square miles. Among the 12 streams flowing from the west of the

Inle Lake, Thanatkha Creek, Yaypae Creek, Thantaung Creek (Kalaw Creek) and Inntein Creek (Belu Creek). The combined watershed area of all streams flowing from the west amounts to 756.8 square miles. The Nam Lat Creek, which flows from the north into Inle Lake, has its watershed covering Yatsauk, Taunggyi, and Nyaung Shwe Townships, and its total watershed area is 528.0 square miles.

Biological Environment

Natural Regeneration

The current environmental condition in Nyaung Shwe township is 15.76 % of forest cover. The eastern protected forest of Inle cover 9.80% and the western protective forest is 14.96%. Due to the growing population, approximately 9598.15 acres of forest area within the township have been degraded. Natural regenerations that are found in Nyaung Shwe township are *Dipterocarpus tuberculatus Roxb*, *Shorea siamensis (Kurz)Miq*, *Melanorrhoea usitata Wall*, *Shorea obtuse*, *PhyllanthusemblicaL*, *Bombox ceiba*, *Bombax insigne*, *Careya arborea Roxb*, *Cratoxylum nerifolium kurz*, *Lanneacoromandelica (Houtt.)Merr*, *Strychnosnux-blundaA.W.Hill* and *Bauhinia acuminata*.

Surrounding Environment

Natural Disaster

The coast and the country's southern regions in and around the Ayeyarwady Delta and around the Rakhine, Mon, and Tanintharyi coastlines experience the highest exposure to tropical cyclones. In Myanmar, 50% of the total number of disasters was related to floods followed by storm (23%), earthquake (15%), and mass movement-wet (12%), whereas 73% of the total affected people by disasters were due to storm followed by floods in 1980-2011.

In Nyaung Shwe township, although there was no disaster of storm, tsunami, and earthquake, it suffered flood, fire disaster and wind disaster. The loss is as follow-

Natural Disaster Occurred in Nyaung Shwe Township

No.	Type of natural disaster	Frequency of occurrence	Number of dead	Damage of building	Loss of value (million/Kyat)
1.	Storm	-	-	-	-
2.	Tsunami	-	-	-	-
3.	Earthquake	-	-	-	-
4.	Flood	1	-	1	3
5.	Fire	4	-	4	1.7725
6.	Wind	2	-	2	2.93
Total		7		7	7.7025

Source: Nyaung Shwe Township Information (GAD, 2023)

(a) Household/ Housing

The Household/ Housing data of Nyaung Shwe Township

No.	Town	Housing	Household	Ward	Village Tract	Village
1.	Nyaung Shwe	409	536	Kan Thar		
2.		247	369	Thar Si		
3.		1430	1460	Nan Da Wun		
4.		104	131	Myo Lel		
5.		198	231	Win		
6.		174	240	Nan Pan		
7.		114	162	Min Ga Lar		
8.		457	520	Mong Li		
9.		430	470	No (1) Ward, Nan Pan		
10.		306	361	No (2) Ward, Nan Pan		
11.		282	308	No (3) Ward, Nan Pan		
12.		120	128	No (4) Ward, Nan Pan		
13.		1499	1499		Nang Thea	8
14.		889	1048		Kyun Gyi	6
15.		1184	1409		Lin Kin	14
16.		873	896		Khaung Taing	5
17.		662	672		Let Maung Kway	8
18.		962	1065		Taung Poet Gyi	14
19.		1466	1630		Taung Chay Myin Sa Hkunt	24
20.		1321	1366		Mong Thauk	17
21.		1080	1146		Ywar Thar	11
22.		3099	3127		Ti Law Sa Khan Gyi	27
23.		2071	2603		Min Chaung	12
24.		995	1140		Tone Lel	9
25.		1289	1453		Tha Pyay Pin	9
26.		628	794		Nga Hpei Chaung	8
27.		908	1121		He Yar Ywar Ma	13
28.		1107	1262		Thar Lay	13

No.	Town	Housing	Household	Ward	Village Tract	Village
29.		494	596		Mong Pyoe	11
30.		1859	1984		Nawng Taw	26
31.		1058	1181		Inn Hlar Keng Hkam	14
32.		1034	1133		Taung To	22
33.		668	669		Kyauk Taing	11
34.		1534	1671		Kyay Paw Hkon	15
35.		765	942		Inn Dein	6
36.		866	1435		Inn Chan Kay Lar	6
37.		982	1225		Inn Paw Hkon	13
38.		1504	1575		Tha Le U	25
39.		841	955		San Kar	9
40.		703	719		Long Kan	9
41.		563	633		Yae Pu	4
42.		680	720		Lin Lan (South)	6
43.		489	597		Inn Tan	9
44.		1554	1714		Bang Pyin	19
45.		748	748		Lin Lan (North)	7
46.		1249	1451		Pont Mu	24
Total		41895	47095	12	34	434

Source: Nyaung Shwe Township Information (GAD, 2023)

(b) Population

Population

No.	Content	Over (18) years			Under (18) years			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
1.	Kan Thar Ward	599	792	1391	201	186	387	800	978	1778
2.	Thar Si Ward	471	553	1024	183	157	340	654	710	1364
3.	Nan Da Wun Ward	2189	2455	4644	766	782	1548	2955	3237	6192
4.	Myo Lel Ward	177	225	402	52	57	109	229	282	511
5.	Win Ward	370	410	780	89	88	177	459	498	957
6.	Nan Pan Ward	331	383	714	110	95	205	441	478	919
7.	Min Ga Lar Ward	217	254	471	71	55	126	288	309	597
8.	Mong Li	764	884	1648	223	193	416	987	1077	2064
9.	No (1) Ward, Nan Pan Town	648	760	1409	266	221	487	915	981	1896
10.	No (2) Ward, Nan Pan Town	528	547	1075	166	138	304	694	685	1379
11.	No (3) Ward, Nan Pan Town	464	532	996	227	189	416	691	721	1412
12.	No (4) Ward, Nan Pan Town	180	206	386	75	68	143	255	274	529
13.	Nan Thea	1669	1732	3401	735	763	1498	2404	2495	4899

No.	Content	Over (18) years			Under (18) years			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
14.	Kyun Gyi	1304	1457	2761	578	533	1111	1882	1990	3872
15.	Lin Kin	1808	1841	3649	741	742	1483	2549	2583	5132
16.	Khaung Taing	1072	1183	2255	432	460	892	1504	1643	3147
17.	Let Maung Kway	851	830	1681	446	457	903	1297	1287	2584
18.	Taung Poet Gyi	1368	1429	2797	691	653	1344	2059	2082	4141
19.	Taung Chay Myin Sa Hkunt	2367	2492	4859	872	827	1699	3239	3319	6558
20.	Mong Thauk	2293	2223	4516	711	711	1444	3004	2956	5960
21.	Ywar Thar	1674	1837	3511	607	607	1143	2281	2373	4654
22.	Ti Law Sa Khan Gyi	4908	5051	9959	2058	2058	4143	6966	7136	14102
23.	Min Chaung	3184	3287	6471	1277	1277	2607	4461	4617	9078
24.	Tone Lel	1404	1482	2886	526	526	1002	1930	1958	3888
25.	Tha Pyay Pin	1999	2107	4106	766	766	1494	2765	2835	5600
26.	Nga Hpei Chaung	1058	1165	2223	373	373	726	1431	1518	2949
27.	He Yar Ywar Ma	1292	1593	2885	372	375	747	1664	1968	3632
28.	Thar Lay	1701	1891	3592	541	521	1062	2242	2412	4654
29.	Mong Pyoe	787	870	1657	348	218	602	1171	1088	2259
30.	Nawng Taw	3082	2997	6079	1353	1362	2705	4435	4359	8794
31.	Inn Hlar Keng Hkam	1590	1862	3452	696	759	1455	2286	2621	4907
32.	Taung To	1721	1887	3608	646	608	1254	2367	2495	4862
33.	Kyauk Taing	1138	1138	2276	454	435	889	1592	1573	3165
34.	Kyay Paw Hkon	2490	2599	5089	959	978	1937	3449	3577	7026
35.	Inn Dein	1177	1308	2485	532	548	1080	1709	1856	3565
36.	Inn Chan Kay Lar	1987	1996	3983	733	712	1445	2720	2708	5428
37.	Inn Paw Hkon	1528	1787	3315	500	487	987	2028	2274	4302
38.	Tha Le U	2303	2404	4707	788	774	1562	3091	3178	6269
39.	San Kar	1401	1419	2820	622	601	1234	2034	2020	4054
40.	Long Kan	1274	1292	2566	443	436	879	1717	1728	3445
41.	Yae Pu	886	904	1790	465	460	925	1351	1364	2715
42.	Lin Lan (South)	1082	1130	2212	474	446	920	1556	1576	3132
43.	Inn Tan	916	1011	1927	412	427	839	1328	1438	2766
44.	Bang Pyin	2235	2210	4445	1365	1397	2762	3600	3607	7207
45.	Lin Lan (North)	1229	1231	2460	466	495	961	1695	1726	3421
46.	Pont Mu	2264	2218	4482	920	916	1836	3184	3134	6318
Total		65981	69864	135845	26378	25860	52238	52238	92359	95724

Source: Nyaung Shwe Township Information (GAD, 2023)

(c) Ethnicity and Religion

Ethnicity Living in Nyaung Shwe Township

No.	Ethnicity	Percentage of township population
1.	Kachin	002.
2.	Kayah	022.
3.	Kayin	009.
4.	Chin	003.
5.	Mon	001.
6.	Burma	542.
7.	Rakhine	002.
8.	Shan	727.
9.	PaO	1726.
10.	Danu	045.
11.	Palaung	001.
12.	Taungyo	360.
13.	Lisu	034.
14.	Inn	6454.
15.	Arkhar	000.
16.	Lahu	000.
17.	Kayan	001.
18.	Maingpan	000.
19.	Loila	000.
20.	Rawang	000.
21.	Kokang	001.
22.	Other	008.

Source: Nyaung Shwe Township Information (GAD, 2023)

22 types of ethnic people live in Nyaung Shwe Township and Inn people are the most (6454.) followed by PaO (1726.) and Shan people (727).

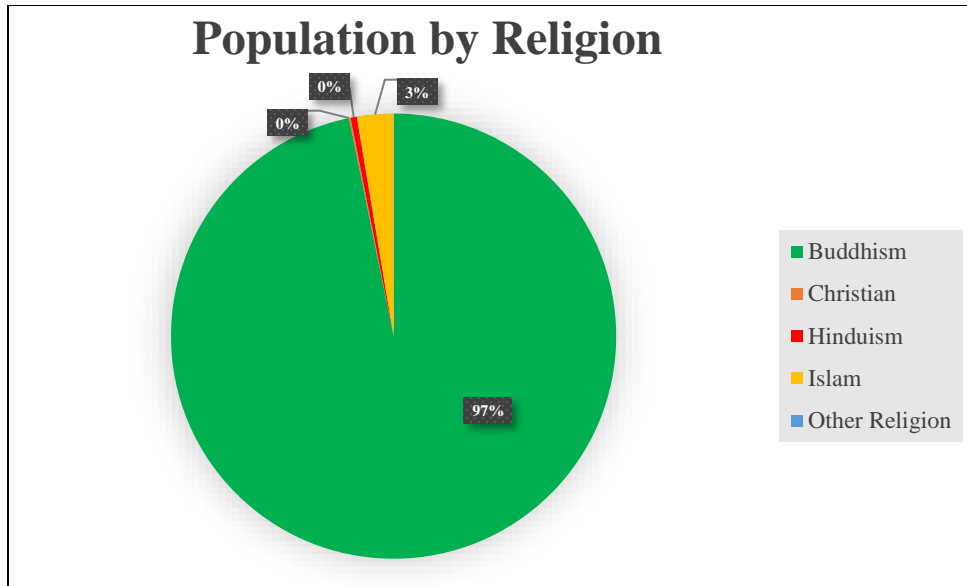
(d) Religion Status

No.	Township	Buddhism	Christian	Hinduism	Islam	Other Religion	Total
1.	Kan Thar Ward	1721	2	8	47		1778
2.	Thar Si Ward	1352			12		1364
3.	Nan Da Wun Ward	5913	44	4	231		6192
4.	Myo Lel Ward	477			34		511
5.	Win Ward	951	6				957
6.	Nan Pan Ward	919					919
7.	Min Ga Lar Ward	595	2				597
8.	Mong Li	2049	12	3			2064
9.	No (1) Ward	1896					1896
10.	No (2) Ward	1374	3			3	1379
11.	No (3) Ward	1255	12			45	1412

No.	Township	Buddhism	Christian	Hinduism	Islam	Other Religion	Total
12.	No (4) Ward	529					529
13.	Nang Thea	4899					4899
14.	Kyun Gyi	3872					3872
15.	Lin Kin	5132					5132
16.	Khaung Taing	3147					3147
17.	Let Maung Kway	2584					2584
18.	Taung Poet Gyi	4141					4141
19.	Taung Chay Myin Sa Hkunt	6548			10		6558
20.	Mong Thauk	5859			101		5960
21.	Ywar Thar	4654					4654
22.	Ti Law Sa Khan Gyi	13886	208		8		14102
23.	Min Chaung	9078					9078
24.	Tone Lel	3888					3888
25.	Tha Pyay Pin	5600					5600
26.	Nga Hpei Chaung	2949					2949
27.	He Yar Ywar Ma	3628			4		3632
28.	Thar Lay	4654					4654
29.	Mong Pyoe	2259					2259
30.	Nawng Taw	8787			7		8794
31.	Inn Hlar Keng Hkam	4907					4907
32.	Taung To	4862					4862
33.	Kyauk Taing	3165					3165
34.	Kyay Paw Hkon	7026					7026
35.	Inn Dein	3565					3565
36.	Inn Chan Kay Lar	5428					5428
37.	Inn Paw Hkon	4302					4302
38.	Tha Le U	6268			1		6269
39.	San Kar	4024	30				4054
40.	Long Kan	3445					3445
41.	Yae Pu	2715					2715
42.	Lin Lan (South)	2828	304				3132
43.	Inn Tan	2766					2766
44.	Bang Pyin	7207					7207
45.	Lin Lan (North)	3421					3421
46.	Pont Mu	6318					6318
Total		186943	623	15	455	47	188083

Source: Nyaung Shwe Township Information (GAD, 2023)

In Nyaung Shwe township, the majority of the population are Buddha religion (97%) followed by Hinduism religion (3 %).



Percentage of Population by Religion

Economy and Livelihood

Nyaung Shwe Township is located in Southern Shan State, Kalaw District and is an economically local point. The local people in the township work primarily in agriculture and service-related activity.

Nyaung Shwe is a well-connected township with national transportation network and is situated in Inle region, which is rich in water resources. The main product of Nyaung Shwe township is tomato which is mostly exported to central and Mandalay Region.

Employment Status of Nyaung Shwe Township

No.	Township/Town	Number of Workable people	Number of employees in workplace	Number of unemployed people	Percentage of unemployment
1.	Nyaung Shwe	181032	154831	4393	2.4%
2.	Nan Pan	3866	3750	116	0.03%
Total		184898	158581	4509	2.43%

Source: Nyaung Shwe Township Information (GAD, 2023)

Number of Employees According to Profession

No.	Township/ Town	Government Staff	Services	Agriculture	Husbandry	Trading	Industry	Water industry	Jobber	Others	Total
1.	Nyaung Shwe	2980	5246	126667	11596	558	4807	3000	3726	26317	184898
2.	Nan Pan	387	-	-	-	1550	-	260	1050	503	3750
Total		3367	5246	126667	11596	2108	4807	3260	4776	26820	188647

Source: Nyaung Shwe Township Information (GAD, 2023)

Literacy Rate of Nyaung Shwe Township

No.	Township/Town	Township population	Population over (15) years	Population of literacy	Literacy rate
1.	Nyaung Shwe	182867	12926	12926	100
2.	Nan Pan	5216	368	368	100
Total		144,713	965,294	965,150	100%

Source: Nyaung Shwe Township Information (GAD, 2023)

Number of Hospitals, Clinics, and Rural Health Care Centers

No.	Content	Number	Government	Private
1.	Hospital	6	4	2
2.	Clinic	7		
3.	Rural health care center	9		
4.	Sub rural health care center	27		
Total		49		

Source: Nyaung Shwe Township Information (GAD, 2023)

In Nyaung Shwe Township, the most common diseases are malaria, diarrhea, tuberculosis, dysentery and hepatitis. According to the data, diarrhea is the most occurring disease with a record of 1473 cases. The second occurring disease is dysentery with 333 cases. There are 40 cases of tuberculosis (TB) with a dead case occurred. Moreover, malaria occurred with a record of 4 cases and hepatitis with a record of 35 cases. There are 5 cases of HIV/AIDS in 2020-2022. The following table shows the details of occurred diseases.

