

Project Report - Myanmar

DEVELOPING THE CAPACITY OF STUDENT SCIENTISTS FOR SUPPORTING DISADVANTAGED COMMUNITIES TO COPE WITH FLOODING (DECAF)



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Summary

Introduction- Overview of the project

The DECAF (Developing the Capacity of Student Scientists for Supporting Disadvantaged Communities to Cope with Flooding) project aims to support undergraduate and graduate-level student scientists in Myanmar to develop knowledge and skills in flood-related natural disasters, vulnerability assessment, and management strategies. As the majority of senior tertiary students in Myanmar have been experiencing education interruptions due to pandemics and major social events, this project's learning goals are to build the research students' capacity in flood risk management and, at the same time, aspire to pursue an applied science and research career in this climate change, water, and flood-related environmental field. The DECAF project consists of two major learning components: Part 1: Online Learning Lecture Series from Expert Educators from New Zealand (Victoria University of Wellington), the U.S., Indonesia, and China, and guided field-learning activities as part of Part 2: Collaborative Experiential Learning .

Project Timeline and Participants

Six learning lectures were conducted virtually between May to early June 2023. Site observation and on-ground field activities were implemented in the week of 4th July. After that, the Myanmar Research Team has gone through the Data Analysis and Visualisation Process and Evaluation and Assessment of the Findings and Results from Modules 1, 2, and 3 to prepare for Module 4: Community-Based Risk Reduction Planning and provide logical recommendations.

Seven young, passionate learners from Yangon, Bago, Mandalay City, are selected to participate in Part 2's on-site field activities. During this field observation, learners successfully completed all four modules of Part 2, guided by a local project assistant. The training activities include interactive discussion sessions among the Myanmar project participants, hands-on flood exposure assessment measuring tasks, and asking vulnerability assessment survey questionnaires to local communities.

Project participants include:

			
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Bachelor in Science, Botany and Environmental Biology (University of Yangon)	Environmental Consultant Ph.D.Environmental Science and Engineering (Suranaree University of Technology)	B.E. Civil engineering M.E Water Resources Engineering (Yangon Technological University)	B.E. Civil engineering M.E Water Resources Engineering (Yangon Technological University)



Brief overview of Project study area

The study area of the project is located inside Kyimyindine township in the western district of Yangon region, called Ba Loat Nyunt (16.8067° N, 96.1182° E). This area is one of the wards located in Kyimyindine Township, on the western bank of the Hlaing River. It has an area of 0.21 square kilometers. Among the two chosen site locations in Yangon, the research team finally decided on this location to conduct field studies because the case study area, Ba Lote Nyunt Ward is almost under threat of flooding each year. In this region, the main reason for the devastating flood is the influence of the Yangon River, especially during Warso and Warkaung (the months of the Myanmar Lunar Calendar), and seasonal rainfall, which eventually makes the district vulnerable to flooding.

A brief overview of four training modules and their outcomes

Module 0: Co-design and planning

As part of Module 0: Co-Design and Planning, it took 2 weeks to develop a work plan and schedule for the on-site field training, including reflection, discussion sessions of Part 1's online lecture, tools and application acquisition to conduct the training modules, and identifying flood-vulnerable field site locations in Yangon.

Module 1: Water Quality Assessment

The research team acquired information on water sources used for household purposes through participatory survey interviews with the local population. There are three usable ponds and one eutrophic pond in Ba Loat Nyunt village, and most homes have cement and plastic tanks with motor pumps to store groundwater. Because river water is unsuitable for residential use, no one uses it directly. The researchers chose four sampling locations: two from local ponds and two from groundwater wells. Water sample testing criteria were communicated to the lab in advance, and the collection process went successfully.

Module 2 : Flood Exposure Assessment

The research team assessed flood exposure in a village by asking for historical flood-related information with 16 qualitative questionnaires and specifically selecting locations near the river confluence and households close to the riverbank. After that, the research team measured household floor heights and water levels during flooding and recorded the data using a QGIS platform. According to local communities' personal experience and the findings of Module 2, the August 2022 monsoon flood significantly impacted Myanmar, causing disruptions to well-being and socioeconomic stability. Traditional beliefs linked extreme floods to Burmese leap years, and many were unaware of their entitlements. Drawing from Cyclone Nargis experiences, demand for cyclone shelters emerged as crucial.

Module 3 : Participatory Vulnerability Assessment

Module 3 questionnaire interviews were conducted over two days. The research team defined age groups to ensure the inclusion of teenagers, adults, and elders from the village. Interviews were conducted in small groups, covering the entire village area. Around 50 survey forms were completed each day, and the coordinates of households were recorded for mapping. Through this Module 3 participatory vulnerability assessment of flood risk in Ba Loat Nyunt Village, insights into the interconnections between local culture, environment, and socio-economic factors are revealed. The challenges posed by flood risk and solid waste pollution impact the environment, living standards, and community well-being. To address

these issues, suggested actions include launching educational campaigns for responsible waste disposal, enforcing regulations through local authorities, enhancing infrastructure, and promoting community participation in waste management initiatives.

Module 4: Develop a community-based risk reduction plan.

Module 4 focuses on developing a community risk reduction plan utilising data cleaning and analysis from survey questionnaires. Results from Modules 1, 2, and 3 enhance citizens' awareness of flood risks and encourage appropriate behavioural responses. Online risk maps and flood-warning applications can help enhance societal resilience against flooding. This community-based risk reduction approach comes with the implementation of modest-scale and practical interventions within the realms of **waste management and water education**. Targeted campaigns and the **"Flood Community Awareness Network"** are also essential components. Community flood action groups are also crucial in promoting resilience against flooding.

1. Introduction

Myanmar faces significant climate change risks and hazards; the country is also taking steps to address these challenges. Efforts are being made to enhance disaster preparedness, promote sustainable development, and reduce greenhouse gas emissions. However, additional support and international collaboration are crucial to effectively mitigate the impacts of climate change in Myanmar in conjunction with other vulnerable nations in the region. According to the climate change impacts and vulnerability report, Myanmar ranked 162nd of 182 countries (University of Notre Dame 2021). About 7.3 million inhabitants reside in the commercial region, Yangon, in which the majority of the population live in urban areas with up to 70% of the population of the region in its 45 townships (GAD 2019). The figure continues to increase as a result of socioeconomic development prospects and security by those displaced elsewhere in Myanmar. This exerts stresses on urban resilience to the situation where accessibility to the city's municipal services and public utilities are barely able to accommodate steadily increasing migration and population.

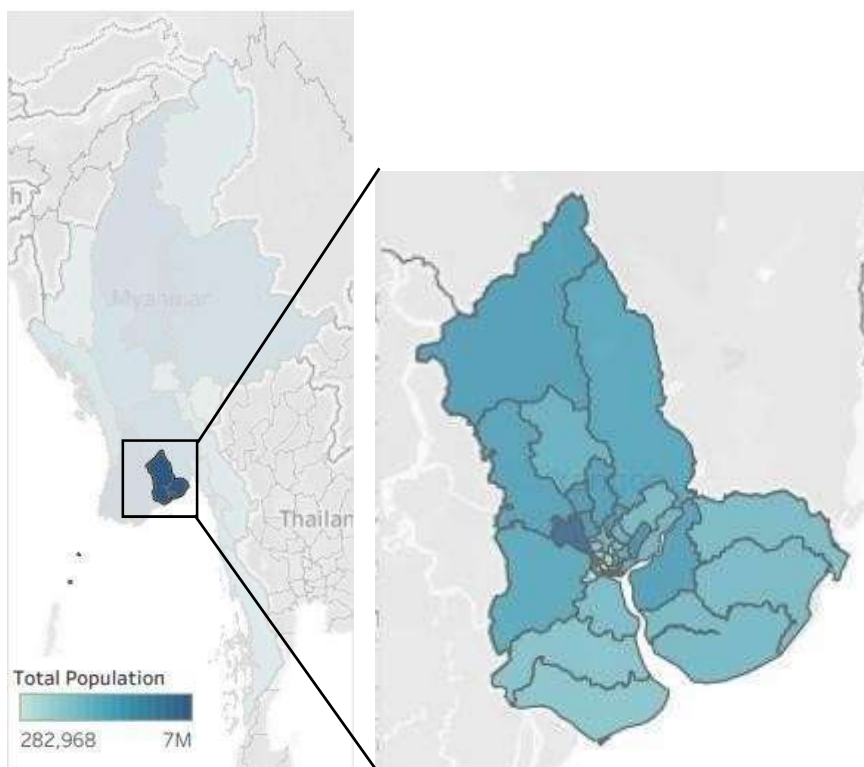


Figure 1: Total Population in Yangon Region, Myanmar

(Source: MIU)

Yangon city's urban resilience to withstand economic, social, health, environment, disaster and climate change risks are constantly subjected to threats and hazards in any development discourse. The climate change driven disasters such as sea-level rise, flooding, cyclones and storm surges put social, economic, health, and environment at risk critically due to their recurrence interval in closer frequency.

2. Background and Study Area

The study area of the project is Ba Loat Nyunt (16.8067° N, 96.1182° E), which is one of the wards located in Kyimyindine Township, on the western bank of the Hlaing River. It has an area of 0.21 square kilometers. According to the data from Ba Loat Nyunt Administrator Office in 2022, there are an estimated number of 2030 households residing in the ward. Essential facilities like water supply infrastructure, sanitation facilities, and drainage lines are conspicuously lacking. In Ba Loat Nyunt Ward, there were originally four ponds, but only one of these ponds remains accessible. This access restriction stems from a designated boundary that prohibits entry into the pond area, aiming to prevent disturbances such as waste disposal and the presence of animals in the vicinity. The other ponds are not subject to such restrictions. Local inhabitants report that Ba Loat Nyunt has long been experiencing persistent water-related issues, including flooding, inadequate sanitation, and chronic water shortages over an extended period of time. In the ward, there are a number of dense and poor-quality houses with improper maintenance, leading to being vulnerable to immediate floods, natural disasters, and so forth.

3. Justification

Location Selection (Kyimyindine-West)

The study area of the project is located inside Kyimyindine township of the western district of Yangon region. The township is part of Yangon City with a distinct geographical divide by Hlaing River into 2 territorial expansions (i.e., east and west).

With Kyimyindine (East) being part of the urban fraction and in close proximity to the central business district of Yangon City on the same continent, the area benefits from uniform distribution of urbanization and economic development under the administration and management of Yangon City Development Committee.

However, Kyimyindine (West) remains neglected and largely unattended neither by municipal nor economic development by private investors because of topographical and geographical barriers that make transportation and communication difficult. Modified artisanal boat is only an option available for direct access to the city or otherwise detour the whole western and northern district of Yangon region by land transportation. This territory has several natural and environmental disadvantages of being subjected to frequent inundation throughout the year resulting in constant

alluvial formation on topsoil by strong tidal pattern and seawater intrusion in subsurface layers of geological formations. Despite the water table is accessible in shallow depth up to tens meter below ground surface, the water quality of the aquifer is unsatisfactory neither for portable nor hygienical purposes. Nevertheless, those residents of the area use it barely for home domestic related cleansing. Since there are no functional township level administration offices nor accessibility to municipal services, this area emerges as a slum or sprawl socioeconomically disadvantaged for equitable access of urban functionality and services.

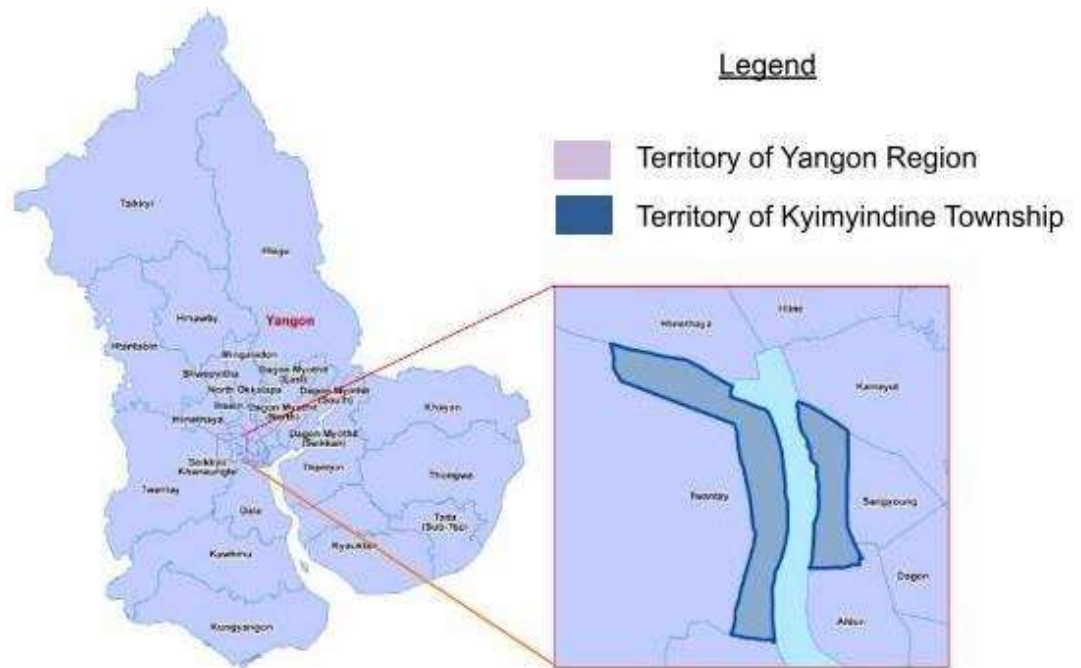


Figure 2: Location and Area Expanse of Kyimyindine Township of Yangon City
(Source: MIU)

The living conditions and social class of the communities of Kyimyindine (west) is observed under extreme poverty. The majority of the people work as peasants and laborers in those marketplaces of Yangon City and labor-intensive fishery produces trades and wholesales. These conditions justify the communities of Kyimyindine (west) suffer shortfalls in several ways to thrive as livable communities and thrive for growth. Thus, the location is considered most disadvantaged inside urban Yangon to conduct the study of program themes.

4. Rationale

4.1 Sites Selection

In this study, sites are selected on the following criteria to reflect aims and objectives for Flood Risk Assessment goal on the basis of exposure and vulnerability.

Exposure: Two reference Sites are selected based on the quantitative factor of location and elevation which have direct correlation to exposure of the receptors.

1. Location – the distance between the benchmark (river-bank top) where flooding initiate and alley intersection, and
2. Elevation – the altitude between benchmark (river-bank top) and peak elevation of the area. The elevation and distance profile are presented below.

Vulnerability: Two reference Sites are selected based on the socioeconomic and demographic factors of those settlements established under project sites which have direct correlation to vulnerability of the receptors are shown in the aerial photo below.

1. Socioeconomic Profile – This includes livelihoods, property, land use, utilities, social and cultural infrastructures, etc.
2. Demographic Profile – This includes population, occupation, disability, sex, age, well-being, etc.

The full socioeconomic and demographic profile is accessible to The 2014 Myanmar Population and Housing Census – [Kyimyindine Township Report on the MIMU](#).

These underlying reasons for site selection from study areas are validated through literature reviews, site visits and field trips. The project implantation is reported in the next section.