Most Common Occurred Diseases in Nyaung Shwe Township

No	Township	Types of diseases											
		Malaria		Diarrhea		TB		Dysentery		Hepatitis		HIV/AIDS (2020-2022)	
		Case	Death	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death
1.	Nyaung Shwe	4	-	1473	-	40	-	323	-	33	-	5	-
2.	Nan Pan	-	-	-	-	-	-	10	-	2	-	-	-
Total		4	-	1473	-	40	-	333	-	35	-	5	-

Source: Nyaung Shwe Township Information (GAD, 2023)

Land Use

Types of Land Use

No.	Type of land use	Area (acre)
		Nyaung Shwe
1.	Total areas of arable land	61,749
	(a) Agricultural land	29,131
	(b) Farm Land (Yar land)	31,152
	(c) Kine/Kyun Land (Alluvial)	-
	(d) Garden land	1,466
	(e) Nipa Palm land	-
2.	Total area of fallow land	5,032
	(a) Agricultural land	4,682
	(b) Farm Land (Yar land)	350
	(c) Kine/Kyun Land (Alluvial)	-
	(d) Garden land	-
	(e) Nipa Palm land	-
3.	Paster land	-
4.	Industrial land	94
5.	Town/Urban land	547
6.	Village land	7,813
7.	Others	-
8.	Reserved forest/ protected public forest area	198,333

No.	Type of land use	Area (acre)
		Nyaung Shwe
9.	Wild forest	-
10.	Virgin land	4,489
11.	Area of non-cultivated land	81,243
Total area		359,300

Source: *Nyaung Shwe Township Information (GAD, 2023)*

Transportation and Communication

Nyaung Shwe township is a town with good transportation. There are three types of transportation in Nyaung Shwe township: airway, waterway and roadway. According to *Nyaung Shwe Township Information (GAD, 2023)* data, there are 13 bus gates for transportation and 258 vehicles are used to transport local people from one place to another. In addition, there is a bridge with lengths over 240 feet. There are 7 roads that are used in both township and connected to surrounding townships. The details are shown in the following tables.

Roads

No.	Name of roads	Within the township		Distance (Mile/Furlong)
		From	To	
1.	Ayetharyar-Nyaung Shwe- Mong Thauk- Nan Pan- Ton Huong- Pin Laung	Ayetharyar	Ton Huong	3/0-40/4 37 mile 4 furlong
2.	Taunglaylone- Yae Pu- Hkawng Taing	Taunglaylone	Hkawng Taing	8 mile 8 furlong
3.	Shwe Nyaung- Nyaung Shwe	Shwe Nyaung	Nyaung Shwe	7 mile 4 furlong
4.	Ton Huong- Sa Kar- Loikaw	Ton Huong		23 mile 0 furlong
5.	Ton Huong- Loi Mun	Ton Huong	Loi Mun	10 mile 7 furlong
6.	Hsihseng -Sa Kar	Loi Mun	Sa Kar	14 mile 0 furlong
7.	Kyuntaung -Kyauktaloneyi- Nawng Yar Hseng- Hsaik Hkawng- Pun Chaung-Mawkmai	Kyuntaung	Kyauktaloneyi	2 mile 6 furlong

Source: *Nyaung Shwe Township Information (GAD, 2023)*

Roads that Link to Surrounding Township

No.	Name of Road	Distance (Mile-Furlong)	Types			
			Bituminous			
1.	Ayetharyar-Nyaung Shwe-Mong Thauk- Nan Pan- Ton Huong- Pin Laung	37/4	37/4			
2.	Taunglaylone- Yae Pu- Hkawng Taing	8/2	8/2			
3.	Shwe Nyaung- Nyaung Shwe	7/4	7/4			
4.	Ton Huong- Sa Kar- Loikaw	23/0	23/0			
5.	Ton Huong- Loi Mun	10/3	3/0	7/3		
6.	Hsihseng -Sa Kar	14/0	-	3/0		11/0
7.	Kyuntaung -Kyauktaloneygi- Nawang Yar Hseng- Hsaik Hkawng- Pun Chaung- Mawkmai	2/6	2/6			
Total		103/3	82/0	10/3	-	11/0

Source: Nyaung Shwe Township Information (GAD, 2023)

Waterways

No.	Name of Waterways	Within the Township		Distance (Mile/Furlong)	No. of Ports	No. of Ships
		From	To			Others
1.	Nyaung Shwe- Phaung Taw Oo			13 miles	-	-
2.	Nyaung Shwe- Sa Kar			40 miles	-	-
3.	Mong Thauk-Nyaung Shwe			7 miles	-	-
4.	Hkawng Taing- Phaung Taw Oo			7 miles	-	-
5.	Inn Dein- Nyaung Shwe			21 miles	-	-
6.	Nan Pan- Phaung Taw Oo			1 mile	-	-

Source: Nyaung Shwe Township Information (GAD, 2023)

Cultural Heritage

According to GAD (2023) data, there are 515 famous pagodas and 237 famous monasteries in Nyaung Shwe. The following table shows the monastic facilities in Nyaung Shwe Township.

Monastic Facilities in Nyaung Shwe Township

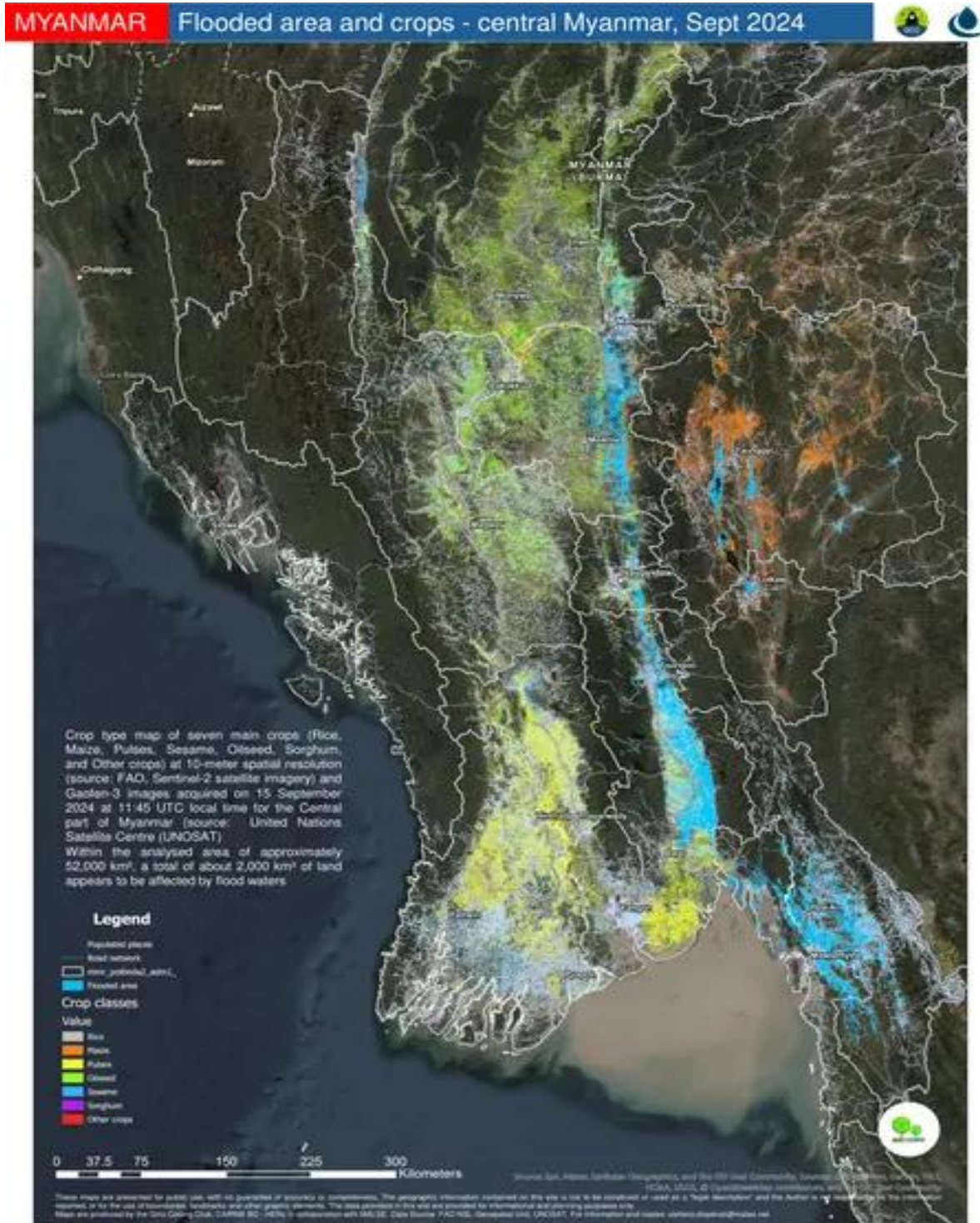
No.	Township	Pagodas	Shrines	Stupa	Monasteries	Nunnery	Community hall
1.	Nyaung Shwe	515	495	3	237	1	70

Source: Nyaung Shwe Township Information (GAD, 2023)

Annex B: Photo Documentation

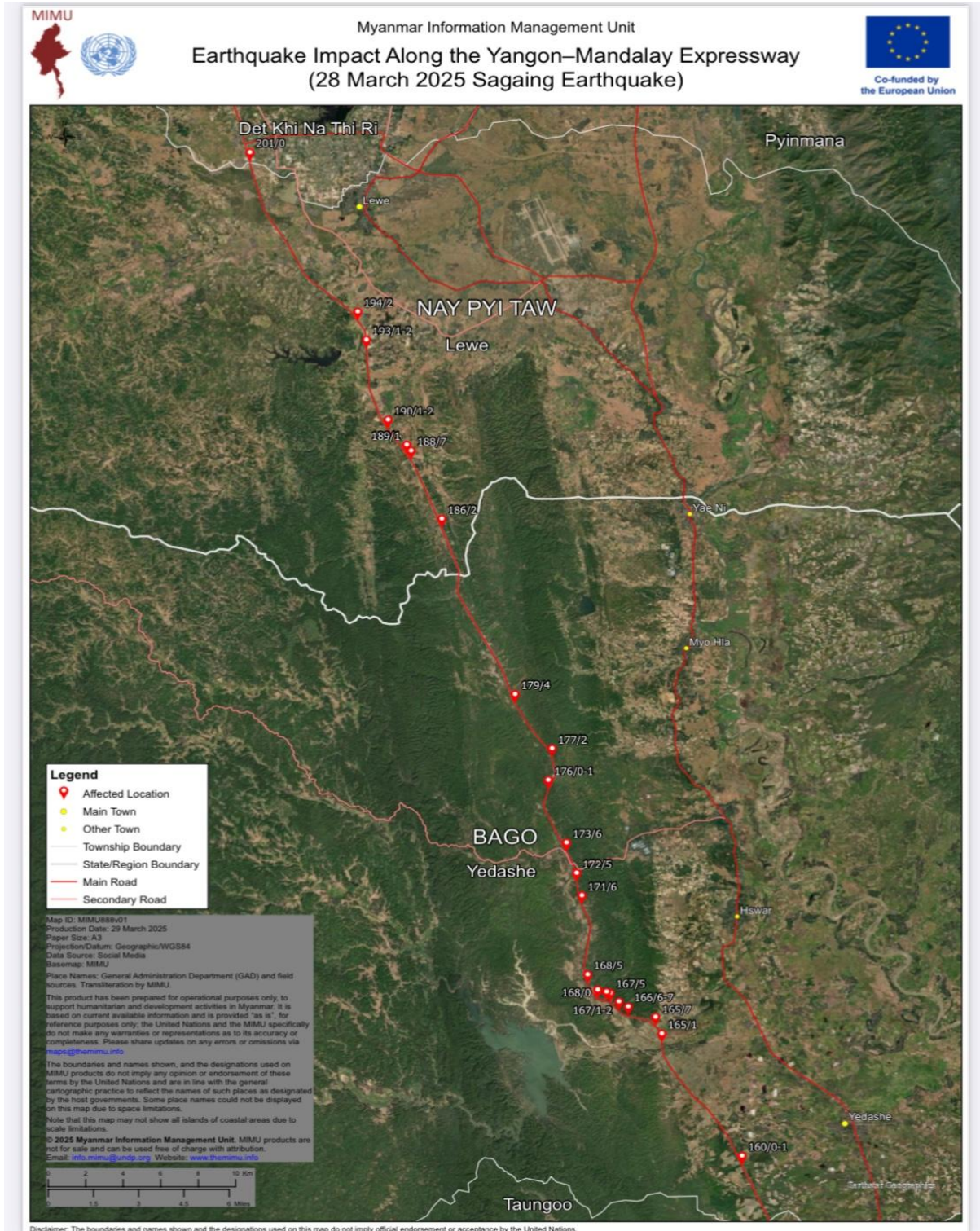
Flood Extent Map – September 2024

This map illustrates the areas affected by flooding between 16 and 30 September 2024, highlighting the inundated regions around Inle Lake and the extent of agricultural land impacted.



Earthquake Impact Map – March 28, 2025

This map depicts the impact zones of the 7.7 magnitude earthquake that struck on March 28, 2025, showing the intensity of ground shaking and the areas most affected along the Yangon-Mandalay Expressway, including regions surrounding Inle Lake.



Annex C: List of Consulted Stakeholders

No.	Name	Location	Contact No.
1.	U Soe Naing U Kham Lin (Deputy Director)	Department of Disaster Management	09 5214395 09 420343902
2.	U Pyae Phyo Kyaw (AD)	ECD	09 400434747
3.	U Khun Ba Hein	GIC Manager	09 253259426
4.	Daw Cho Mar Sein		09 402631585
5.	U San Win U Nyi Nyi Aung (Teacher)	Kyee Sar Kone North	09 428363928 09 251157765
6.	Daw Tin Yi	Ann Heritage Lodge	09 5142261
7.	U Thein Swe (Boatman)	Kay Lar	09 785359354
8.	U Soe Naing U Kham Lin (Deputy Director)	Department of Disaster Management	09 420343902
9.	U Pyae Phyo Kyaw (AD)	ECD	09 400434747
10.	U Kyi Swe	Nam Pang, Kyar Taw	
11.	Daw Myint Myint Htay	Tha Lae Oo Inn	09 791990931
12.	Ko Wai Lin	Floating Garden	09 420082861
13.	U Nyi Nyi Soe	Inn Paw Khom	09 951532978
14.	Daw Khin Ohm Myint	Sal Khaung	09 428338663
15.	U Kyaw Moe+Daw Nan Khin Chaw	Nan Pan (Ye Lal)	09 428329698
16.	U Pyae Sone Oo	Inn Dain -Pyae Sone Oo Restaurant	
17.	U Thank Htike	Fed. MES _ Taunggyi	09 778880295
18.	U Aung Ye Kyaw	White Swam Boating	09 262668972
19.	Daw Ei Khaing Soe Zin	Sanitation Support	09 799838984
20.	U Min Min Tun U Aung Thet Khaing	Kyi Lay Kyi Social Support Society	09 669983335

Annex G: Illustration of Multipurpose Floating Shelters for The Inle Lake

အင်းလေးဒေသအတွက် ရေကြီးခြင်း နှင့် ငလျင် သဘာဝဘေးဒဏ်ခံ ရေပေါ် အဆောက်အဦများ



White Swan Boating

SAFE HARBOURS FOR EVERY HEART

ရည်ရွယ်ချက်

အင်းလေးဒေသသည် ၂၀၂၄ ခုနှစ်တွင် စံချိန်တင် ရေကြီးခြင်း ၊ ၂၀၂၅ ခုနှစ်တွင် ငလျင်ဘေးသင့်ခြင်း စသည့် သဘာဝ ဘေးဒဏ်များကို ဆက်တိုက် ကြုံတွေ့ခဲ့ရပြီး ဒေသခံပြည်သူများ၏ အသက်အိုးအိမ်စည်းစိမ် ဆုံးရှုံးမှု များစွာ ဖြစ်ပေါ်ခဲ့ပါသည်။