Figure 3 :Aerial Maps of Project Sites inside Study Area

5.DECAF Aims and Objectives

This project has three practical objectives. It aims

- To strengthen students' knowledge and skills in flood risk management and help local communities address flood risks
- To support learners in completing scientific tasks, assessing vulnerability, and developing a community-based risk reduction plan, such as co-designing and conducting field-based assessments under guidance
- To improve learners' technical capacity and create digitally reusable resources for future capacity development initiatives

Project participants' expectation

The participants' learning goals include

- Exploring water-related issues in local communities through field surveys and online research,
- Networking with experts, increasing familiarity with water issue research, and supporting academic studies.
- Collaborating, exchanging experiences, addressing neglected areas, expanding water-related studies,
- Working alongside professionals, expanding interests in climate change and water management, acquiring practical skills, and learning about climate-related research projects.

They also aim to gain insights into future flood risks and impacts by becoming more acquainted with water-related research and learning new perspectives from fellow members.

Learning Outcomes

Participants have identified water-related environmental issues and learned how to develop sustainable solutions for the case study communities. DECAF project fosters collaboration and networking among participants, allowing them to exchange knowledge and experiences. Key outcomes include

- Extending knowledge on water issues, enables exploration of a broader scope of water resource management in Myanmar,
- Capacity development for effective water resource management, and climate change adaptation.
- Building connections with fellow water professionals is emphasised, with the goal of collaborating on future water projects.
- Future Networking opportunities with VUW professors and others partners University and research institutions to enhances academic research in water-related and climate change issues, and encourages active participation in future projects.

5. Project Framework

There are 5 separate modules involved in the study; They are;

Module 0: Codesign and Planning

Module 1: Water Quality

Assessment Module 2: Flood

Exposure Assessment

Module 3: Community Participatory Vulnerability

Assessment Module 4: Community Based Risk Reduction

Planning Module 0: Codesign and Planning

The table summarizes tasks and activities undertaken in Module 0 – Codesign and Planning for successfully implementing module 1 – 4 of the project and program’s goals.

Table 1: Codesign and Planning for successfully implementing module 1 – 4 of the project and program’s goals.

Description	Individual	Group Work (online or F2F Meeting)	Field Trips
Module 1: Water Quality Assessment	- Literature reviews	- Developing Work Plans and schedule	- Preliminary Site Visits
Module 2: Flood Exposure Assessment	- Tools and Application Acquisition	- Field trips	- Site Surveys
Module 3: Community Participatory Vulnerability Assessment	- Translation and transcript	- Evaluation & Review	- Household Interviews
	- Data processing and Mapping	- Safety and Awareness	- Water Sample Collection
Module 4: Community Based Risk Reduction Planning	- Data Analysis	- Assessments Workshop	
	- Reporting & Feedback		

6. Project Timeline and Schedule

Activities	July			August				
	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4	Week 5
Participants Recruitment process and Pre-Orientation	July 6 - 11							
Module 0 Codesign and Planning Desktop studies Summary lecture from Part 1	July 12- 20							
Site Observation Talking with local authorities and village administrator		July 21						
Module 1 Water Sampling and Collection Surface water and ground water for water quality assessment			July 24					
Module 2 Flood Exposure Assessment			July 25					
Module 3 Participatory Vulnerability Assessment			July 27, 28					
Module 4 Community Based Risk Reduction Plan			July 29					
Data Processing and Analysis Module 1, 2 and 3				Aug 1 - 13				
All Modules Assessment and Evaluation					Aug 14- 19			
Report Writing						Aug 17-21		
Report Draft and Finalization							Aug 21-23	
Preparation for DECAF Virtual Learning Conference								Aug 24- 31

Table 2: Project Timeline and Schedule

Color Code Representation

Blue	Stage 1
Pink	Stage 2
Green	Stage 3
Deep Purple	Stage 4
Yellow	Stage 5

7. Module 1 : Water Quality Assessment

8.1 Material and Methodology

Sample collection and Analytical Sampling

Laboratory analytical sampling involves sources from 2 groundwater from Shallow tube-wells and 2 surface waters from ponds located at the proximity of project sites of study area. Water samples were collected applying good guiding principles and instructions provided by the laboratory. 24 water parameters linked to physicochemical characteristics were tested for water quality in their different presence of the environment. The analytical sampling results of both water sources in their respective sites is attached in the appendix.

8.2 Finding and Discussion

Finding Module 1: Water Quality Assessment

Laboratory analysis reveals that no formidable pollution is found in physical and chemical properties of both ponds' water. The concentration of those alkalinity and hardness indicators are presumed those of the surface runoff from ground surface into ponds. Before portable drinking water or bottled water was marketed in the area, the pond water was being major source for drinking and personal hygiene purposes. The respondents of households that are in extreme poverty acknowledged that pond water is their major water source for both drinking and family domestics since they can't afford to have access to electricity. Despite the fact that the ponds are fenced in iron wired mesh to avoid herds of domestic and farm animals' entry, the overland flow into the pond could not be properly secured. This catalyzes the exponential growth of bacteria and pathogens transforming the pond as a reservoir for waterborne disease. The local are not aware the droppings of domestics and farm animals strewn all on land could lead to water pollution and see the issue as a nuisance. The majority of the respondents answered that waterborne disease and bacterial infections are habitual for most of the locals of the community. Apparent eutrophication is noticed in all ponds which could be linked to those practices of clothing washing, cleaning utensils nearby and feeding fish as part of the religious practice. In times of climate emergency

and disaster, these ponds could be highly likely to be exposed to flooding and inundation leading to water and sanitation crisis of the community.

Ground Water Quality

With the area is well-known that groundwater of area is objectionable for drinking and consumption, few households applied groundwater as a major source for drinking purpose. Laboratory sampling results revealed the concentration of hardness, salt in chloride and sulfate is significantly higher even than water quality for general water (raw water). The higher concentration of different salt radicals and carbonate are linked to the sorption process of those soil minerals and water particles in the aquifers of recent formation of alluvial plain that has greater clay and silt composition in the soil. In addition, salinity concentration is detected at apparent level. It is good evidence and proved that salt water intrusion reaches a considerable distance into the freshwater zone of the aquifer. The salinity of the groundwater of the community tends to be increasing during dry weather and rising sea-level. Since the locals are habitual to abnormal tide actions and frequency that is under the influence of the attraction among lunar pull and gravity forces. However, they have very limited or no knowledge of sea level rise that the magnitude and severity of salt water intrusion and flood risk could increase steadily.



Figure 4 : Collecting water samples

8. Module 2: Flood Exposure Assessment

9.1 Material and Methodology

Ba Lote Nyunt Ward is almost under threat of flooding each year. In this region, the main reason for the devastating flood is the influence of the Yangon River especially during Warso and Warkaung (the months of Myanmar Lunar Calendar), and due to seasonal rainfall which eventually makes the district vulnerable to flooding.

For the flood exposure assessment, the team developed 40 questions to ask the community about flooding in the village. After several meetings, 16 questions were finalized. Using satellite images, the team selected locations near the river confluence and households close to the riverbank, as these areas are most affected by tidal floods annually. Measurements of household floor heights and water levels during flooding were taken, and data were recorded and mapped using QGIS platform.

Those occupants reside along Ingyin Street, and Shwe Nyaung Pin Street of Kyimyindine (west) were selected for transect study for examining their exposure and vulnerability risks as the geographic, environmental, and socioeconomic conditions were observed the worst ten of the community that is in extreme poverty. As part of the flood assessment, extreme flood events in their history were collected through questionnaires and interviews to communicate the recent and previous floods experiences. Then, the height between the road's level and the plinth level was measured, the ground level of the front door in relation to the level of the street, and the flood level in relation to the building's ground floor were all measured using a measuring tape. The buildings' locations were then marked on Google Earth. The height of the brick fence and plinth levels at their front doorways were recorded if they are exposed to flood or contain flood vulnerability.