ရေယာဉ်ဗိသုကာအထူးပြုဖြစ်ပြီး ရေပေါ် အဆောက်အဦများကို မြန်မာနိုင်ငံ အနှံ့အပြားတွင် ဆောက်လုပ် လျက်ရှိသည့် ကျွန်တော်တို့အဖွဲ့အစည်းမှ မိမိတို့ ကျွမ်းကျင်သည့် ရှုထောင့်မှ သဘာဝဘေးဒဏ်သင့် ပြည်သူများကို အကျိုးပြုနိုင်ရန်အတွက် ဤစာလွှာကို ပြင်ဆင် ရေးသားရခြင်း ဖြစ်ပါသည်။ ရေပေါ်အဆောက်အဦများ တည်ဆောက်ရန်လိုအပ်ပါကလည်း ကျွန်တော်တို့အဖွဲ့အစည်းမှ ဒီဇိုင်း ၊ ထုတ်လုပ်ရေး၊ တည်ဆောက်ရေး ၊ နေရာ ချထားရေး ကိစ္စရပ်များအား အကျိုးအမြတ် မရယူဘဲ ဆောင်ရွက်ပေးသွားမည် ဖြစ်ပါသည်။

သဘာဝဘေးဒဏ်ခံ ဒီဇိုင်းများ ဖြစ်သော

- ငလျင်နှင့်ရေဘေး အရေးပေါ်အခြေအနေများတွင် အသုံးပြုနိုင်မည့် ရေပေါ် အရေးပေါ်ဆောင်
- ရေပေါ်အိမ်
- စွယ်စုံသုံး ဖောင်များ အကြောင်းကို မိတ်ဆက် ဖော်ပြထားပါသည်။

ငလျင်နှင့်ရေဘေး အရေးပေါ် အခြေအနေများတွင် အသုံးပြုနိုင်မည့် ရွေ့လျား ရေပေါ် အရေးပေါ်ဆောင် (FLOATING EMERGENCY SHELTER)

သဘာဝဘေးဒဏ်ခံရချိန်

- အင်းရေမျက်နှာပြင် မြင့်တက်ချိန် (ရေကြီးချိန်) တွင် ရေပေါ်ပေါ်ခြင်းကြောင့် ရေဘေးမှ ကင်းလွတ်ခြင်း
- ငလျင်လှုပ်ရှားချိန်တွင် ရေပြင်ပေါ်တွင်သာ တည်ရှိခြင်းကြောင့် ပြိုလဲဒဏ်မခံရခြင်း
- မုန်တိုင်း ၊ လေပြင်းနှင့် ရေလှိုင်းဒဏ်များကို ခံနိုင်ရန် ဒီဇိုင်း တည်ဆောက်ထားမည် ဖြစ်ခြင်း တို့ကြောင့် ရေပေါ်အဆောက်အဦအား ဘေးအန္တရာယ် ဖြစ်ပွားရာ ရပ်ရွာ အနီးအနားသို့ ပို့ဆောင်ကာ ဘေးဒဏ်သင့်သူများအား ယာယီ နေရာချထားခြင်း ၊ ကယ်ဆယ်ရေးလုပ်ငန်းများအား အထိုင်ချ ဆောင်ရွက်ခြင်း ၊ ဆေးကုသခြင်း ၊ ချက်ပြုတ်ကျွေးမွေးခြင်း ၊ ရိက္ခာ နှင့် ပစ္စည်းများ သိုလှောင်ခြင်း စသည့် ကိစ္စများကို ထိထိရောက်ရောက် ဆောင်ရွက်နိုင်ပါမည်။

ဆိုလာလျှပ်စစ်/မီးစက် ၊ သောက်ရေသန့်စက် ၊ ဆက်သွယ်ရေးစနစ် စသည်တို့ကိုပါ အဆောက်အဦတွင် တပ်ဆင်ထားခြင်းဖြင့် ဘေးဒဏ်ကြောင့် အဆိုပါအခြေခံများ ပျက်စီးသည့် ပတ်ဝန်းကျင် နေရာများကိုပါ ထောက်ပံ့ရေးလုပ်ငန်းများ ဆောင်ရွက်နိုင်ပါမည်။

အခြားအချိန်များတွင် အသုံးပြုနိုင်ပုံများ

- သာသနိက/ရပ်ရွာ လူမှုရေး / သာရေးနာရေး ကိစ္စရပ်များ
- ပွဲလမ်းသဘင်များ လက်ခံကျင်းပခြင်း
- သင်တန်းဆောင် ၊ ကျောင်း ၊ အစည်းအဝေးဆောင်
- ရုံးခန်း ၊ စာကြည့်တိုက် ၊ ဆေးပေးခန်း



ရေပေါ်ကယ်ဆယ်ရေးဆောင် နမူနာ (ရပ်ရွာ အခမ်းအနားပွဲတွင် အသုံးပြုစဉ်)



ရေပေါ်ကယ်ဆယ်ရေးဆောင် နမူနာ (ရေကြီးချိန်တွင် အသုံးပြုစဉ်)



ရေကြီးချိန်တွင် အသုံးပြုစဉ်



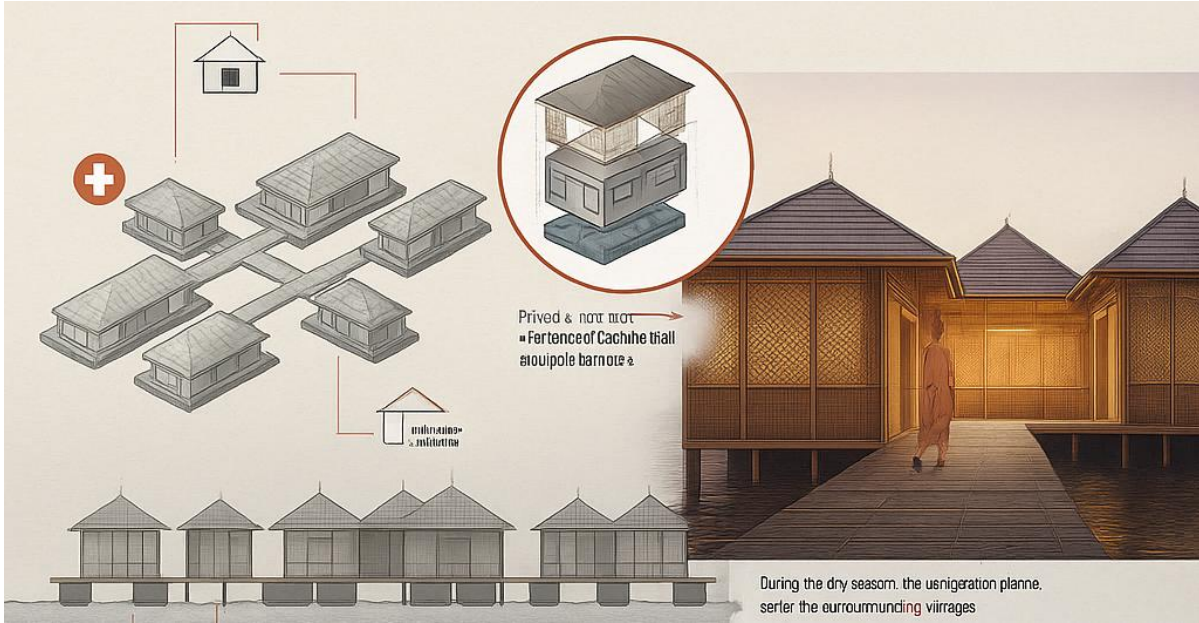
ညောင်ကျွန်းမြို့နယ်ရှိ အဆောင်များ အဖြစ် စုပေါင်း နေရာချ အသုံးပြုစဉ်



အတွင်းပိုင်းမြင်ကွင်း နမူနာ



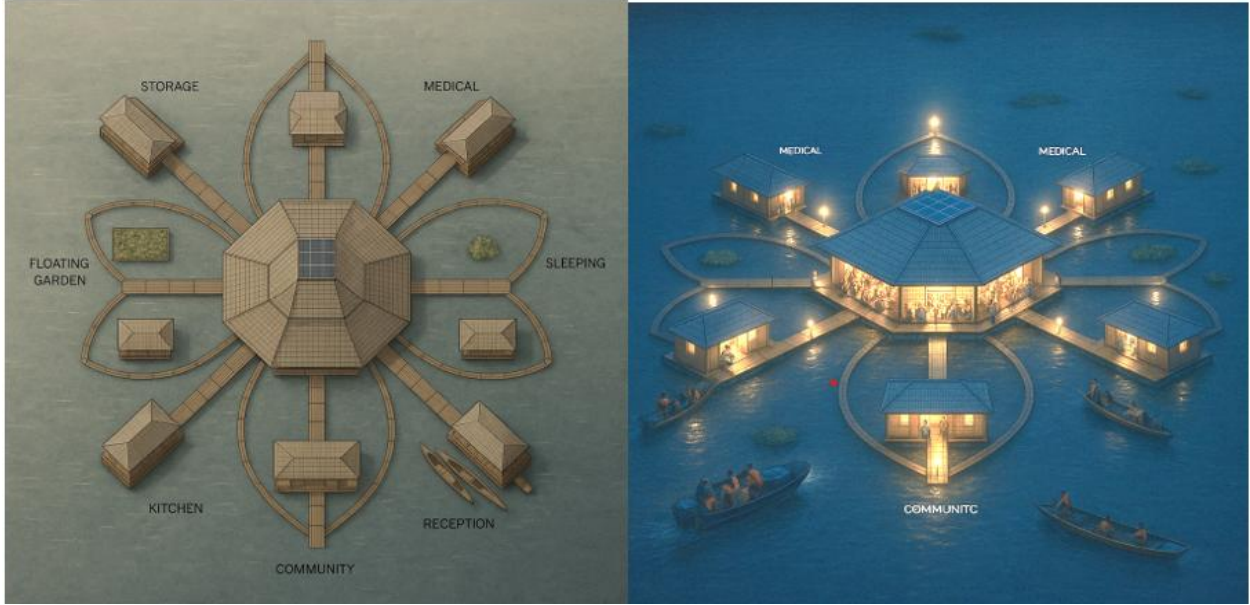
ဒီဇိုင်းအမျိုးမျိုး



ရေပေါ်အဆောက်အဦများ၏ ပေါင်းစပ်နိုင်ပုံ ၊ Phase အလိုက် တိုးချဲ့နိုင်ပုံ



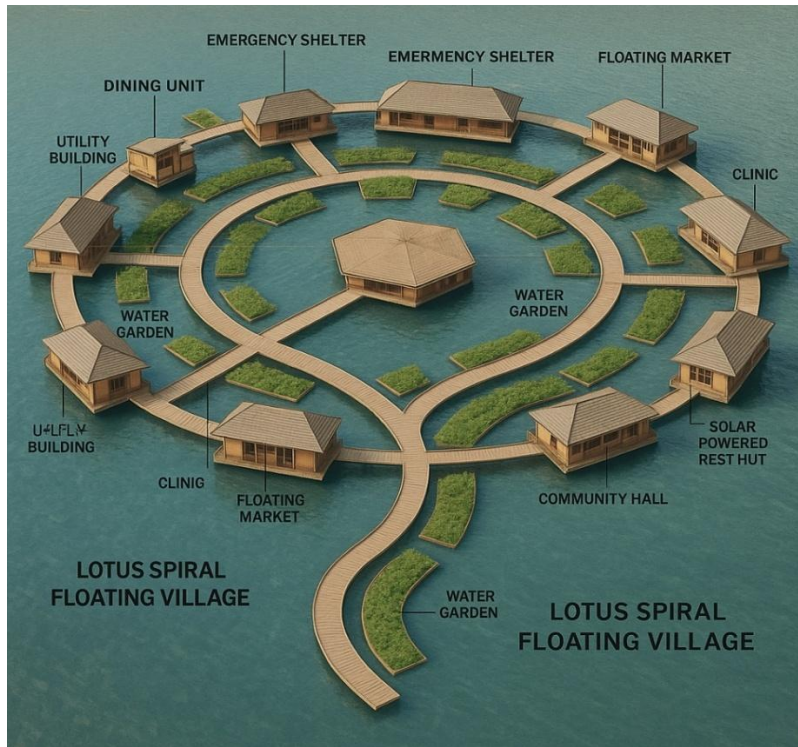
အဆောက်အဦများအား ရေပေါ်တံတားများဖြင့် လုပ်ငန်းလိုအပ်ချက်အတိုင်း လိုသလို တွဲဆက် ပြောင်းလဲ နိုင်ခြင်း (ပြန်လည်ထူထောင်ရေးစခန်း ၊ ယာယီဆေးရုံ ၊ ရေသန့်ဆောင် ၊ ချက်ပြုတ်ဆောင် ၊ မီးစက်ဆောင် ၊ ရေပေါ်ဈေး စသဖြင့်)



ဒီဇိုင်းပုံဖော်၍ ပုံမှန်အချိန်များတွင် ခရီးသွားဧည့်သည် ဆွဲဆောင်မှု တခုအနေဖြင့်ပါ အသုံးချနိုင်ပါသည်
 (အင်းလေးအမှတ်အသားဖြစ်သော ကြာပန်းပုံအဆောက်အဦတွဲဆက်မှု နမူနာ ဒီဇိုင်း)



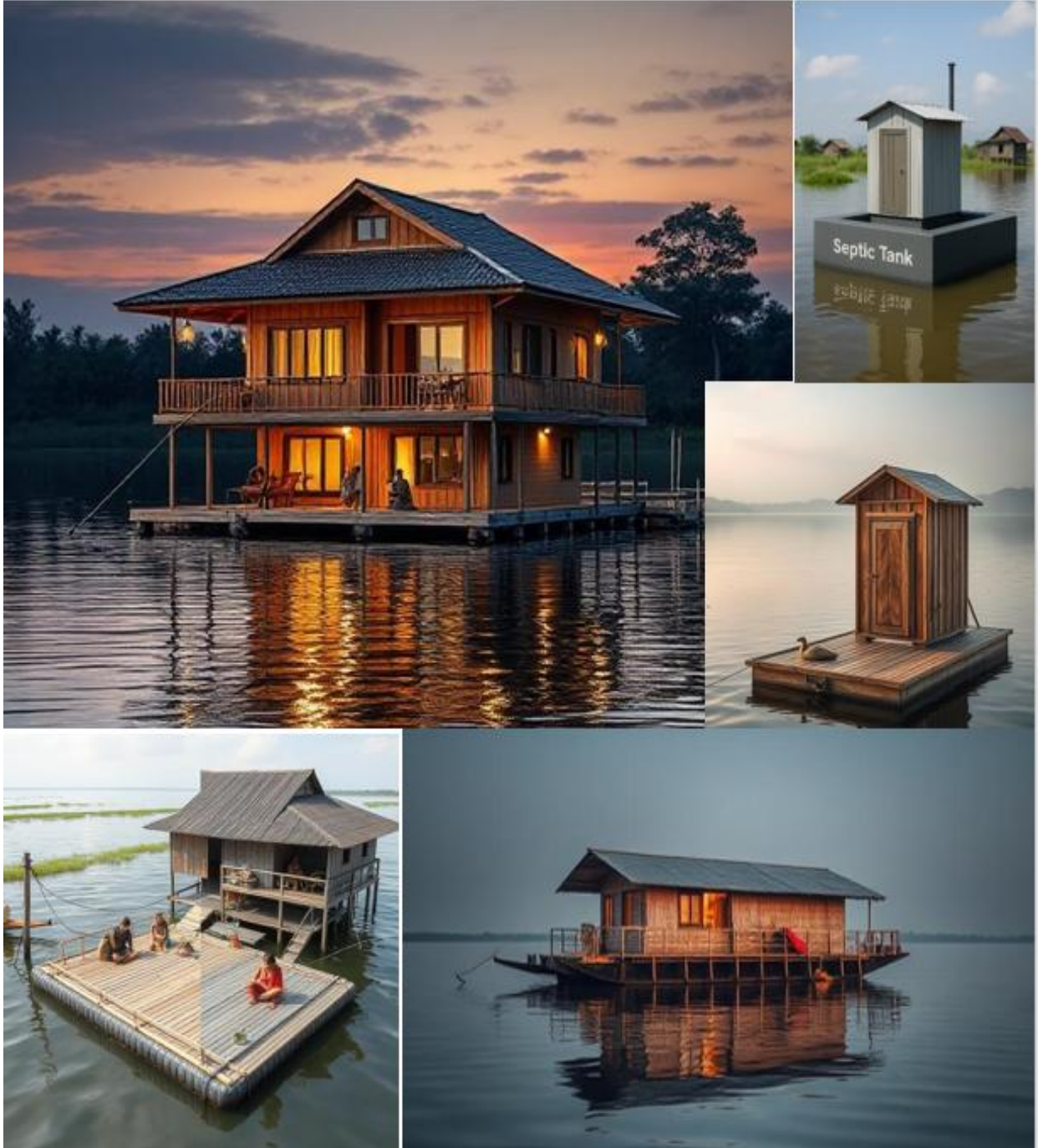
အင်းလေးကန်နှင့် သဘောသဘာဝတူညီသည့် ကမ္ဘောဒီးယားနိုင်ငံ ၊ တုံလေးဆပ်ရေကန်အတွက်
 ရေးဆွဲထားသော အချင်းချင်း ချိတ်ဆက်ထားသည့် ရေပေါ်ကျေးရွာ ဒီဇိုင်း တစ်ခု