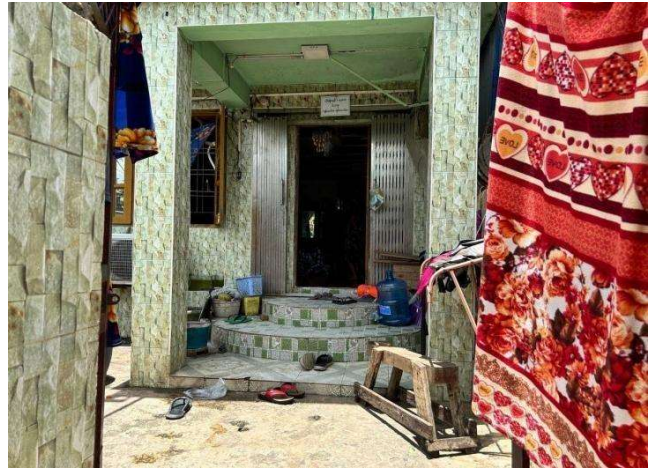


Figure 5 :Buildings with flood-proof measures

Different flood levels were classified into standard ranges based on obtained field data. Then, Colour variants were also defined and mapped on Google Earth based on these ranges.





Figure 6: Flood Exposure map of In Gyin street and Shwe Nyaung Pin Street in Kyimyindine (West)

9.2 Finding and Discussion

That information obtained from the household interviews revealed the monsoon flood event that happened in August 2022 (the Warso and War Khaung months in the Myanmar Lunar calendar) was considered the extreme flood period. The main causes of the abnormality being the combination of strong tidal waves and torrential rains of wet season. The majority of the respondents agreed their buildings and they encountered flooding at some point that hinder their welfare and socioeconomic wellbeing. It was also discovered that only 20 % of the sampled buildings located on each transect face temporary flood in their yard on a seasonal basis while the rest of the buildings of the transects study reported flooding reach into their building ground floor.

Table 3: In Gyin Street, Kyimyindine (West) Township, Yangon

House No.	A. Distance From the River (meters)	B. Environmental Observations		C. Face to Face Interview	
		Ground Floor Conditions of Buildings in the transect	Estimation of the level of the front door relative to the street (centimeters)	Flooding Occurrence:	The flood level relative to the ground floor of the building (centimeters)
H_1.1	2.5	Higher than street level	<10	inside the building	30 - 39

H_1.2	17	Higher than street level	20 - 29	outside the building	<10
H_1.3	23	Higher than street level	30 - 39	inside the building	10 - 19
H_1.4	36	Higher than street level	>50	outside the building	<10
H_1.5	55	Higher than street level	30 - 39	inside the building	40 - 49
H_1.6	59	Higher than street level	30 - 39	inside the building	20 - 29
H_1.7	64	Higher than street level	30 - 39	inside the building	30 - 39
H_1.8	81	Higher than street level	40 - 49	inside the building	<10
H_1.9	83	Higher than street level	>50	inside the building	10 - 19
H_1.10	90.7	Higher than street level	30 - 39	inside the building	40 - 49

Table 4 : Shwe Nyaung Pin Street, Kyimyindine (West) Township, Yangon

House No.	A. Distance From the River (Meters)	B. Environmental Observations		C. Face to Face Interview	
		Ground Floor Conditions of Buldings in the transact	Estimation of the level of the front door relative to the street (centimeters)	Flooding Occurrence:	The flood level relative to the ground floor of the building (centimeters)
H_2.1	8	Higher than street level	>50	inside the building	10 - 19
H_2.2	10	Higher than street level	>50	inside the building	>50
H_2.3	17	Higher than street level	40 - 49	inside the building	<10
H_2.4	23	Higher than street level	>50	outside the building	<10
H_2.5	31	Higher than street level	>50	inside the building	20 - 29
H_2.6	38	Higher than street level	>50	outside the building	30 - 39
H_2.7	45	Higher than street level	>50	inside the building	20 - 29

H_2.8	47	Higher than street level	30 - 39	inside the building	10 - 19
H_2.9	49	Higher than street level	40 - 49	inside the building	10 - 19
H_2.10	54	Higher than street level	40 - 49	inside the building	20 - 29

While the first building located is located about 2.5 m away from the river-bank, had a flood level of up to 45 cm according to observed field data that is on Ingyin Street, the last building's highest point is found at 90.7 m from the river-bank that has 76 cm of flood high. The maximum flood level among the 10 houses in this street was 79 cm, while the minimum was 39 cm. The first building on Shwe Nyaung Pin Street, which is around 8 m from the river bank, showed up to 68 cm of flood level. The last one's peak flood level, which was roughly 54 m from the river bank, was about 70 cm. In this corridor, the maximum flood level was 102 cm, while the minimum was almost 48 cm. All of the survey's findings indicated that the front door's ground level is up to 50 cm higher than the street level. But most of the flood points were always higher than the streets' levels. Therefore, it is impossible to suppose that the buildings, which have higher levels of front doors than the streets' level, provide more opportunities to access higher ground than those at other lower levels.



Figure 7: Measuring Flood Exposure

9.3 Module 2: Qualitative Response Summary

According to the interview data, their traditional beliefs indicate that extreme floods mainly occur in leap years of the Burmese calendar (the addition of an intercalary month to the Burmese lunar calendar). Although the August 2022 flood was quite severe for them, flood levels have decreased slightly over the past three years. Living near riverbanks has made flooding events seem normal for some residents. Surprisingly, one of the interviewees (Interview No. 2.4) said he felt happy when he saw floods because he genuinely enjoys being around water. From site observations, it

was also found that the amount of sediment transport at this riverbank was significantly higher than at another site, Kyimyindine (East). Due to the impact of sediment transport, their floating columns were covered with silt up to 2 meters high.

In terms of physical and mental damages from floods, most didn't suffer harm or loss of life. However, one interviewee sadly mentioned calling local rescue for her mother during the flood, and another cited the death of an older relative due to extreme nervousness.

The community's most severe natural disaster throughout its 20 years was Cyclone Nargis, which brought high winds and torrential rains, causing extreme flooding and building damage. When the interviewer asked about the community's experience during this worst and most destructive natural disaster tragedy, some said they felt fear, anxiety, nervousness, tariffication, and a sense of helplessness, as the majority of them had no idea how to keep their families secure. Only the old, children, and those who can't swim were put forward as needing to be saved. Only the elderly, children, and non-swimmers were identified as needing rescue. Cyclone shelters were scarce, with the monastery being the only option despite its capacity limitations.

During emergencies, the top priorities for the community are drinking water, rice, oil, salt, clothing, communication tools, and shelter. Water was crucial as high tidal floods introduced saltwater intrusion to their groundwater. In addition, sanitation, food preparation (without a stove), food shortages, drinking water, damp clothes, wet pillows, and beds, health issues (physical discomfort), rare pharmaceuticals, a place to live and sleep (shelters), and the danger of snakes and scorpions are all issues that people face. Importantly, most respondents were unaware of their rights to request essentials during emergencies. Some want to claim their rights but do not know how to proceed. Therefore, sharing basic human rights knowledge was deemed essential. Based on Cyclone Nargis' experience, Nargis priority emergency needs, and their recommendations for flood relief, the need for cyclone shelter was also critical to the Kyimyindine (West) case study communities.



Figure 8: Qualitative Interview

9. Module 3 Participatory Vulnerability Assessment

10.1 Material and Methodology

The participatory vulnerability assessment was conducted through an 83-questioned survey in the Ba Loat Nyunt ward. The survey questionnaire regarding flood risk aims to engage local community in assessing their vulnerability and preparedness in the face of potential flooding events. The questionnaire also aims to collect valuable insights into the community's understanding of flooding (tidal or seasonal), past and current existing coping strategies. The questionnaire involves key aspects such as flood awareness, evacuation and safety plans, infrastructure concerns, and community-based adaptation measures.