ရေပေါ်အဆောက်အဦများဖြင့် အရေးပေါ်သုံးသာမက ခရီးသွားဆွဲဆောင်မှုအဖြစ်ပါ ဖန်တီးထားခြင်း ဒီဇိုင်းနမူနာ



အခြားတည်ဆောက်နိုင်သည့် ရေဘေး ၊ ငလျင်ဘေးဒဏ်ခံ ရေပေါ်ပုံစံအချို့



ရေအနိမ့်အမြင့်အတိုင်း လိုက်ပါရွေ့လျားနေမည့် ဖောင်သဘောတရား လူနေအိမ်များ ၊ စွယ်စုံသုံးဖောင်များ
 (ယာစောင့်တဲ ၊ ဇရပ် ၊ တံငါလုပ်ငန်းသုံး ၊ ဈေးဆိုင် ၊ လှေဆိပ် စသည်)

ရေပေါ်အဆောက်အဦများ တည်ဆောက်ခြင်း နှင့် ကုန်ကျစရိတ်

ရေပေါ်အဆောက်အဦများသည် အသုံးပြုမည့် ရေပြင် ၊ လူဦးရေ ၊ သက်ဆောင်ရမည့် အလေးချိန် ၊ ကိုယ်ထည်ပေါ်တွင် တည်ဆောက်မည့် ဒီဇိုင်း စသည်ဖြင့် မျိုးကွဲအလွန်များပြားရာ ကုန်းပေါ် အဆောက်အဦ များကဲ့သို့ တပေချင်း ဈေးနှုန်း သတ်မှတ်ရန် ခက်ခဲပါသည်။ အသုံးပြုလိုသည့် ရည်ရွယ်ချက် အတိအကျ အတိုင်း ဒီဇိုင်းရေးဆွဲပြီးမှသာ သံထည်အလေးချိန် ၊ စက်ပစ္စည်း ၊ လူနေ အဆောက်အဦ ၊ အသက်ကယ် ပစ္စည်း (Lifesaving Appliances) ၊ နေရာချထားခြင်း (Mooring) ၊ မောင်းနှင်ခြင်း စသည့် ကဏ္ဍစုံအား တွက်ချက်ပြီးမှသာ ဈေးနှုန်းတွက်ထုတ်နိုင်မည် ဖြစ်ပါသည်။

အင်းလေးဒေသအတွက် ရေပေါ်အဆောက်အဦတည်ဆောက်မည် ဆိုပါက သံထည်အတွက် ထုတ်လုပ်ရေး အခြေခံ (ကုန်ကြမ်း ၊ စက် ၊ ယန္တရား ၊ ကျွမ်းကျင်လုပ်သား) မရှိသေးသော ဒေသသစ်တွင် တည်ဆောက် ရခြင်းဖြစ်ရာ ကနဦးအဆောက်အဦများအတွက် ရန်ကုန်မြို့သဘောကျင်း စက်ရုံများတွင် ကြိုတင် တည်ဆောက်ခြင်း (Prefabrication) နှင့် အင်းလေးကန်စပ်တနေရာ (ကမ်းစပ် ဆင်ခြေလျှော ၊ လျှပ်စစ်၊ သယ်ယူပို့ဆောင်ရေး စသည်တို့ အဆင်ပြေသည့်နေရာ) တွင် တွဲစပ်ခြင်းများ (Assembly)၊ ရေချခြင်း များကို လုပ်ကိုင်ရမည်ဖြစ်ပါသည်။

ရေပေါ်အဆောက်အဦများသည် အင်းလေးအတွက် ဘေးအန္တရာယ် ကျော်လွှားနိုင်ရန် အသုံးပြုနိုင်သည့် နည်းလမ်းဟု ဒေသခံများမှ လက်ခံကာ ရွေးချယ် တည်ဆောက်လာပါက နည်းပညာ လွှဲပြောင်း သင်ကြားပေးခြင်း (Technological Transfer) ၊ ကုန်ကြမ်း ပစ္စည်း နှင့် ထုတ်လုပ်ရေး စက်အခြေခံ ပစ္စည်းများ ၊ ယဉ်ယန္တရားများ ၊ တည်ဆောက် ပြုပြင် ထိန်းသိမ်းရာ ကမ်းစပ်အလုပ်ရုံ (Dockyard & Launching Facility) များ တည်ထောင်စေခြင်း တို့ဖြင့် ထုတ်လုပ်မှုစရိတ်ကို အနည်းဆုံးဖြစ်အောင် လျှော့ချသွားနိုင်ပါသည်။

ရေပေါ်အဆောက်အဦ၏ သက်တမ်း နှင့် ပြုပြင်ထိန်းသိမ်းခြင်း

ရေပေါ်အဆောက်အဦတွင် ရေနှင့်ထိစပ်သည့် ကိုယ်ထည် နှင့် အပေါ်ထည်တို့ ပါဝင်ပါသည်။ ရေနှင့်ထိစပ်သည့်ကိုယ်ထည်ကို သံဖြင့် ပြုလုပ်ရန်သာအသင့်တော်ဆုံးဖြစ်ရာ သံပြား၏ အရည်အသွေး ၊ အထူ ၊ အသုံးပြုသည့် သဘောအဆေး ၊ သံချေးတက်ကာကွယ်မှု စနစ် ၊ ကျွမ်းကျင်လုပ်သား အသုံးချမှု စသည်တို့ အပေါ်မူတည်ပြီး ကိုယ်ထည်သက်တမ်း ပြောင်းလဲနိုင်ပါသည်။ အင်းလေးသည် ရေချိုကန်သာ ဖြစ်ရာ အဆိုပါ ကိုယ်ထည်၏သက်တမ်းမှာ သံဖြင့်ပြုလုပ်သော လှေ ၊ သဘောများ ကဲ့သို့ပင် ၁၅ နှစ်မှသည် ထိန်းသိမ်းမှု ပြုလုပ်လျှင် ပြုလုပ်နိုင်သလို နှစ် သုံးဆယ်-ငါးဆယ် အထိ ကြာမြင့်စွာ အသုံးပြု နိုင်ပါမည်။ အပေါ်ထည်အဆောက်အဦမှာ ဆောက်လုပ်သည့် သစ်သား ၊ သံ ၊ ဝါး စသည်တို့ အပေါ်မူတည်ပြီး ကုန်းပေါ်ရှိ အဆောက်အဦများ သက်တမ်းကဲ့သို့ပင် ရရှိနိုင်မည် ဖြစ်ပါသည်။

သံကိုယ်ထည်များကို စတင် ဆောက်လုပ်စဉ်ကာလကပင် လျော်ညီသော သံချေးတက်ခြင်းမှ ကာကွယ်နိုင်သော သဘော၊ဆေး အမျိုးအစားများကို နည်းစနစ်မှန်ကန်စွာ ဆေးသုတ်ရပါသည်။ ပထမ သုံးနှစ်တာတွင် ထိန်းသိမ်းရန် များစွာမလိုအပ်ဘဲ သုံးနှစ်နောက်ပိုင်းတွင် ထုံး၊ ရေညှိ နှင့် ခရစ္စကပ်မှုများ အပေါ်မူတည်၍ လိုအပ်လျှင်လိုအပ်သလို ထိန်းသိမ်းဆောင်ရွက်သွားနိုင်ပါသည်။ သံချေးများခွာခြင်း ၊ ဆေးသုတ်ခြင်းများကို ရေထဲတွင်ပြုလုပ်၍ မရနိုင်ရာ ကမ်းစပ်ရှိ ပြုပြင်ထိန်းသိမ်းရန်နေရာသို့ ဆွဲယူခြင်း ဖြင့်ဖြစ်စေ (Dockyard) ၊ ဆောက်လုပ်ထားသည့် ရေပေါ်အိမ် အရေအတွက်များပြားလာပါက (Floating Dock) ရေပေါ်မြောက် ပြင်ဆင်ရေး ယန္တရားတခုအား ပြုလုပ်၍ အိမ်များ အလှည့်ကျ ဆောင်ရွက်ခြင်းဖြင့် ဖြစ်စေ ထိန်းသိမ်းသွားနိုင်ပါသည်။

WHITE SWAN BOATING မှ အင်းလေးဒေသ ထူထောင်ရေးတွင် မိမိတို့၏ အသိပညာ ၊ အတတ်ပညာအား အသုံးချ၍ အကျိုးပြု ပါဝင်လိုသည့် အစီအစဉ်

White Swan Boating သည် ရန်ကုန်အခြေပြု ရေယာဉ်ဗိသုကာအထူးပြု အဖွဲ့အစည်းဖြစ်ပြီး ရေပေါ် အဆောက်အဦများကို နိုင်ငံအဝှမ်း တည်ဆောက်လျက်ရှိပါသည်။

ပုံထုတ် ဒီဇိုင်းအဖွဲ့ ၊ အင်ဂျင်နီယာ အဖွဲ့ ၊ ကျွမ်းကျင်လုပ်သား ၊ ထုတ်လုပ်ရေး အခြေခံ စက်ပစ္စည်း ၊ ယန္တရား ၊ အလုပ်ရုံများ အသင့်ရှိပြီးဖြစ်ရာ အဆိုပါ အခြေခံများကို အသုံးပြု၍ အင်းလေးဒေသအတွက် လိုအပ်မည့် ရေပေါ် အဆောက်အဦများကို အချိန်တိုအတွင်း တည်ဆောက်ပေးနိုင်ပါသည်။

အင်းလေးဒေသသည် ရေဘေး ၊ ငလျင်ဘေးများ ဆက်တိုက်ကြုံခဲ့ရပြီး ခရီးသွားလုပ်ငန်းလည်း ကျဆင်း လျက်ရှိရာ ကျွန်တော်တို့အဖွဲ့မှ အင်းလေးဒေသ ပြန်လည်ထ ထူထောင်ရေးလုပ်ငန်းများတွင် အသုံးပြုလိုသည့် ရေပေါ် အဆောက်အဦများ တည်ဆောက်ရန်လိုအပ်ပါက ဒီဇိုင်း ၊ ထုတ်လုပ်ရေး ၊ တည်ဆောက်ရေး ၊ နေရာချထားရေး ကိစ္စရပ်များအား အကျိုးအမြတ် မရယူဘဲ ဆောင်ရွက်ပေးသွားမည် ဖြစ်ပါသည်။

သို့ဖြစ်ပါ၍ အကူအညီရယူလိုသည့် အဖွဲ့အစည်းများ ၊ အလှူရှင်များမှ ပူးပေါင်း ဆောင်ရွက်နိုင်ပါကြောင်း တင်ပြ အပ်ပါသည်။

WHITE SWAN BOATING

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(FACEBOOK PAGE – WHITE SWAN BOATING)

WHITE SWAN BOATING မှ တည်ဆောက်ခဲ့သည့် ရေပေါ်အဆောက်အဦအချို့
(ရှမ်းတောင် ဖယ်ခုံမြို့နယ် မိုးဗြဲဆည် နှင့် ရပ်စောက်မြို့နယ် ဇော်ဂျီဆည်)



Annex H: Illustration of Floating R.O Water Station for Inle Lake



WHITE SWAN BOATING CO.,LTD.

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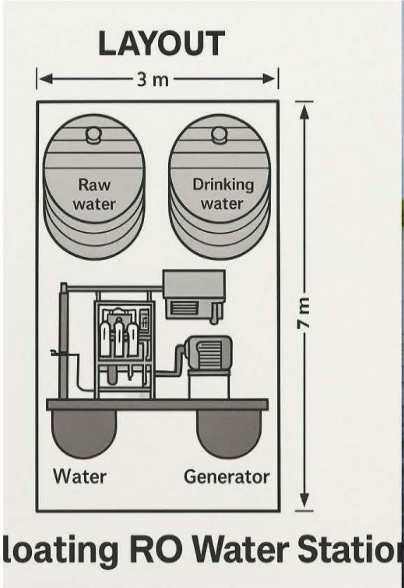
အင်းလေးကန်အတွင်း ရေသန့်စနစ်တင်ဆောင်နိုင်သည့် ရေပေါ်ဆောင် (Floating R.O Water Station for Inle Lake)

ဒီဇိုင်းပြုလုပ်ခြင်း ရည်ရွယ်ချက်

အင်းလေးကန်အတွင်းတွင် ယခုလက်ရှိအသုံးပြုနေသော ရေသန့်စနစ်များ တင်ဆောင်ထားရှိနိုင်မည့် ရေပေါ်ဆောင်ကို ဒီဇိုင်းပြုလုပ်ထားခြင်း ဖြစ်ပါသည်။

ယခုအသုံးပြုနေသော ရေသန့်စနစ်များကို ရေပေါ်ဆောင် (Floating Station) တွင်ထားရှိခြင်းဖြင့် ရေကြီးသည့် အချိန်များတွင် ရေသန့်စနစ်ကို ရေလွှမ်းသည့်ဒဏ်များ ၊ ရေသန့်ထုတ်လုပ်ရာတွင် အခက်အခဲ တွေ့ခြင်းများကို ရှောင်ရှားနိုင်မည် ဖြစ်ပါသည်။ ဒေသခံလူထု၏ အခြေခံရေသန့်လိုအပ်ချက်ကို ဖြည့်ဆည်းရန် ထားရှိသည့် စနစ်ဖြစ်သောကြောင့် ရေသန့်စနစ်တစ်ခုလုံးကို ရေပေါ်ဆောင်ပေါ်တွင် ထားရှိတပ်ဆင်၍ တည်ထားခြင်းဖြင့် ရေဘေးကြုံတွေ့ချိန်တွင်ပါ ဆက်လက်လည်ပတ်နိုင်မည်ဖြစ်ပြီး အင်းလေးဒေသခံလူထု၏ အခြေခံရေသန့်လိုအပ်ချက်ကို စဉ်ဆက်မပြတ် ဆက်လက်ဖြည့်တင်း နေနိုင်မည် ဖြစ်ပါသည်။

ရေပေါ်ဆောင်မှာ ရွှေ့လျားနိုင်သည့်အတွက် လိုအပ်သည့်နေရာသို့ ရွှေ့ပြောင်းတည်ထားနိုင်သော အားသာချက်လည်း ရှိပါသည်။



ရေပေါ်ရေသန့်ဆောင် နမူနာပုံစံ (Floating R.O Water Station)



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ဒီဇိုင်းအချက်အလက်များ

ယခု ရေပေါ်ရေသန့်ဆောင် (Floating R.O Water Station) ဒီဇိုင်းမှာ အောက်ပါ အချက်အလက်များရှိ ရေသန့်စနစ်ပေါ်အခြေခံ၍ သင့်တော်သည့်ဒီဇိုင်း ထုတ်လုပ်ထားခြင်း ဖြစ်ပါသည်။

(၁) အသုံးပြုနိုင်မည့် ဖောင်၏ စုစုပေါင်းအကျယ်

- အလျား ၇ မီတာ x အနံ ၃ မီတာ (အလျား ၂၁ ပေ x အနံ ၉ ပေ ခန့်)

(၂) အောက်ခံကိုယ်ထည်အရွယ်အစား

- အလျား ၁ မီတာ x အမြင့် ၁ မီတာ x အရှည် ၇ မီတာ
အရွယ်အစားရှိ အောက်ခံ ကိုယ်ထည် (၂) ခု နှင့် တွဲဆက်မည့် ဖရိန်စနစ်

(၃) ဘေးကင်းစွာအသုံးပြုနိုင်မည့် တင်ဆောင်ဝန် (Safe Working Load)

- စုစုပေါင်း ၆ တန် ခန့် (၅၀၀၀ - ၅၅၀၀ ကီလိုဂရမ်)