The eight participants spread across the village in order to interview the respondents. For each interview, it takes about 45 mins to one hour to finish it. Just within two days, the team was able to accomplish all 100 surveys. A total of 100 respondents, who were interviewed in the Ba Loat Nyunt village which is illustrated in the below map.

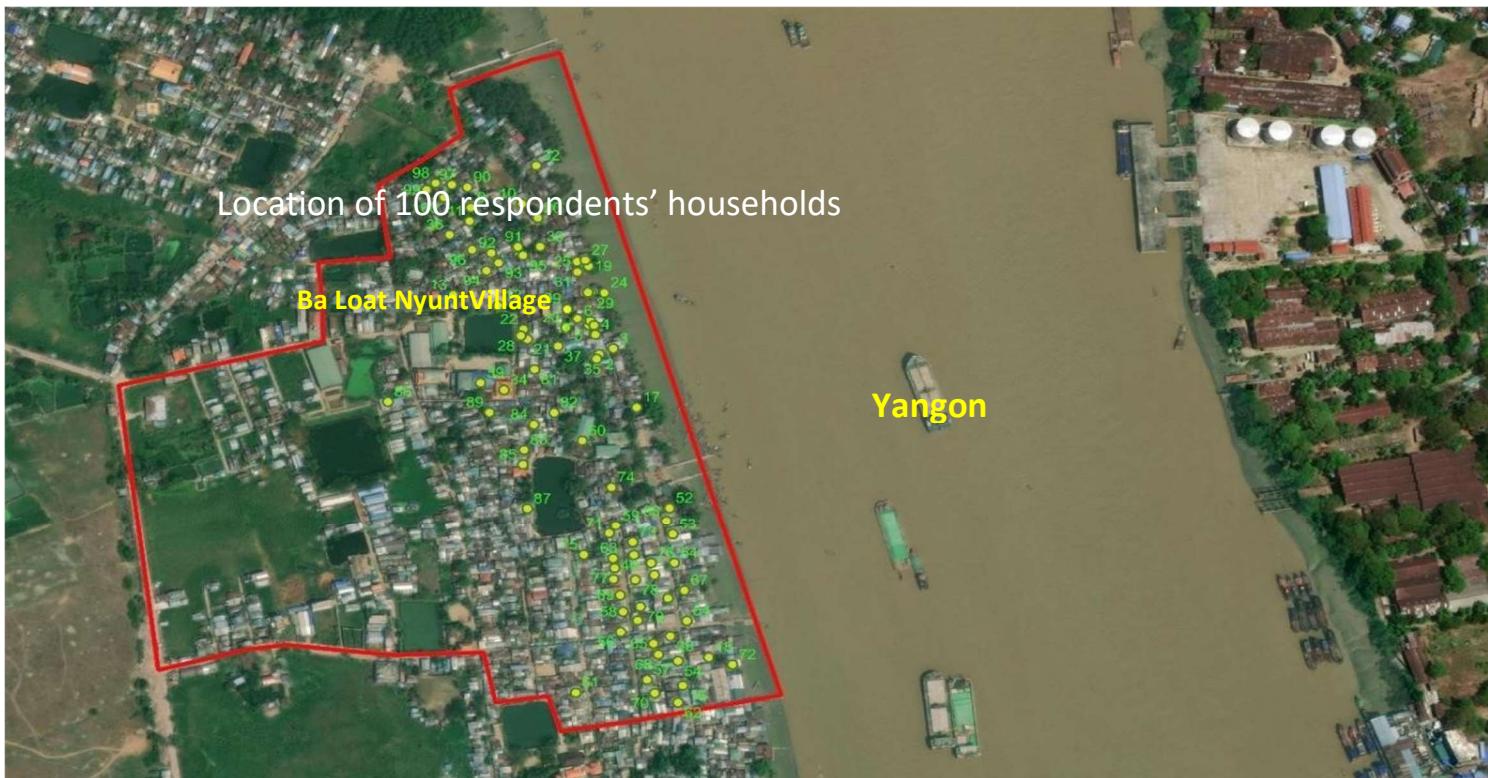
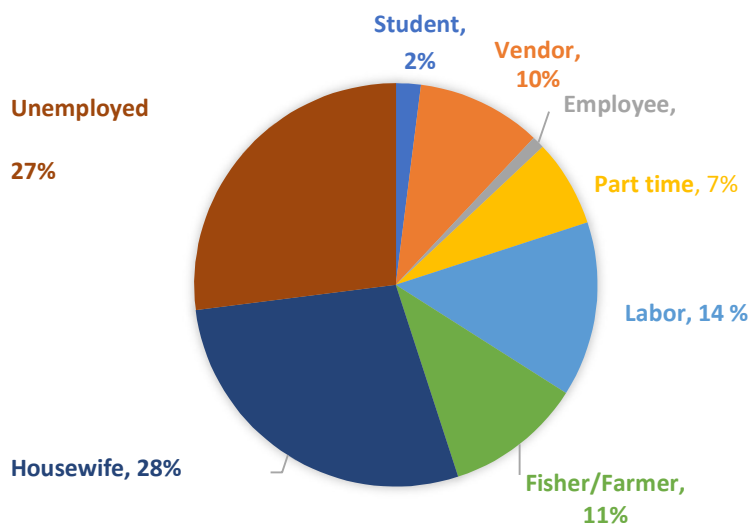


Figure 9: Location of 100 respondents' households

Table 5: Information of Age and Sex of the respondents

Information of Age and sex of the respondents						
Age group	<18	19-30	31-50	51-70	>70	
Male	2	9	14	13	2	40
Female	2	12	20	19	7	60
	4	21	34	32	9	100

PROFESSION OF 100 RESPONDENTS



LEVEL OF EDUCATION

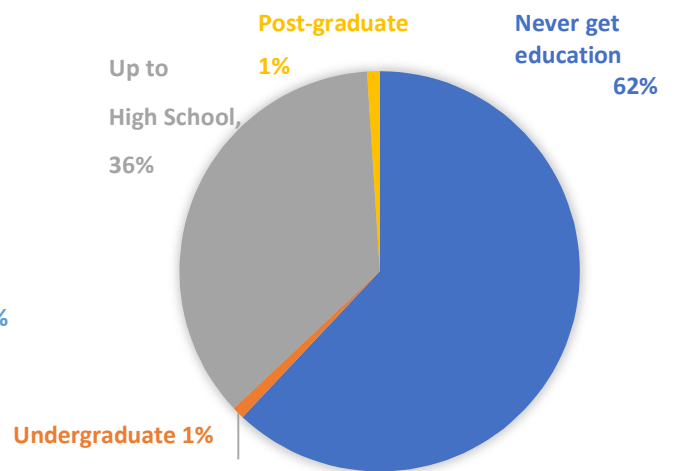


Figure 11 :Profession of 100 respondents

Figure 10 : level of education

10.2 Finding and Discussion

10.2.1 Capabilities

Table 6 :Capabilities

SE : Sensitivity *AC : Adaptive Capacity*

Yes=1, No=0 Strongly disagree=1, Disagree=2, Neither=3, Agree=4, Strongly Agree=5

	Yes/No (except agency)		Five-point scale	
SE	Does your household have a private car or vehicle?	0.2	It is too difficult for us to learn new skills to cope with flooding	3.2
SE	Do you know how to repair your home	0.5	We do not have an adequate stock of tools to cope with flooding	4
SE	Has anyone in your household completed/is completing a tertiary qualification?	0.2	Public information about flooding is too difficult to understand	2.8
AC	Did anyone in your household receive training to cope with flooding	0.0	We have started planning for tidal flooding getting worse	2.8
AC	Can all of your adult household members access the internet any time they want?	0.6	My household members know quite well how to cope with flooding	2.8
AC	Are you or your household head physically fit for coping with flooding?	0.7	We know how global climate change is impacting us	3.2

10.2.1.1 Discussions on Capabilities

In vulnerability assessment, capabilities refer to the range of skills, resources, knowledge, and capacities that individuals, communities possess to effectively prepare for, respond to, and recover from flood events. Recognizing capabilities within the community is essential for building resilience and ensuring the well-being of communities in the face of natural hazards. From the values above, the community is not sensitive to flood and the community holds adaptive capacity in the face of flood since they are very used to living with tidal or seasonal flood. The response can be generally considered to be neutral on learning new skills,

preparing for worsening tidal floods, having adequate skills in household members to cope with tidal floods.

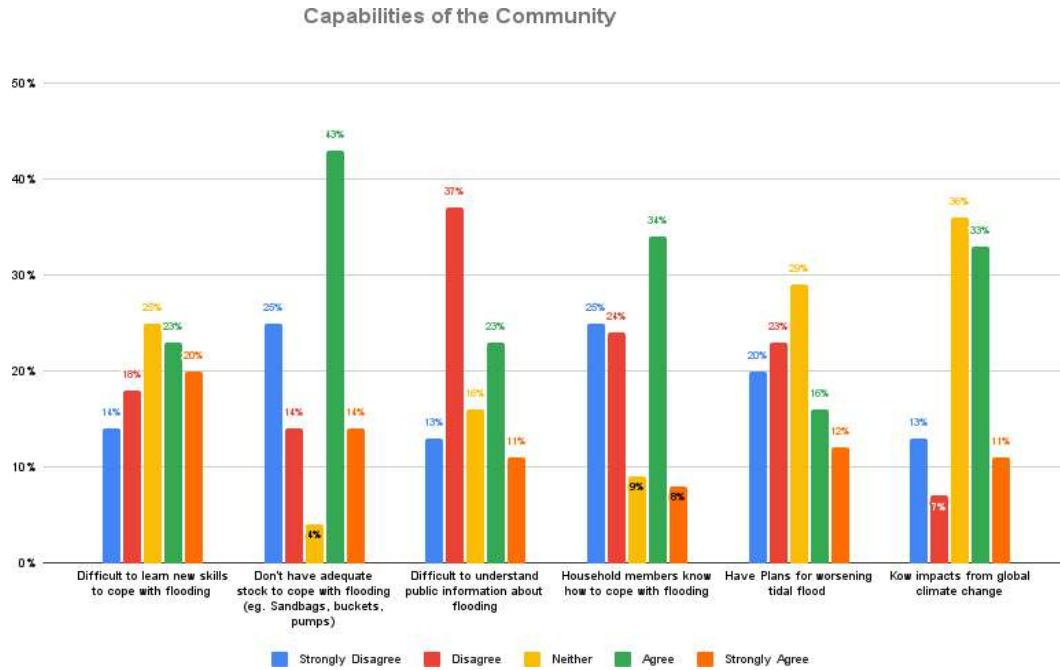


Figure12: Capabilities of the Community

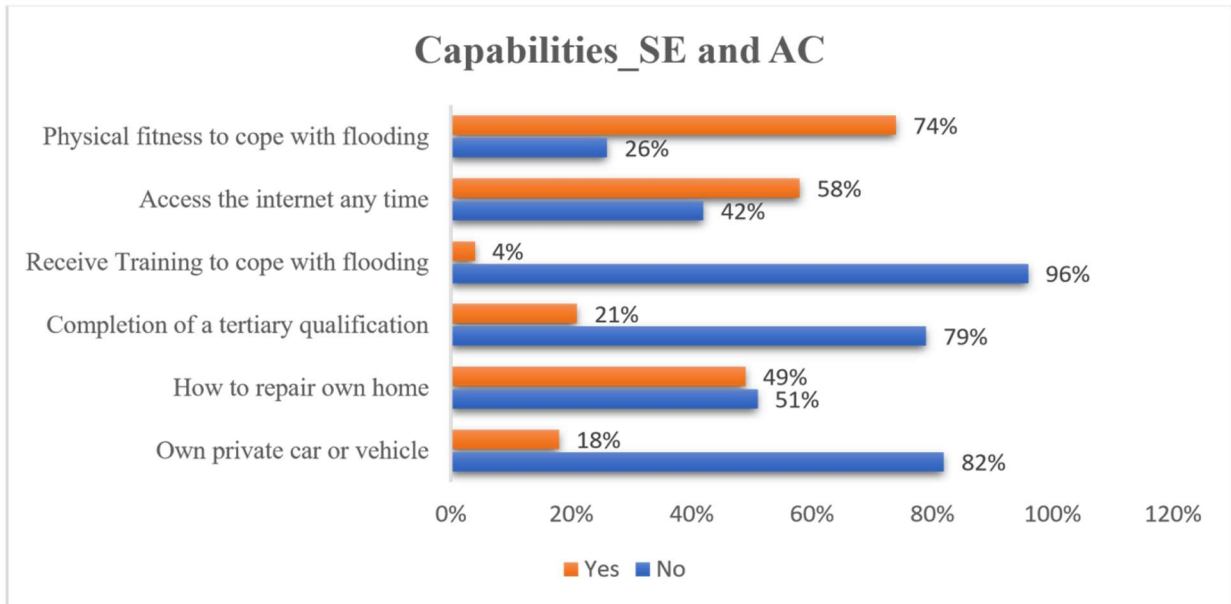


Figure 13: Capabilities_SE and AC

10.2.2 Agency

Table 7: Agency

SE : Sensitivity *AC : Adaptive Capacity*

	Yes/No (except agency)		Five-point scale	
AC	We are confident that we can deal efficiently with unexpected events ^ 1	3.3	We don't mind changing job or school if this would help cope with flooding better 3	2.8
AC	We can remain calm during flooding because we can rely on our abilities ^ 2	3.5	We don't mind relocating to another place if this would help coping with flooding better 4	3.4
AC	We can find several options for coping with flooding^ 5	3.1	We want to do something to reduce flood risks 6	3.7
SE	In Ba Loat Nyunt, we cannot make decisions independently about how we manage our home 1	2.3	In Ba Loat Nyunt, it is hard for my household to start new activities on our own* 4	3.4
SE	In Ba Loat Nyunt, we cannot make decisions independently about how we make a living 2	2.3	My household would need a lot of time to get accustomed to a new environment* 5	4
SE	In Ba Loat Nyunt, we don't have much influence on how flood risk is managed 3	2.7	My household does not have a strong opinion on community issues* 6	3

SE : Sensitivity *AC : Adaptive Capacity*

10.2.2.1 Discussions on Agency

Agency in the context of vulnerability assessment refers to the capacity of individuals, communities, and institutions to take purpose and proactive actions to reduce vulnerability and enhance resilience in the face of flooding. Many of the respondents agreed that they would need a lot of time to get used to new adjustments with jobs, daily lives if they were to be relocated to a new place. Additionally, the local people can face the flooding situation calmly and trust in their abilities in unexpected floods and agreed to take part in flood reduction plans and activities in the community. Making decisions on how people manage their homes and how to make a living is not restricted by any governing body except from illegal activities. The community do not mind changing jobs and schools if they were

provided when relocated and most households do not have strong opinions on community issues.