ထည့်သွင်းစဉ်းစားထားသော ရေသန့်စနစ်များနှင့် အဆောက်အဦ အလေးချိန်များ

(က) ၂၀၀၀ လီတာဆန့် ရေတိုင်ကီ - ၂ လုံး (စုစုပေါင်း ၄၀၀၀ ကီလိုဂရမ်)

(ခ) R.O စက် နှင့် ပိုက်များ (စုစုပေါင်း ၂၀၀ - ၃၀၀ ကီလိုဂရမ်)

(ဂ) 8kW မီးစက် ၁ လုံး (၁၀၀ - ၁၂၀ ကီလိုဂရမ်)

(ဃ) အမိုး ၊ အကာ စသည့် အဆောက်အဦ (၅၀၀ - ၇၀၀ ကီလိုဂရမ်)

(င) ဝန်ထမ်း + အခြားအပို (၂၀၀ - ၃၀၀ ကီလိုဂရမ်)

(၄) ရေစူး

- ဝန်အပြည့်တင်ဆောင်ထားချိန်တွင် ရေပေါ်ဆောင်၏ ခန့်မှန်းရေစူး ၁ ပေ ခွဲ ခန့် ရှိနိုင်ပါသည်။



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ဆောက်လုပ်မည့်ပုံစံ

အောက်ခံ သံကိုယ်ထည်များ နှင့် ကြမ်းခင်းအား ထုတ်လုပ်မှု၊ အတွက်လိုအပ်သော အခြေခံ ပစ္စည်းများ နှင့် အထောက်အကူလုပ်ငန်းများတည်ရှိရာ ရန်ကုန်မြို့တွင် တည်ဆောက်သွားမည်ဖြစ်ပါသည်။ ထိုအခြေခံ ကိုယ်ထည်ပေါ်တွင် အခံအဖြစ် ရှိုင်းဆက်များ (Connection Joints များ) ပြုလုပ်ပေးလိုက်မည် ဖြစ်ပါသည်။ ဆောက်လုပ်လိုသော အဆောက်အဦးကို ထို ရှိုင်းဆက်များ (Connection Joints များ) အပေါ်မှ တွဲဆက်၍ ဆက်လက်ဆောက်လုပ်နိုင်မည် ဖြစ်ပါသည်။

ပြီးစီးသော အောက်ခံကိုယ်ထည်ကို ကားဖြင့် အင်းလေးသို့ ပို့ဆောင်မည်ဖြစ်ပြီး၊ ထိုမှတစ်ဆင့် ဝန်ချိစက် (ကရိန်းကား) ဖြင့် ရေထဲသို့ချကာ တပ်ဆင်မည့်နေရာသို့ ယူဆောင်သွားနိုင်မည် ဖြစ်ပါသည်။

ရောက်ရှိပါက ရေသန့်ထုတ်လုပ်ရေးစနစ်ကို တပ်ဆင်နိုင်မည်ဖြစ်ပြီး၊ ရာသီဥတုဒဏ်မှ ကာကွယ်ရန် ခေါင်မိုး နှင့် အကာများအား ဒေသခံဆောက်လုပ်ရေးအဖွဲ့များဖြင့် ဆက်လက်တည်ဆောက်နိုင်မည် ဖြစ်ပါသည်။

ကုန်ကျစရိတ်

ရေပေါ်ဆောင်၏ အောက်ခံသံကိုယ်ထည် နှင့် ကြမ်းခင်း အထိ အပြီးအစီး **ရန်ကုန်စက်ရုံဈေးနှုန်း မှာ ၁၈၀ သိန်း (ကျပ် သိန်း တစ်ရာရှစ်ဆယ် တိတိ)** ဖြစ်ပါသည်။

ဈေးနှုန်းကို ၂၀၂၅ မေလ စတုတ္ထအပတ် တွင်ရှိသော ကုန်ကြမ်းနှင့်အခြားစားရိတ်များအား အခြေခံ၍ တွက်ချက်ထားခြင်း ဖြစ်ပါသည်။

မှတ်ချက် ။ ။ ဖော်ပြထားသည့် ကုန်ကျစရိတ်မှာ ရောင်းချသည့် ဈေးနှုန်းမဟုတ်ဘဲ ကျွန်တော်တို့ ကုမ္ပဏီ၏ ဒီဇိုင်း ၊ ထုတ်လုပ်ရေး စက်ကိရိယာ ၊ အခြေခံ အဆောက်အဦးများအား အခမဲ့ လှူဒါန်းအသုံးပြုကာ တွက်ချက်ထားခြင်း ဖြစ်ပါသည်။ ရန်ကုန် သင်္ဘောကျင်းတွင် တည်ဆောက်အပြီး ဈေးနှုန်းဖြစ်ပြီး သယ်ပို့ခြင်း ကိစ္စများ ထည့်သွင်းမထားပါ။ တပ်ဆင်ခြင်းမှာ လွယ်ကူပြီး ဒေသခံများမှ ပြုလုပ်နိုင်ပါသည်။

ဆက်သွယ်ရန်

White Swan Boating Co., Ltd
FACEBOOK – White Swan Boating
၀၉ - ၂၆၂၆၆၈၉၇၂ / ၀၉ - ၇၉၁၆၆၉၆၆၅

Annex F: Illustration of Floating Toilet System for The Inle Lake

Promoting Sustainable Sanitation and Protecting Water Ecology

Inle Lake, home to 200,000 people, faces increasing sanitation challenges due to population pressure, limited land and the collapse of stilt-based infrastructure following the recent earthquake. Traditional open-lake defecation and substandard toilet systems are contributing to the degradation of water quality, threatening both public health and the lake's unique ecosystem.

We would like to introduce a low-cost floating toilet solution equipped with sealed bio-septic tanks, design to adapt to floating life without relying on land or deep foundations. This system aims to improve hygiene, reduce pollution and preserve the cultural and environmental integrity of the lake.

Design of each toilet unit will be varied in accordance with the capacity of the users. Here is the sample one for a typical household unit (5~10 persons)

Technical Specifications

Structure

4ft (W) x 8ft (L) x 4ft(H) steel pontoon barge divided into

-2ft (FWD) + 2ft (AFT) Buoyancy chambers

-4ft central section for a sealed bio-septic tank with baffle plate, vent & manhole

Superstructure

One or two traditional-style toilet units built on a flat deck above the barge

Ventilation provided by natural airflow

Cultural design using familiar forms to encourage adoption

Others

Steel Weight – with 3mm plates – 700kg

Coating – Exterior – Anticorrosive paint suitable for freshwater

Interior – Epoxy-based coating suitable for sewage and waste waters

Sewage Holding Capacity – 1800 Litre approx.

Net buoyancy when sewage tank is full – 1000 kg

Positioning – attached to bamboo pole or wooden spud by mooring rope (self-level adjusting)

Production Cost

Due to import restrictions, price of consumable items like marine & epoxy paint, electrodes, tools go up obviously during these months. Shortage of electricity is also a determining factor for steel works. Based on market price of mild steel during the 1st week of May, 2025 (i.e 3600000 MMK per ton), production cost of each pontoon barge in Yangon is estimated 5,800,000 MMK (equivalent 1300 USD). Cost reduction is possible if user capacity is less and size of each tank is made smaller.



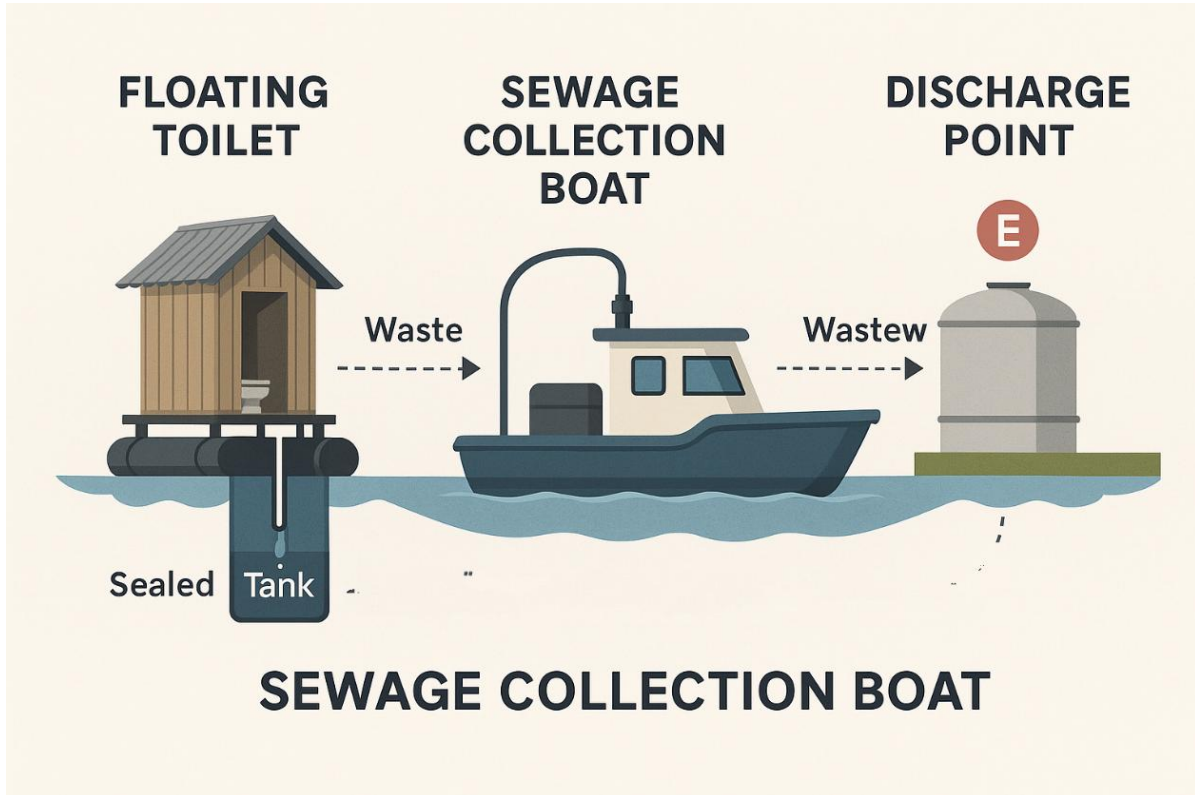
Source: *White Swan Boating*

CONCEPTUAL MODELS

FURTHER IMPROVEMENT (ZERO DISCHARGE IS POSSIBLE)

Tanks used as temporary storage and Waste Collection Boat (Inspired by Venice's sewage boat model) periodically empties tanks using vacuum pump system (Community-Operated).

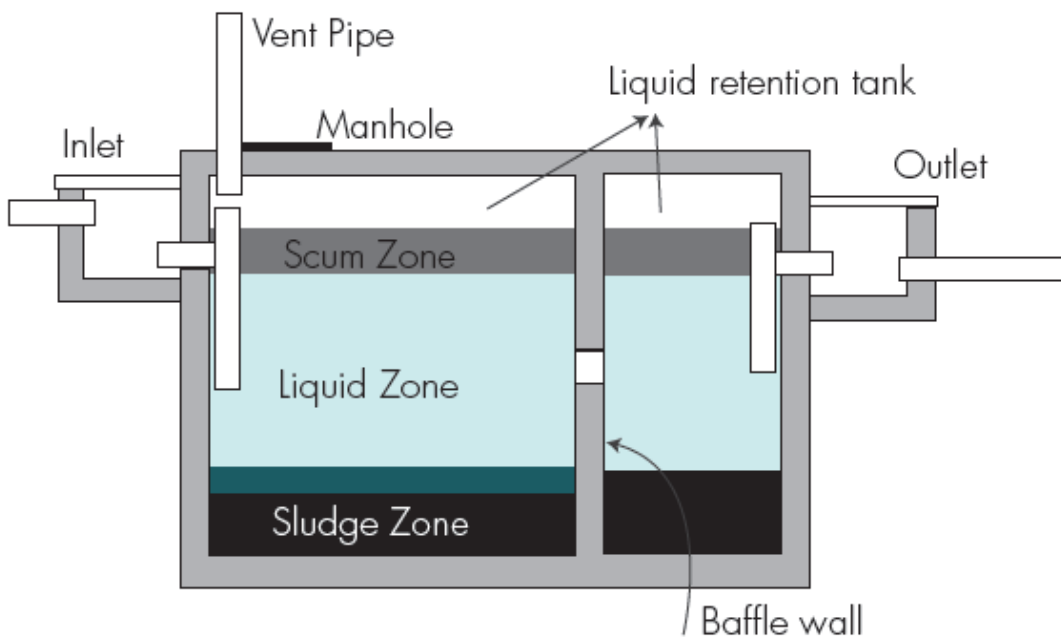
Collected waste is safely disposed of or processed on land-based treatment stations.



Annex E: Septic Tank and Sewage Treatment System

Wastewater treatment using septic systems typically involves three key stages: primary treatment, secondary treatment, and potential reuse of the treated effluent.

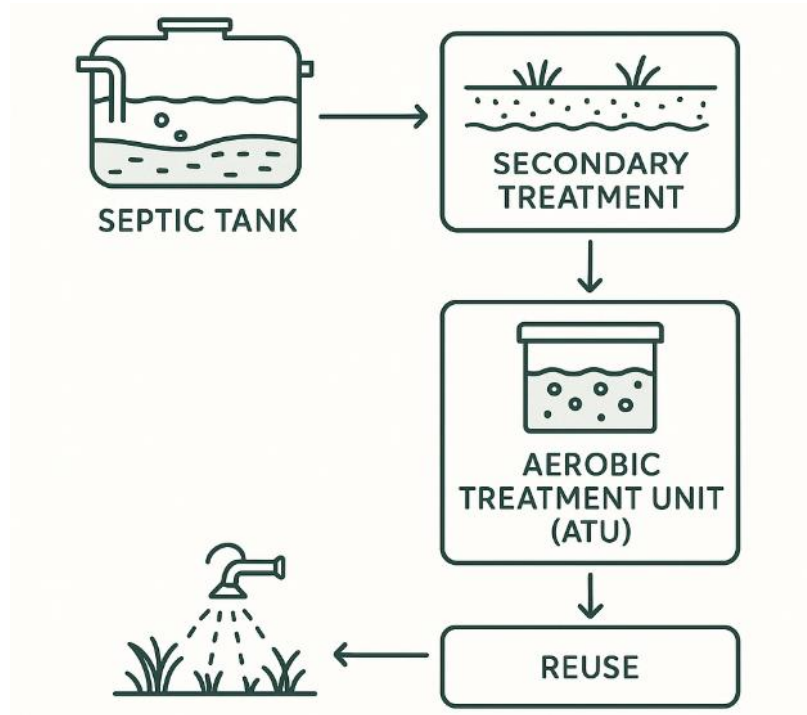
In the primary treatment stage, which occurs inside the septic tank, wastewater enters the tank and undergoes a separation process. Solids settle at the bottom, forming sludge, while oil and grease float to the top as scum. The clearer liquid, known as effluent, remains in the middle layer. During this stage, anaerobic bacteria microorganisms that thrive without oxygen begin breaking down the organic matter in the wastewater. However, the effluent that exits the septic tank still contains pathogens, nutrients such as nitrogen and phosphorus, and some remaining organic material, making further treatment necessary before it can be safely reused or discharged.



Key component of septic tank (Primary Treatment Unit)

Secondary treatment involves additional purification of the effluent through one of several systems. The most common is a drain field or leach field, where effluent percolates through soil layers that act as a natural biofilter. Microorganisms in the soil help remove pathogens and nutrients as the water is absorbed. Alternatively, sand filters or constructed wetlands may be used; in these systems, effluent is passed through sand beds or planted wetland areas, where microbial life and vegetation contribute to the removal of contaminants. Aerobic treatment units (ATUs) are

another option; these systems introduce oxygen to encourage aerobic bacterial activity, which breaks down waste more efficiently and is often used when higher-quality effluent is required, especially near sensitive ecosystems or water bodies. In some cases, an additional disinfection step may be employed using ultraviolet light, chlorine, or ozone to eliminate any remaining pathogens, particularly if the treated effluent is intended for reuse or discharge into environmentally sensitive areas.



Septic tank effluent/liquid waste treatment and reuse at non-potable use

Once effluent has been sufficiently treated, it can be reused for a variety of non-potable purposes. These include irrigation of lawns, gardens, and agricultural fields, flushing toilets in buildings equipped with dual plumbing systems, recharging groundwater aquifers through infiltration, and supporting landscape or wetland restoration efforts. However, the reuse of treated wastewater is subject to local regulations, which typically require advanced treatment systems and ongoing monitoring to ensure that environmental and public health standards are met.

The approach aimed to minimize direct discharge of untreated wastewater into the lake, thereby improving water quality, reducing environmental degradation and community health. This is demonstrated that bio-septic tanks are an effective solution for areas situated on firm ground and can significantly contribute to reducing pollution levels when properly maintained.

According to the United Nations Development Programme: Inle Lake Conservation and Rehabilitation Project Report (2015), bio-septic technology was successfully introduced in eight villages in Nyaung Shwe Township. The project demonstrated that these systems are technically feasible, environmentally sound, and socially acceptable. However, challenges such as the high cost of installation were noted.

In Cambodia, the social enterprise called Wetlands Work has created a sanitation solution with lots of potential. WaterAid is partnering with them to test the 'HandyPod'. The HandyPod is a basic water purifying system resembling a floating garden.

According to this solution, a simple and natural toilet system design in floating villages is proposed to improve sanitation in a low-cost and sustainable way, an alternative approach will also be offered. For households unable to afford bio-septic tanks, a traditional nature-based system combining floating gardens, installing sealed holding tank system, or natural absorption zones with basic treatment improvements will be introduced. This low-cost system will integrate local materials, natural filtration, and improved containment structures to provide an affordable, environmentally sensitive sanitation solution for floating villages and economically vulnerable families.

Design Approach

1. Bio-Septic Tank (Primary treatment)

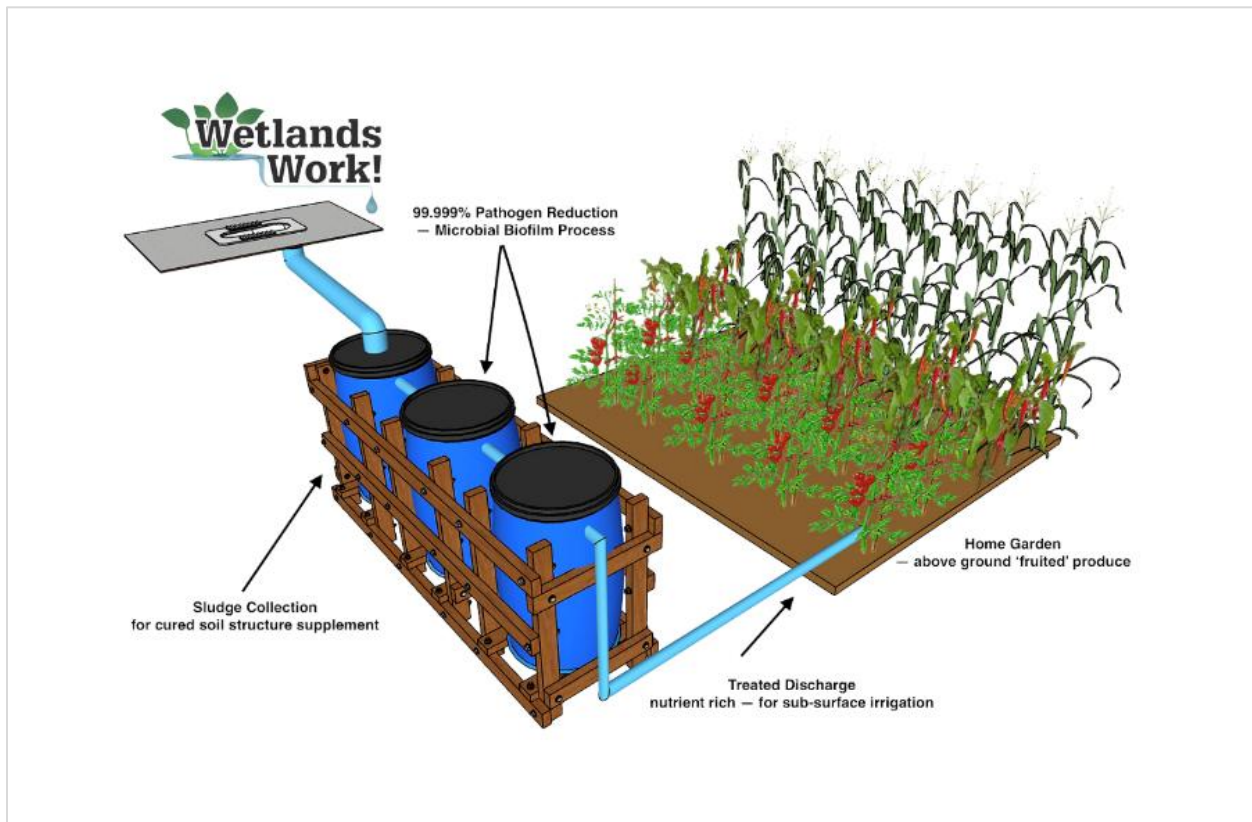
According to the UN supported in 2015, 21 bio -septic tank latrine was constructed within 5 months since the program started. The bio-Septic-tank is a small-scale decentralized wastewater treatment solution for households located on land and floating households that need to be handle or connected to stable with structures or wooden frame. The system operates by separating solids from liquids and treating it through anaerobic biological digestion or filtration of organic waste. The liquid waste or effluent, is then further treated in a soak pit or filtration trench.

Locally available materials such as PVC pipes, concrete rings, or recycled barrels can be used. This system is best for locations where the foundation is stable and waste discharge into soil or sub-surface systems is possible. But latrine constructed on lake water need to handle the effluent for secondary treatment at nearby space or dispose to the central treatment plant.

2. Nature-based solution (Primary and secondary treatment)

The floating garden latrine is a simple, low-cost toilet design for floating houses with treatment of septic tank effluent. It consists of a latrine built on a floating platform using bamboo frames and sealed plastic drums or recycled barrels for buoyancy. Waste is collected in the sealed storage containers installed under the house.

The system requires regular monitoring but is inexpensive and uses locally available resources, making it ideal for small floating communities. A simple septic tank can be constructed from two or more connected plastic barrels to improve containment and initial treatment. The system separates waste into compartments: one for solids and one for liquids. Materials such as sawdust, ash, or sand are regularly added to control odor and help dry the waste. Liquid waste (septic tank effluent) can pass through a gravel-sand-soil filter before safe discharge into the aquatic plants like water hyacinths and grasses, placed on coir mats or floating beds as the natural filters. The plants are replaced every six months.



Source: *Wetlands Work*

Conceptual design of nature-based solution for septic tank and liquid waste

3. Treatment of effluent from septic tank

The treatment system is still prone to flood disaster. For sustainable and flood resilient system, the effluents/liquid waste from the sealed septic tanks must be collected and conveyed to treatment plant which is built nearest on shore of the lake. Thus, licensed septic liquid waste collection and treatment services provider will do conveyance and treatment services. Based on the location available and design of treatment plant septic liquid waste can be reused as non-portable water and making manual fertilizer.

Challenges and Limitations

Bio-septic tanks face challenges such as requiring subsidies or external support for implementation. Nature-based solutions, like constructed wetlands, also have limitations of regular sludge removal, plant replacement, and cleaning are necessary to maintain functionality. These systems are not resilient to flooding, which can lead to failure during extreme weather events. Poor design with improper installation emphasizes the need for robust technical support. Additionally, long-term success relies on community education and engagement to ensure proper maintenance and understanding of the system's operation.

Annex D: Illustration of Working Platform for Construction/Demolition work on the Lake Water

အင်းလေးဒေသ ငလျင်ဒဏ်သင့် အဆောက်အဦ အောက်ခြေတိုင်များ ဖယ်ရှားရန်အတွက် အသုံးပြုနိုင်သော ဘက်စုံသုံးရေပေါ်ဖောင်



ငလျင်ကြောင့်ပျက်စီးသွားသည့် အဆောက်အဦများမှ ကျန်ရစ်သည့် အိမ်အောက်ခြေ သစ်သားတိုင်များ

ကျွန်တော်တို့ White Swan Boating အဖွဲ့မှ ၁၂.၅.၂၀၂၅ နေ့တွင် အင်းလေးဒေသသို့ ကွင်းဆင်း လေ့လာမှုများအရ ငလျင်သင့် ပျက်စီး အိမ်များ၏ အိမ်အောက်ခြေတိုင်များကို ပြန်လည်ဆွဲနုတ် ဖယ်ရှားရန်အတွက် လုပ်ငန်းသုံး ဖောင်များ လိုအပ်လျက်ရှိသည်ကို သိရှိခဲ့ရပါသည်။

ချိန်းဘလောက်များအား သတ်မှတ်ဝန်အား တန်ချိန်အတိုင်း အသုံးပြုနိုင်ရန်အတွက် လိုက်လျော ညီထွေသော ရေပေါ်ဖောင်များကို ပလတ်စတစ် ပီပါ (HDPE Drum) များဖြင့်ပြုလုပ်၍ စတင်နေကြပြီ ဖြစ်သော်လည်း ပျက်စီးအိမ်ခြေနှင့် ဖောင်အရေအတွက် မမျှတခြင်း ၊ ချိန်းဘလောက်၏ အလုပ်လုပ်ပုံ သဘောသဘာဝအရ အရှိန်နှေးဖြင့်သာ ရွေ့လျားခြင်းကြောင့် အချိန်ကြာမြင့်ခြင်းများကို တွေ့ကြုံ နေရပါသည်။ ထို့ကြောင့် အထက်ပါ လုပ်ငန်းလိုအပ်ချက်နှင့် လျော်ညီသော လုပ်ငန်းသုံးရေပေါ်ဖောင် ဒီဇိုင်းအား ကျွန်တော်တို့မှ ပြုလုပ်ခဲ့ပါသည်။

သစ်သားတိုင်များအား ဆွဲနုတ်ရန်အတွက် ဒီဇိုင်းတွင် ထည့်သွင်းထားသည့် သဘောတရားမှာ အောက်ပါ အတိုင်းဖြစ်ပါသည်။

၁။ ကုတ် သဘောတရားဖြင့် တိုင်များအား မ ထုတ်ခြင်း (တိုင်အသေးများ ၊ မြေတွင် နစ်ဝင်မှု နည်းပါးသည့် တိုင်များကို အချိန်တိုအတွင်း ဖယ်ထုတ်နိုင်ရန်)

၂။ လူအားသုံး ဝန်ချိစက် (Manual Winch) ဖြင့် မတင်ခြင်းဖြင့် အချိန်ပိုမိုတိုတောင်းစေခြင်း

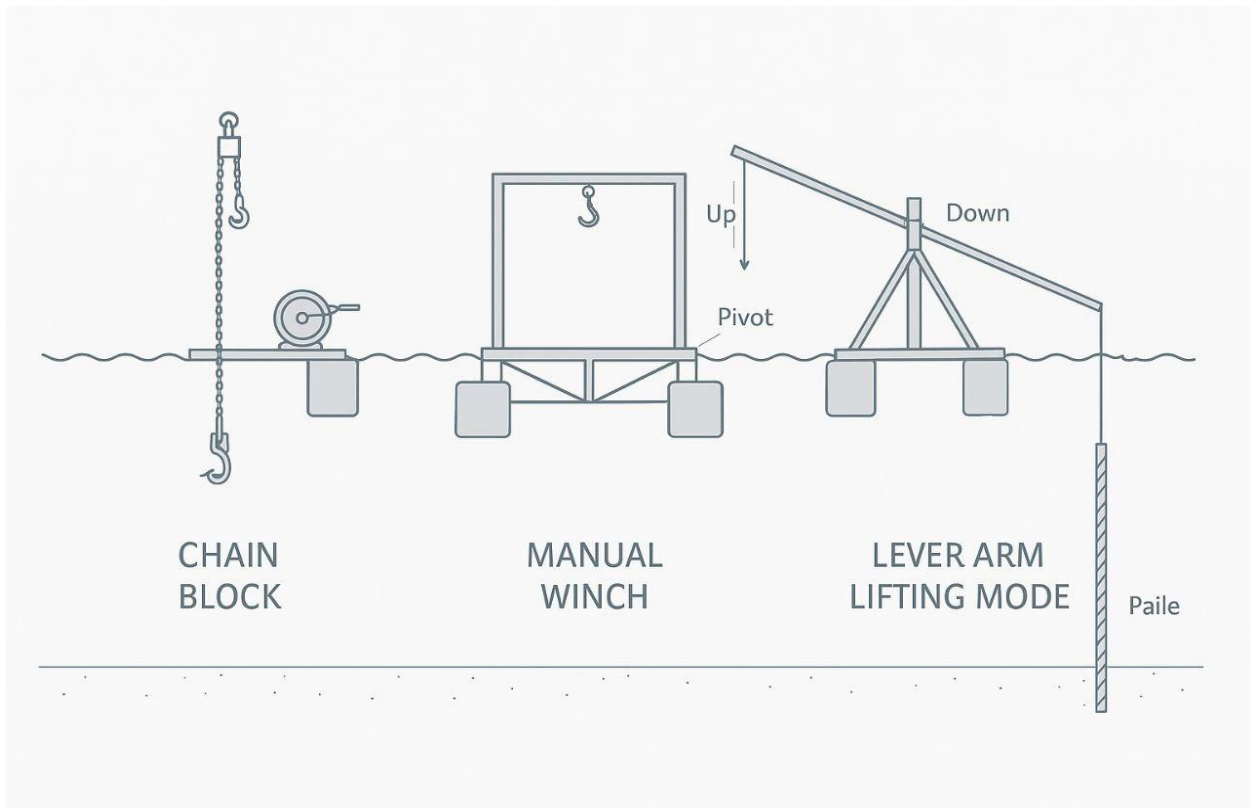
၃။ ယခုအသုံးပြုလျက်ရှိသည့် ချိန်းဘလောက်ဆွဲတင်နည်းအတိုင်းအသုံးပြုရန်အတွက် သင့်လျော်သည့် ကိုင်းတန်း (Gantry Frame) နှင့် ရေပင့်အား ဖန်တီးပေးခြင်း



ကုတ်သဘောတရားအသုံးပြုခြင်း ပုံစံ (သဘောတရားပြပုံ)



ဝန်ချိစက် ၊ ချိန်းဘလောက် ၊ ကရိန်းစသည့် ကိရိယာများတပ်ဆင်ထားသည့် လှုပ်ငန်းသုံး
ရေယာဉ်အမျိုးအစားများ



လုပ်ငန်းသုံးဖောင်၏ ဒီဇိုင်းအချက်အလက်များ

ပြုလုပ်မည့် ပစ္စည်း - သံထည် နှင့် သင့်လျော်သော သဘောဆေး (Marine Paint)

အလျား - ၁၃ ပေ

အနံ - ၆ ပေ

အမြင့် (ကိုယ်ထည်) - ၂ ပေ

အမြင့် (မတင်သည့်ကိုင်) - ၄ ပေ

ရေစူး - ၈ လက်မ ခန့်

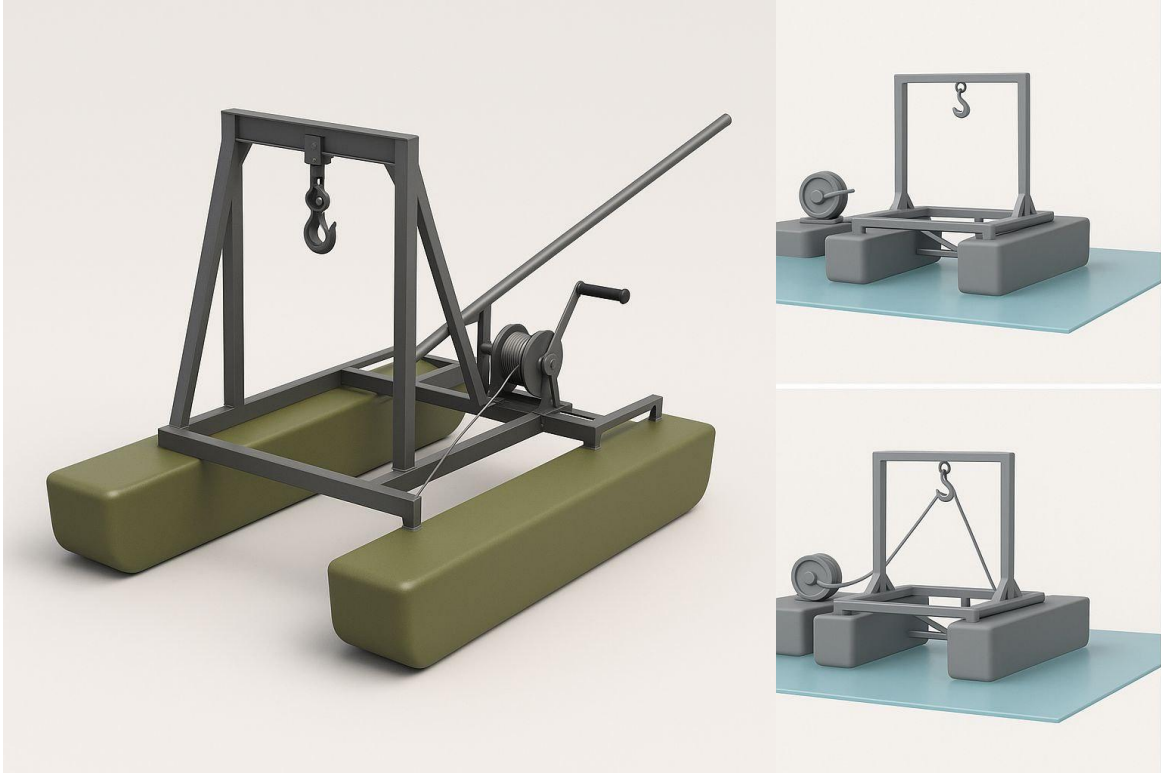
တင်နိုင်သည့် ဝန်အား / ရေပင့်အား - ၁၀၀၀ ကီလိုဂရမ် (၁.၀ တန်)