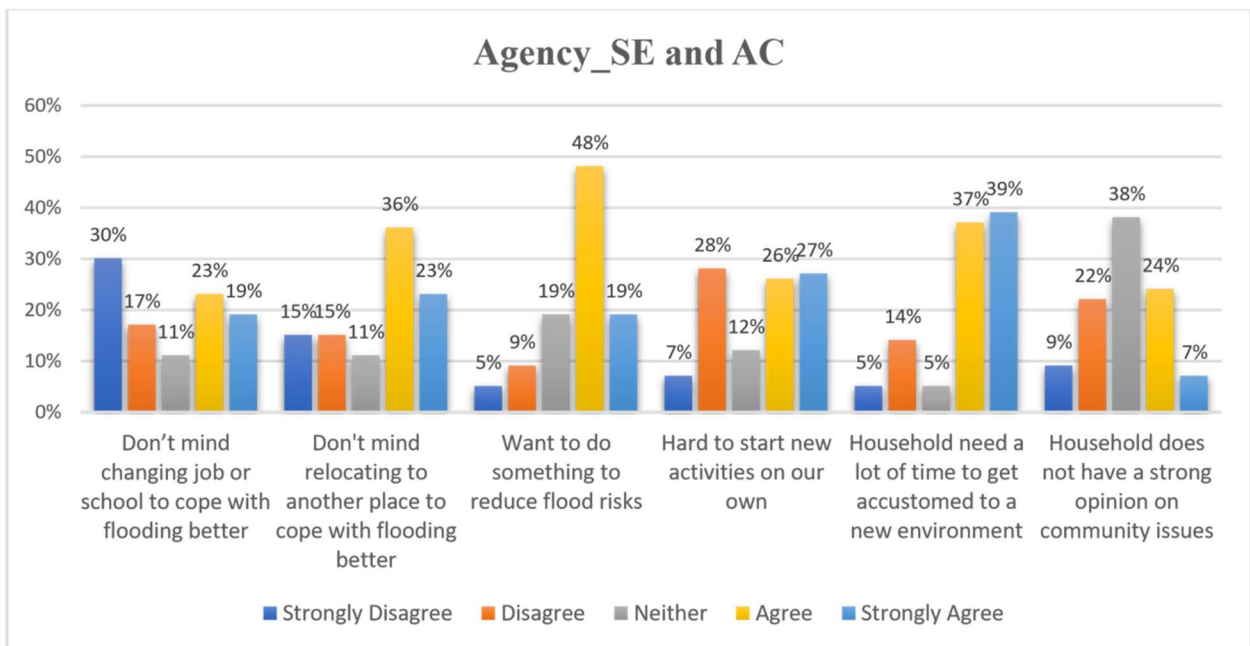
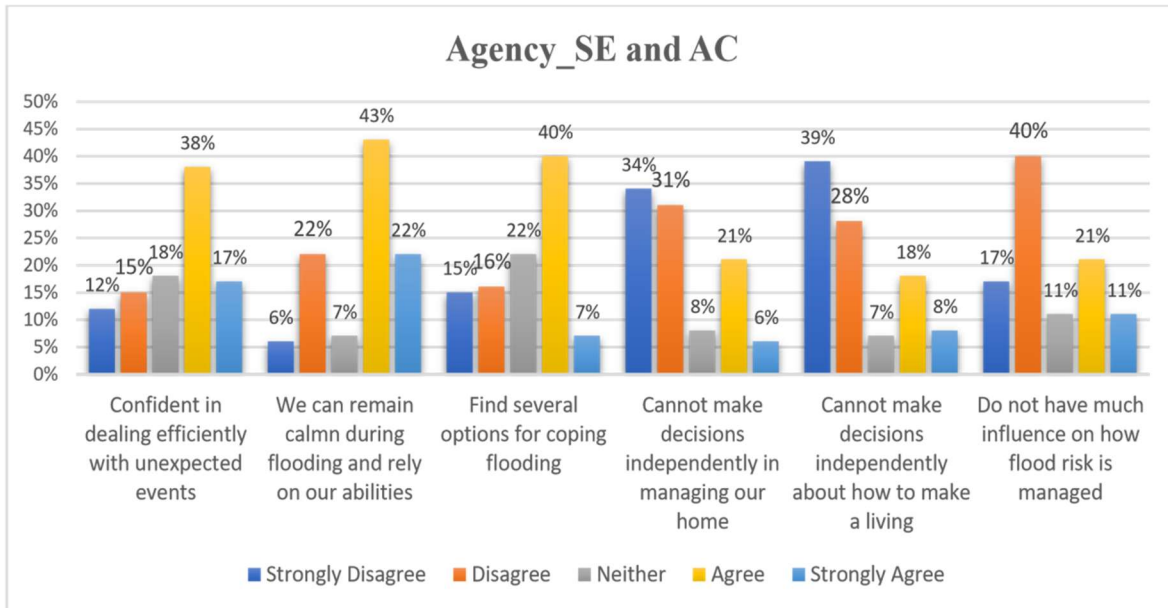


Figure 14: Agency_SE and AC

10.2.3 Embeddedness (Eb)

Table 8: Embeddedness

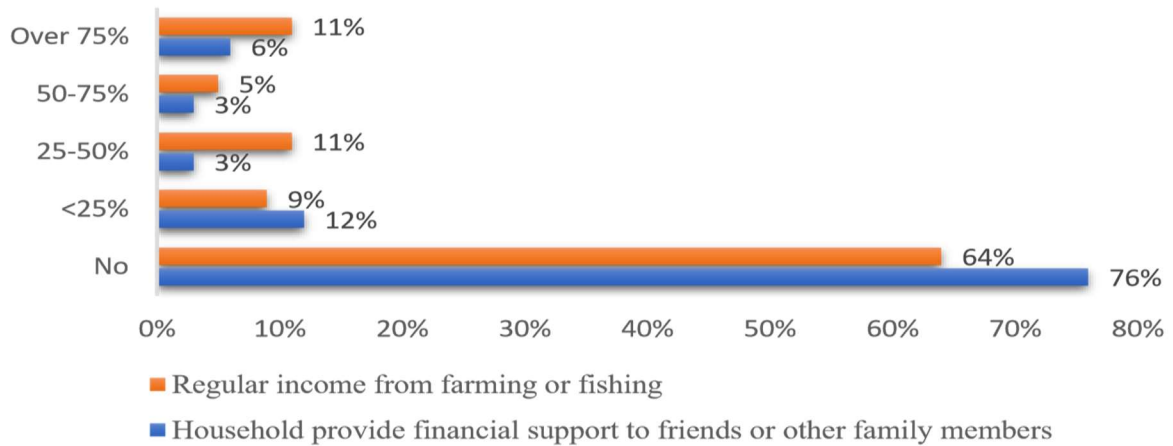
SE : Sensitivity *AC : Adaptive Capacity*

	Yes/No (except agency)		Five-point scale	
SE	Does anyone of your household members work in a location that was severely flooded before? 4	1.5	If we relocate to another place, we may lose our job and cannot find a new one 2	3.6
SE	Does anyone of your household have to commute for one hour or longer every day in order to make a living? 5	0.6	Flooding will make commuting to and from our area challenging 1	3.8
SE	Do you have regular incomes from farming or fishing? 3	2	What is the % of these incomes in your total household income? 3	25-50%
AC	Can anyone of your household work from home? 1	0.2	If we want to, we can do all of our paid work at home without commuting 1	2.5
SE	Does anyone of your household regularly visit an elderly, disabled, or chronically ill person/people who depend on you but are not living with you? 6	2	I think it is difficult to visit them in the event of flooding (4pt) 6	2
SE	Does anyone of your household regularly provide financial support to friends or family members who depend on you but are not living with you? 7	1.5	How large is (%) this financial commitment, as % of monthly household incomes? 7	<25%
AC	Do you read/watch news (printed media, TV, or online)? 2	3	How frequent do you read/watch news? (4pt) 2	everyday
SE	(Excluding the respondent) Do you have children under 5-year-old living with you? Are you living with any elderly over 70 years old? Are you living with any chronically ill, disabled, or mentally impaired people?	0.4 0.2 0.3	We look after our young/old/ill household members and this keeps us busy everyday	2.7