အလုပ်သမား ဦးရေ - ၄ ဦး

ဝန်ချိစက်အရွယ်အစား - ၁၀၀၀ ကီလိုဂရမ် (ဈေးကွက် အရွယ်အစားအတိုင်း)

သံထည် အလေးချိန် - ၀.၇ တန် ခန့်

ရွေ့လျားမှု - ဒေသခံ စက်လှေဖြင့် ဆွဲယူခြင်း



အဆိုပါ ဖောင်၏ ထုတ်လုပ်မှု ကုန်ကျစရိတ်မှာ ကျပ်သိန်း (၅၀) ခန့်ဖြစ်ပြီး တည်ဆောက်ရန် ကြာမြင့်ချိန်မှာ (၁၄) ရက်ခန့် ဖြစ်ပါသည်။ အစိတ်အပိုင်းများဖြင့် ခွဲ၍ တည်ဆောက်ထားမည် ဖြစ်ပြီး သယ်ယူပို့ဆောင်ရန် လွယ်ကူကာ အခြားလိုအပ်သည့် ပုံစံသို့ အချိန်မရွေး အလွယ်တကူ ပြောင်းလဲ နိုင်ပါသည်။

တိုင်များရှင်းလင်းသည့် လုပ်ငန်းများ ပြီးဆုံးပါက ကိုယ်ထည်အား ပုံပြောင်းအသုံးပြုနိုင်မည့် နည်းလမ်းများ

- ဆောက်လုပ်ရေးပစ္စည်းသယ်ယူရာ
- ဆောက်လုပ်ရေး ဘက်စုံသုံးရေယာဉ် (အပေါ်ဖက် စက်ကိရိယာများ ပြောင်းလဲ တပ်ဆင်၍)
- ရေပေါ်တံတား
- ရေပေါ် အဆောက်အဦ ၊ စတုရန်းဆောင် ၊ ရုံးခန်း စသည်
- ရွှေ့လျားမီးစက်လှေ
- ရွှေ့လျားရေသန့်စက်ဆောင်
- ရေပေါ်အိမ်သာ စသည်

ဒေသ၏ လိုအပ်ချက်အတိုင်း သင့်လျော်မည့် ပုံစံအား ဒီဇိုင်းဆင့်ပွားပြုလုပ်၍ အသုံးပြုနိုင်ပါသည်။

မှတ်ချက် ။ ဖော်ပြထားသည့် ကုန်ကျစရိတ်မှာ ရောင်းချသည့် ဈေးနှုန်းမဟုတ်ဘဲ ကျွန်တော်တို့ ကုမ္ပဏီ၏ ဒီဇိုင်း ၊ ထုတ်လုပ်ရေး စက်ကိရိယာ ၊ အခြေခံ အဆောက်အဦ များအား အခမဲ့ လှူဒါန်း အသုံးပြုကာ တွက်ချက်

ထားခြင်း ဖြစ်ပါသည်။ ရန်ကုန် သဘောကျောင်းတွင် တည်ဆောက်အပြီး ဈေးနှုန်းဖြစ်ပြီး သယ်ပို့ခြင်း ကိစ္စများ ထည့်သွင်းမထားပါ။ တပ်ဆင်ခြင်းမှာ လွယ်ကူပြီး ဒေသခံများမှ ပြုလုပ်နိုင်ပါသည်။

ဆက်သွယ်ရန်

White Swan Boating Co., Ltd

FACEBOOK – White Swan Boating

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Annex I: Survey Tools/ Questionnaires

Profile of Nan Pan Kyar Taw Village, Kyay Sar Kone (North) Village, Kay Lar Village, Inn Dein Village, Tha Le U Inn Village (Day 1)

No.	Question of Key Informant Interview	Nan Pan Kyar Taw Village	Kyay Sar Kone (North) Village	Kay Lar Village	Inn Dein Village	Tha Le U Inn Village
(A)	Information of Area, Population, Households, and Charity Organization of the Village					
1	Area of the village (acres)	-	-	-	-	-
2	Nearest township's name	Nyaung Shwe	Nyaung Shwe	Nyaung Shwe	Nyaung Shwe	Nyaung Shwe
3	Distance between nearest township and the village (miles)	-	-	-	-	-
4	Total number of households (nos.)	-	-	-	-	-
5	Total number of housings (nos.)	254	448	-	-	155
6	Total number of women-headed households	-	-	-	-	-
7	General economic situation of households	-	-	-	-	-
8	Total population	1200	-	-	-	316
9	Number of people who can work	-	-	-	-	-
10	Number of jobless populations	-	-	-	-	-
11	Number and name of the organizations in the village	-	1 (involve 47 persons)	-	-	-
12	Number and name of charity organizations in the village	-	-	-	-	-
(B)	Information of the Climate and Fauna and Flora of the Village					
13	Occurrence of drought	-	-	-	-	-
14	Experience of flooding	Yes	Yes	Yes	Yes	Yes
15	Common flora	-	-	-	-	-
16	Common fauna	-	-	-	-	-
(C)	Pagodas, religious buildings, and Schools					

No.	Question of Key Informant Interview	Nan Pan Kyar Taw Village	Kyay Sar Kone (North) Village	Kay Lar Village	Inn Dein Village	Tha Le U Inn Village
17	Number, names, and lifespan of Pagodas	Alodaw pauk pagoda	Sin Gaung Phyu Pagoda, 150 years	-	Inn Dein Pagoda	-
18	Number of religious buildings	Monastery-1	Monastery-1	Monastery- 1	Monastery-1	Monastery-1
19	Number of religious community halls	-	3	-	-	-
20	Number of schools	1	Basic Education High School - 1	-	-	-
21	Number of students	-	Over 700	-	-	-
22	Number of teachers	-	30	-	-	-
23	Status of education of the village	-	Moderately	-	-	-
(D)	Health					
24	Existence of clinics	-	Yes	-	-	-
25	Number of clinics	-	1	-	-	-
26	Number of medical staffs	0	4	-	-	-
27	Name of the nearest hospital	-	Nyaung Shwe	-	-	-
28	Distance between the village and the hospital	-	6 miles	-	-	-
29	Common diseases occurred in children in the past year	-	Diarrhea, Mumps, Seasonal flu	-	-	-
30	Common diseases occurred in elderly in the past year	-	Hypertension, Diabetes, Heart Disease	-	-	-
31	Diseases common in middle age in the past year	-	Hypertension	-	-	-
(E)	Resources					
32	Access to grid electricity by the government	Yes	Yes	Yes	Yes	Yes
33	Sources of electricity	National Grid	National Grid	National Grid (Electricity is currently unavailable due to earthquake.)	National Grid	National Grid

No.	Question of Key Informant Interview	Nan Pan Kyar Taw Village	Kyay Sar Kone (North) Village	Kay Lar Village	Inn Dein Village	Tha Le U Inn Village
34	Fuel used for cooking	-	-	-	-	-
35	Sources of drinking water	Water Bottle/Water Purifier	Spring water/ water purification machine from monastery	purified water from monastery, Inle lake	-	purified water from monastery, seepage spring
36	Sources of domestic water	-	Inle Lake	Inle Lake	-	Seepage Water
37	Sufficiency of drinking water	Yes	Yes	Yes	Yes	Yes
38	Sufficiency of domestic water	Yes	Yes	Yes	Yes	Yes
39	Quality of drinking water	Good	Good	Good	Good	Good
40	Quality of domestic water	-	Good	Fair	-	Fair
(F)	Transportation					
41	Main Transportation	Waterway	Waterway	Waterway	Road, Waterway	Waterway
42	Situation of the transportation	Good	Good	Good	Good	Good
43	Existence of boat station	Yes	Yes	Yes	Yes	Yes
44	Situation of the telecommunication	Good	Good	Good	Good	Good
(G)	Occupational Status					
45	Agricultural workers	Yes	Yes	-	Yes	-
46	Common Crops	Tomato	Tomato, Pumpkin, Chayote	-	-	-
47	Land Value	-	-	-	-	-
48	Livestock breeders	-	-	-	-	-
49	Common livestock	-	-	-	-	-
50	Fishery	-	Yes	-	-	-
51	Common Fish	-	Tilapia, Bronze featherback, Common snakehead, Mrigal carp, Inle carp	-	-	-

No.	Question of Key Informant Interview	Nan Pan Kyar Taw Village	Kyay Sar Kone (North) Village	Kay Lar Village	Inn Dein Village	Tha Le U Inn Village
52	Other occupations	Small business (weaver)	Carpenter, Office Staff, Hotel, Agriculture	-	-	-
53	Name and number of workshops near to the village	-	No	-	-	-
(H)	Information about Religions, Races, and Ethnic Minority					
54	Races in the village	Intha people	Intha people	Intha people	Intha people	Intha people
55	Religion	Buddhism	Buddhism	Buddhism	Buddhism	Buddhism
56	Existence of the ethnic minority	No	No	No	No	No
57	Name of the ethnic minority	-	-	-	-	-
58	Number of households of ethnic minority	-	-	-	-	-

Source: E Guard Study Team (April 2025)

Profile of Floating Garden Kyay Sar Kone (North) Village, He Yar Ywar Ma Village, Inn Paw Hkon Village, Se Khaung Village, Yae Lel Village (Day 2)

No.	Question of Key Informant Interview	Floating Garden (Kyay Sar Kone (North) Village)	He Yar Ywar Ma Village	Inn Paw Hkon Village	Se Khaung Village	Yae Lel Village
(A)	Information of Area, Population, Households, and Charity Organization of the Village					
1	Area of the village (acres)	-	-	-	-	-
2	Nearest township's name	Nyaung Shwe	Nyaung Shwe	Nyaung Shwe	Nyaung Shwe	Nyaung Shwe
3	Distance between nearest township and the village (miles)	-	-	-	-	-
4	Total number of households (nos.)	-	-	350	-	-
5	Total number of housings (nos.)	-	-	280	-	105
6	Total number of women-headed households	-	-	-	-	-
7	General economic situation of households	-	-	-	-	-
8	Total population	-	-	-	-	375

No.	Question of Key Informant Interview	Floating Garden (Kyay Sar Kone (North) Village)	He Yar Ywar Ma Village	Inn Paw Hkon Village	Se Khaung Village	Yae Lel Village
9	Number of people who can work	-	-	-	-	-
10	Number of jobless populations	-	-	-	-	-
11	Number and name of the organizations in the village	-	-	-	-	-
12	Number and name of charity organizations in the village	-	-	-	-	-
(B)	Information of the Climate and Fauna and Flora of the Village					
13	Occurrence of drought	-	-	-	-	-
14	Experience of flooding	Yes	Yes	Yes	Yes	Yes
15	Common flora	-	-	-	-	-
16	Common fauna	-	-	-	-	-
(C)	Pagodas, religious buildings, and Schools					
17	Number, names, and lifespan of Pagodas	-	-	-	-	-
18	Number of religious buildings	Monastery - 1	Monastery - 10	Monastery - 1	Monastery - 1	Monastery - 1
19	Number of religious community halls	-	-	-	-	-
20	Number of schools	Basic Education High School -1)	-	2 (Basic Education Primary School -1 Basic Education High School -1)	1	No
21	Number of students	-	-	-	-	-
22	Number of teachers	-	-	-	-	-
23	Status of education of the village	-	-	-	-	-
(D)	Health					
24	Existence of clinics	-	-	Yes	-	-
25	Number of clinics	-	-	1	-	-
26	Number of medical staffs	-	-	-	-	-
27	Name of the nearest hospital	-	-	-	-	-

No.	Question of Key Informant Interview	Floating Garden (Kyay Sar Kone (North) Village)	He Yar Ywar Ma Village	Inn Paw Hkon Village	Se Khaung Village	Yae Lel Village
28	Distance between the village and the hospital	-	-	-	-	-
29	Common diseases occurred in children in the past year	-	-	-	-	-
30	Common diseases occurred in elderly in the past year	-	-	-	-	-
31	Diseases common in middle age in the past year	-	-	-	-	-
(E)	Resources					
32	Access to grid electricity by the government	Yes	Yes	Yes	Yes	Yes
33	Sources of electricity	National Grid	National Grid	National Grid, Solar	National Grid	National Grid
34	Fuel used for cooking	-	-	-	-	-
35	Sources of drinking water	Spring water/ water purification machine from monastery	-	Water bottle, Water purifier	Water purifier	Water bottle, Water purifier
36	Sources of domestic water	-	-	Tube well (depth – 250 feet)	Tube well (depth – 260 feet)	Spring water
37	Sufficiency of drinking water	-	-	-	-	-
38	Sufficiency of domestic water	-	-	-	-	-
39	Quality of drinking water	Good	-	Good	-	Good
40	Quality of domestic water	-	-	Good	-	Good
(F)	Transportation					
41	Main Transportation	Waterway	Waterway	Waterway	Road, Waterway	Waterway
42	Situation of the transportation	-	-	Good	Moderately	-
43	Existence of boat station	Yes	Yes	Yes	Yes	Yes
44	Situation of the telecommunication	Good	Good	Good	Good	Good

No.	Question of Key Informant Interview	Floating Garden (Kyay Sar Kone (North) Village)	He Yar Ywar Ma Village	Inn Paw Hkon Village	Se Khaung Village	Yae Lel Village
(G)	Occupational Status					
45	Agricultural workers	Agriculture (Tomato)	Agriculture	Agriculture, Fishing, Small plant (Weaver)	-	-
46	Common Crops	Tomato, Cucumber, Pumpkin, Gourd, Bean	-	Tomato, Eggplant	-	-
47	Land Value	-	-	-	-	-
48	Livestock breeders	-	-	-	-	-
49	Common livestock	-	-	-	-	-
50	Fishery	-	-	-	-	-
51	Common Fish	Common snakehead, Bronze featherback, Tilapia	-	Tilapia, Bronze featherback, Common snakehead,	-	-
52	Other occupations	Agriculture	Goldsmith, Blacksmith, Weaver	Weaver	Farm, Blacksmith	A boat construction business, Carpenter, Vendor in Alodaw Pauk pagoda
53	Name and number of workshops near to the village	-	-	-	-	-
(H)	Information about Religions, Races, and Ethnic Minority					
54	Races in the village	Intha people	Intha people	Intha people	Intha people	Intha people
55	Religion	Buddhism	Buddhism	Buddhism	Buddhism	Buddhism
56	Existence of the ethnic minority	No	No	No	No	No
57	Name of the ethnic minority	-	-	-	-	-
58	Number of households of ethnic minority	-	-	-	-	-

Source: E Guard Study Team (April 2025)

Flood

Building Loss and Damage Inventory Survey Form

Village : 226:025 GPS Location : Lat _____
 Village Tract : 226:025 :Long _____
 Population : _____ :Ele _____
 Date : 15.4.2025 Contact Person : _____

Building / Structures

Type of building	RC	Masonry	wooden_B	wooden_S	Bamboo	Other	
	/	/	X	X	2		
Number of Story	1	2	>3	Complex	Remark:		
	/	/					
Utility	Religious	Public	Private	Factory / Mill	Other	Remark: Hotel 2	
	/	X	/				
Appr. Age of Building	< 10 yrs	10 - 30 yrs	30 - 50 yrs	50 - 100 yrs	> 100 yrs	Remark: 30 yrs	
	/	/	X	X	X		

2/10

Infrastructures

Type	Road	Bridge	Agriculture	Other	If other please specify	
	/	/	/	/	Wier 226	2
Damage Level	Total damage		Partial damage		Distort/ cracks	Minor
	/		X		X	X

Disaster

Event	From <u>Sept 17</u>	To	Duration	<u>A</u> days			
Damaged by	Inundation	current	wind	Rain	F_Fire	U_Fire	Landslide
	/	/					
	Ground Shaking		Liquefaction	Human activity		Other	

<p>Remark</p> <p>226:025 Flood duration 4 day</p> <p>226:025 - 226:025</p> <p>Debris flow - up to into lake</p> <p>226:025 - deposited 3' ft</p> <p>The debris flow departed up to 3 feet settle over Agri area and stop cultivation</p>	<p>Photo</p> <p>226:025: 226:025</p> <p>226:025: 226:025</p>
--	--

Source: E Guard Study Team (April 2025)

Building Loss and Damage Inventory Survey Form

Village : ၈၆:၀၂:၄၅
 Village Tract : ၈၆:၀၂
 Population :
 Date : 13.4.2025

GPS Location : Lat _____
 :Long _____
 :Ele _____

Contact Person : U San Win
 428363928

Building / Structures

Type of building	RC	Masonry	wooden_B	wooden_S	Bamboo	Other	
Number of Story	1	2	>3	Complex	Remark: ၇၅၆၀၀၀၀၀၀ RC		
Utility	Religious	Public	Private	Factory / Mill	Other	Remark:	
Appr. Age of Building	< 10 yrs	10 - 30 yrs	30 - 50 yrs	50 - 100 yrs	> 100 yrs	Remark:	

Infrastructures

Type	Road	Bridge	Agriculture	Other	If other please specify		
	X	X		X			
Damage Level	Total damage		Partial damage		Distort/ cracks		Minor

Disaster

Event	From 28.3.	To 31.3.	Duration		3074 day days		
Damaged by	Inundation	current	wind	Rain	F_Fire	U_Fire	Landslide
	Ground Shaking		Liquefaction	Human activity		Other	

Remark	Photo
Total 118 updated mostly caused by ground shaking, no evidence of liquefaction. little damage -> agriculture mostly, the building in the water damage severely, driven pile foundation conducted by human energy 4 to 6' ft clayey soil	

07/07/2024 4:30' in April. 8' to 6'
 - 15' on rainy season

၂၀၂၀-၂၀၂၁

Building Loss and Damage Inventory Survey Form

Village : Nan Pan Kya Tu GPS Location : Lat _____
 Village Tract : Nan Pan : Long _____
 Population : 1200 (254 household!) : Ele _____
 Date : _____ Contact Person : U. Aung Mye

Building / Structures

Type of building	RC	Masonry	wooden_B	wooden_S	Bamboo	Other	Remark
	/	/	/	/	/		
Number of Story	1	2	>3	Complex	Remark: <u>အောက်ဖွဲ့၊ ဘယ်လ်</u>		
	/	/	X		Remark: <u>အောက်ဖွဲ့</u>		
Utility	Religious	Public	Private	Factory / Mill	Other	Remark: <u>အောက်ဖွဲ့</u>	
	/	/	/	/	/		
Appr. Age of Building	< 10 yrs	10 - 30 yrs	30 - 50 yrs	50 - 100 yrs	> 100 yrs	Remark: _____	
	/	/	/	/	/		

Infrastructures

Type	Road	Bridge	Agriculture	Other	If other please specify	
	/	/	/	/		
Damage Level	Total damage		Partial damage		Distort/ cracks	Minor
	/		/		/	/

Disaster

ရေတက်ကြီးစွန်းစွန်း total damage.

Event	From	To	Duration	days	
	<u>28.9</u>	<u>31.</u>		<u>5</u>	
Damaged by	Inundation	current	wind	Rain	F_Fire
	/				
	Ground Shaking		Liquefaction	Human activity	Other
	/		X		

damage.
 28/9/20
 254.
 9

Remark	Photo
Bamboo house total collapse	Some fishes died water level fall after 1 to 2 days ↓ about $\frac{1}{4}$ feet
G houses at rest which built on ground.	
RC buildings total collapse.	
Sympton of liquefaction observed, Sandboils on cracks and snail shell floated.	
Houses collapsed multiple direction.	

Building Loss and Damage Inventory Survey Form

Village : 225606
 Village Tract : 225015
 Population :
 Date : 17.11.2025
 GPS Location : Lat _____
 :Long _____
 :Ele _____
 Contact Person : 428338663

Building / Structures						
Type of building	RC	Masonry	wooden_B	wooden_S	Bamboo	Other
	X	/	/	/	/	/
Number of Story	1	2	>3	Complex	Remark: 3000... 3000... 3000...	
	/	/	3000... 3000...	X		
Utility	Religious	Public	Private	Factory / Mill	Other	Remark:
	/	/	/	/	/	2250... 2250... 2250...
Appr. Age of Building	< 10 yrs	10 - 30 yrs	30 - 50 yrs	50 - 100 yrs	> 100 yrs	Remark:
	/	/	/	/	1	1800... 1800... 1800...

Infrastructures					
Type	Road	Bridge	Agriculture	Other	If other please specify
	X	X	/	6000...	
Damage Level	Total damage		Partial damage		Distort/ cracks
	X		/		/

Disaster							
Event	From	To	Duration		days		
	25	28					
Damaged by	Inundation	current	wind	Rain	F_Fire	U_Fire	Landslide
	X	X	X	X	X	X	X
	Ground Shaking		Liquefaction	Human activity		Other	
	/		/	X		X	

Remark	Photo
BE - Cracks	wooden pile foundation 4' ~ 5' shallow footing on ground some shallow footing are to cut the wood and fill
Mason - cracks	
Wood - distort, minor disturb	
bamboo - Major distort, etc	
School - 2000.../2000... 2000.../2000... 2000...	
Liquefaction - 2000... 2000...	
No evidence	

Source: E Guard Study Team (April 2025)

Building Loss and Damage Inventory Survey Form

Village : Heya Kwana GPS Location : Lat _____
 Village Tract : Kwama 09/15 : Long _____
 Population : _____ : Ele _____
 Date : 11.1.2025 Contact Person : _____

Building / Structures

Type of building	RC	Masonry	wooden_B	wooden_S	Bamboo	Other	
Number of Story	1	2	>3	Complex	Remark: <u>Anderson</u>		
Utility	Religious	Public	Private	Factory / Mill	Other	Remark:	
Appr. Age of Building	< 10 yrs	10 - 30 yrs	30 - 50 yrs	50 - 100 yrs	> 100 yrs	Remark:	

70 60%

Infrastructures

Type	Road	Bridge	Agriculture	Other	If other please specify		
	X	X	X	X			
Damage Level	Total damage		Partial damage		Distort/ cracks	Minor	

Disaster

Event	From		To		Duration	days	
Damaged by	Inundation	current	wind	Rain	F_Fire	U_Fire	Landslide
	Ground Shaking		Liquefaction	Human activity		Other	

Remark	Photo
No liquefaction symptom.	Mostly founded on
Water loss along cracks	filled soil
Water deplete along channel	3-4 ft timber foundation.
Inn Tein Channel is shallow	pile
due to deposition during	Timber pile foundation on
2024 flood	water deep 20 cm
collapse multiple direction.	30 ft

Building Loss and Damage Inventory Survey Form

Village : ၂၈၅၂၆ GPS Location : Lat _____
 Village Tract : ၂၈၅၂၆ :Long _____
 Population : _____ :Ele _____
 Date : 13-4-25 Contact Person : ၁၆၆-၆၆၅

791990931

Building / Structures

Type of building	RC	Masonry	wooden_B	wooden_S	Bamboo	Other	
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Number of Story	1	2	>3	Complex	Remark:		
Utility	Religious	Public	Private	Factory / Mill	Other	Remark:	
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	School/Clinic → Crack damage	
Appr. Age of Building	< 10 yrs	10 - 30 yrs	30 - 50 yrs	50 - 100 yrs	> 100 yrs	Remark:	
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

Infrastructures

Type	Road	Bridge	Agriculture	Other	If other please specify	
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
Damage Level	Total damage		Partial damage		Distort/ cracks	Minor
	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	

Disaster

Event	From		To		Duration		
	Inundation	current	wind	Rain	F_Fire	U_Fire	days
Damaged by							
	Ground Shaking		Liquefaction	Human activity		Other	
	<input checked="" type="checkbox"/>						

Remark	Photo
Most of the wooden houses are damaged cause are older 50-100	
Wooden houses and bamboo collapsed mostly	
Fatality - 2 Nos (women)	
Injure - X	
2 deaths are caused by building collapsed.	
Annual dredging is conducted for heavy siltation	
No evidence of liquefaction	

ကျေးဇူးတင်အားဖြင့် - မိမိတို့အား အထောက်အကူပြုပေးပါ။
 ၂၈၅၂၆ - မိမိတို့ - ၆၆၆-၆၆၅

ନିମ୍ନୋକ୍ତ ଗ୍ରାମ

Form 2

Hazard Assessment Form

1. Name of village tract : *Nan Pu.*

2. Name of village : *Nan Pu Kyar Tau*

3. Types of hazards happening in village (✓):

Storm / Cyclone	Storm surge	Flood	Erosion	Tsunami	Earthquake	Landslide	Drought	Fire	Forest Fire	Tornado	Lightning	Health related
✓		✓	✓	X	✓	✓	✓	X	X	X	✓	✓

4. Type of past disaster events (10 ye *m:05* *2005*).

Year	Hazard type	# of human losses			Household property losses										Property Loss					Land (erosion)/ embankment length (feet)	Agriculture land acre		
		male	female	total	# of animal died					Building					Village road		Jetty		bridge				
					buffalo	cow	chicken	pig	others	house	school	Monast-ery	Other	feet	Mile	Big	Small	Big	Small				
2005	EA			1																			

Source: E Guard Study Team (April 2025)

၂၅၅ မြို့နယ် - ဝေလ်ကန်မြို့နယ်

Hazard Assessment Form

Form 2

1. Name of village tract: ၂၅၅ မြို့နယ်

2. Name of village: ၂၅၅ နယ်

3. Types of hazards happening in village (✓):

Storm / Cyclone	Storm surge	Flood	Erosion	Tsunami	Earthquake	Landslide	Drought	Fire	Forest Fire	Tornado	Lightning	Health related
✓		✓	✓	X	✓	✓	✓	X	X	✓	✓	✓

၂၅၅ မြို့နယ်

4. Type of past disaster events (10 ye

Year	Hazard type	# of human losses			Household property losses										Land Agriculture land acre							
		# male	# female	total	# of animal died					Building			Village road			Property Loss			Land (erosion)/ embankment length (feet)			
					buffalo	cow	chicken	pig	others	house	school	Monast-ery	Other	feet	Mill	Big	Small	Big		Small		
2001	Flood									✓	X	X		X	X	X	X	X	X	X		X
2002	Flood																					

Hazard Assessment Form

Form 2

1. Name of village tract: *Ungge*

2. Name of village: *Ungge-gehde*

3. Types of hazards happening in village (✓):

Storm / Cyclone	Storm surge	Flood	Erosion	Tsunami	Earthquake	Landslide	Drought	Fire	Forest Fire	Tornado	Lightning	Health related
✓	X	✓	X	✓	✓	X	X	✓	X	X	✓	X

4. Type of past disaster events (10 ye *deposition*)

Year	Hazard type	# of human losses			Household property losses													Property Loss					Land Agriculture land acre	
		# male	# female	total	# of animal died													Village road						Land (erosion)/ embankment length (feet)
					buffalo	cow	chicken	pig	others	house	school	Monast-ry	Other	feet	Mile	Big	Small	Big	Small					
2004	Fl	X	X	2	X	X	X	X	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	✓	✓
2005	Ev		A	A	X	X	X	X	X	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X

deposition

व. नं. १०१. ११.

Form 2

Hazard Assessment Form

1. Name of village tract: ३६.६०१/१

2. Name of village: २२५०६/६

3. Types of hazards happening in village (✓):

Storm / Cyclone	Storm surge	Flood	Erosion	Tsunami	Earthquake	Landslide	Drought	Fire	Forest Fire	Tornado	Lightning	Health related
✓	X	✓	X	X	✓	X	X	X	X	X	✓	+

२२५०६/६ ११/१०११ / ११११/११११ → ११११/६
 Tube well - २६०'

4. Type of past disaster events (10 ye

Year	Hazard type	# of human losses			Household property losses										Property Loss					Land Agriculture land acre			
		male	female	total	buffalo	cow	chicken	pig	others	house	school	Monast-ery	Other	Village road	Jetty	bridge	Land (erosion)/ embankment length (feet)						
२०२१	FL	X	X	X						X	X												3 acre
२०२५	Eq	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

२२५०६/६

Hazard Assessment Form

1. Name of village tract: *916:084*

2. Name of village: *916:084*

3. Types of hazards happening in village (X):

Storm / Cyclone	Storm surge	Flood	Erosion	Tsunami	Earthquake	Landslide	Drought	Fire	Forest Fire	Tornado	Lightning	Health related
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

2021 only

4. Type of past disaster events (10) ye

Year	Hazard type	# of human losses			Household property losses										Property Loss						Land		
		male	female	total	buffalo	cow	chicken	pig	others	house	school	Building Monast- ery	Other	feet	Mile	Big	Small	Big	Small	bridge		Land (erosion)/ embankment length (feet)	Aggriculture land acre
<i>2024</i>	<i>Fl</i>	<i>4</i>	<i>2</i>	<i>6</i>	<i>1</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>10</i>	<i>X</i>	<i>X</i>	<i>10</i>	<i>X</i>	<i>4</i>	<i>X</i>	<i>2</i>	<i>X</i>	<i>X</i>	<i>1</i>	<i>1</i>	
<i>2025</i>	<i>Eq</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	

*2024: 916:084
2025: 916:084*

Annex J: Brief Integrated Conservation Strategy for Flood and Earthquake Protection of Ancient Structures

Ancient structures represent invaluable cultural heritage and require specialized protection against natural disasters such as floods and earthquakes. To ensure their long-term preservation, the following integrated measures are recommended, combining traditional conservation practices with modern technology and community involvement.

1. Comprehensive Condition Assessment

Conduct detailed surveys by archaeologists and conservation experts to document all damage caused by floods and earthquakes.

Understand the original construction techniques and current state of deterioration.

2. Structural Reinforcement

Use durable joint systems to stabilize stupas, pillars, brick walls, and timber components while preserving traditional joinery methods to maintain authenticity.

Employ Fiber Reinforced Polymer (FRP) wrapping on timber elements for additional seismic reinforcement.

3. Integration of Modern Technologies

Install Base Isolation Systems beneath major structures to reduce seismic impact.

Improve drainage infrastructure and implement water-resistant designs that do not alter historical features to mitigate flood damage.

4. Environmental and Site Management

Modify and manage the surrounding landscape to prevent ground cracking and control floodwater flow.

Protect timber and other vulnerable materials from moisture damage through proper site management and maintenance.

5. Digital Documentation and Monitoring

Digitize architectural details, inscriptions, and artifacts for long-term preservation and academic access.

Deploy sensors for real-time monitoring of structural health and moisture intrusion.

6. Regular Inspection and Maintenance

Conduct routine seismic risk assessments and flood vulnerability evaluations.

Systematically inspect timber components and other materials for signs of decay or damage and address issues promptly.

7. Community Engagement and Capacity Building

Train local communities in heritage conservation, disaster preparedness, and emergency response.

Promote awareness programs to foster local stewardship of heritage sites.

8. Legal Protection and International Support

Advocate for official government recognition of heritage sites to ensure legal protection.

Seek technical and financial assistance from international organizations such as UNESCO and SEAMEO-SPAFA.

9. Preventive Measures and Emergency Planning

Establish early warning systems for floods and earthquakes tailored to heritage zones.

Construct flood barriers and ensure clear evacuation routes.

Develop and regularly update emergency preparedness and response plans specific to heritage conservation.

By implementing these integrated approaches, ancient structures can be safeguarded against the combined threats of flooding and earthquakes, ensuring their survival and cultural significance for future generations.

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