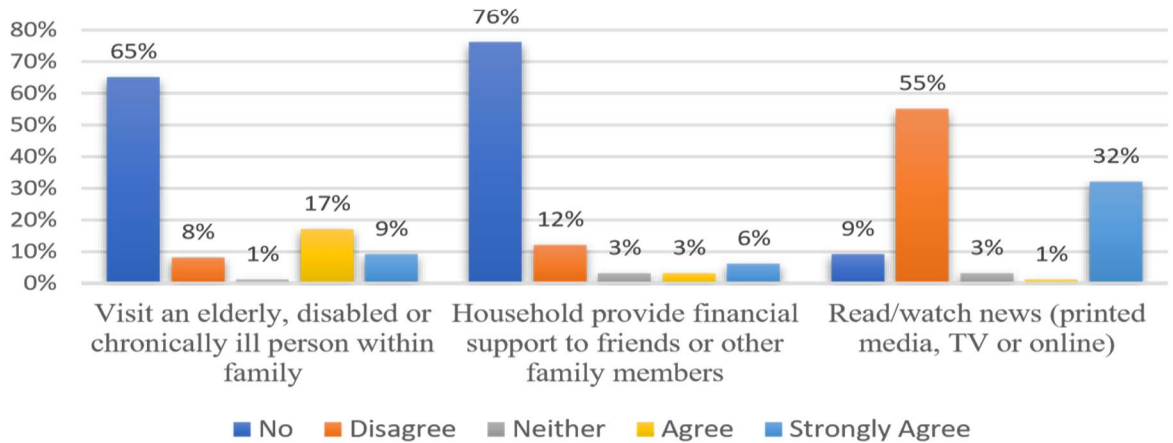
10.2.3.1 Discussions on Embeddedness

Embeddedness in flood risk assessment refers to the intricate interconnectedness of various factors that contribute to understanding and addressing flood vulnerabilities. The social, economic and environmental situation in the community is questioned to understand and address in flood vulnerabilities. There is very little opportunity to work at home in the community, that is also the reason many people are jobless and depend mainly on one income. Most household agree that relocation to another place may bring challenges in finding jobs and maintaining daily household expenses. From the findings, the community seems to have the resilience and rebuilding capacity in facing tidal and flash floods. However, the community still needs to develop more holistic and sustainable strategies to mitigate flood impacts.

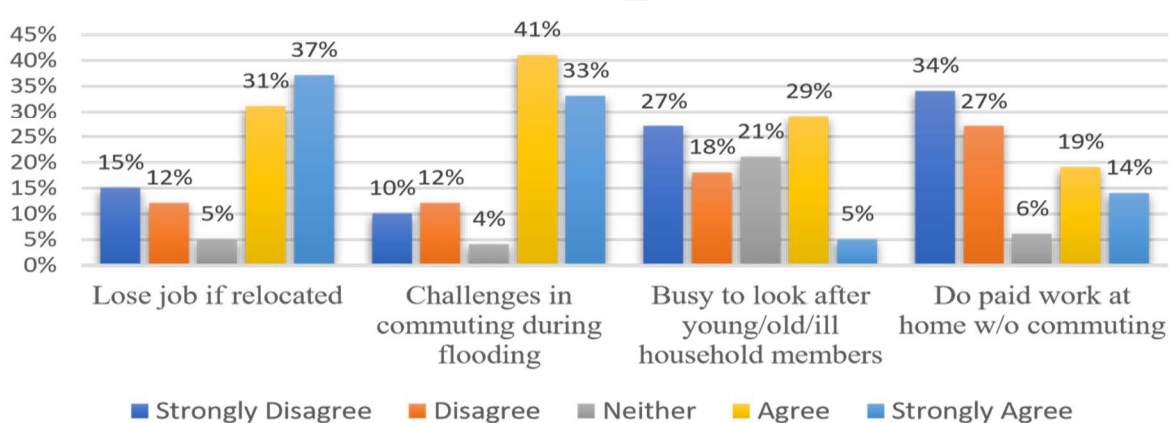
Embeddedness_SE and AC



Embeddedness_SE and AC



Embeddedness_SE and AC



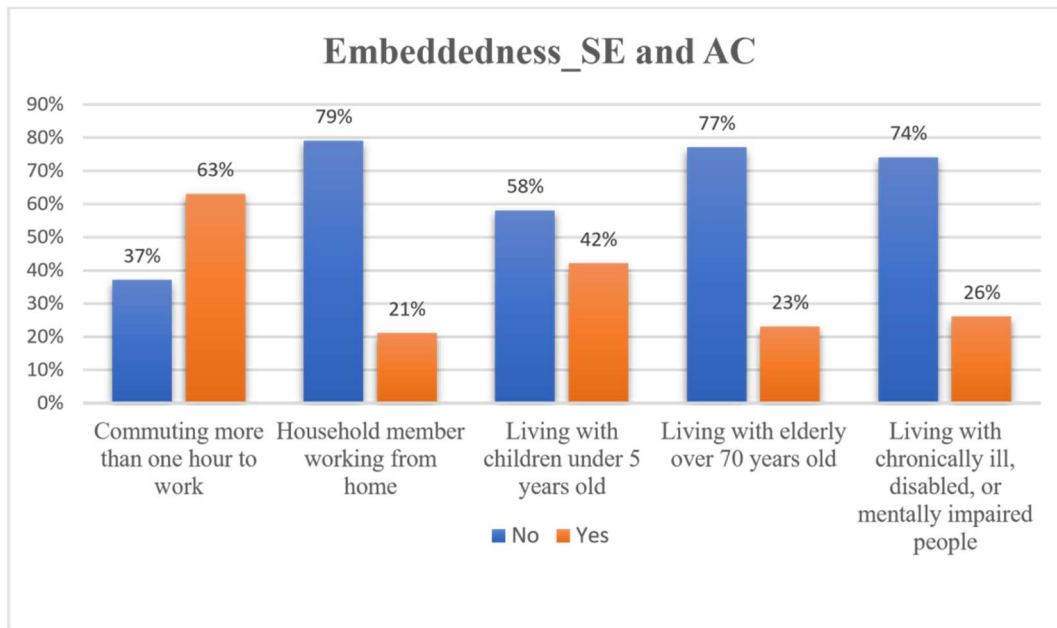


Figure 15: Embeddedness_SE and AC

10.2.4 Entitlements

Table 9 Entitlements

SE: Sensitivity AC: Adaptive Capacity

	Yes/No (except agency)		Five-point scale	
AC	Do you think you or other household members can get social security benefits if you need? 1	0.4	If we ask, our friends and family members would come to help us cope with flooding 2	3.7
AC	Do you think you can sell your assets (e.g., properties, land, vehicles, inventories, farm tools) for cash any time you want? 3	2	I believe we can sell them at reasonable market prices (4pt) 3	No
AC	Do you think you can use your assets in any way you want? 4	2.4	There are restrictions on the use of my assets 4	2
SE	Does anyone work for you or your household members? (e.g., through employment, apprenticeship, or contract work) 5	1.6	If we ask, these people (e.g., employees, apprentice or contract workers) would come to help us cope with flooding (4pt) 5	2
SE	Do you have the right to select your local representatives 7	0.7	Our community leaders do not listen to us 6	3

10.2.4.1 Discussions on Entitlements

As the community prepares to acquire certain protections and benefits, it is not privileged to request aids, claims, and benefits from the legal and governing authorities. The village community also has the right to select local representatives, therefore, they can express their opinions in shaping the distribution of resources and opportunities within societies to ensure fairness and equity.

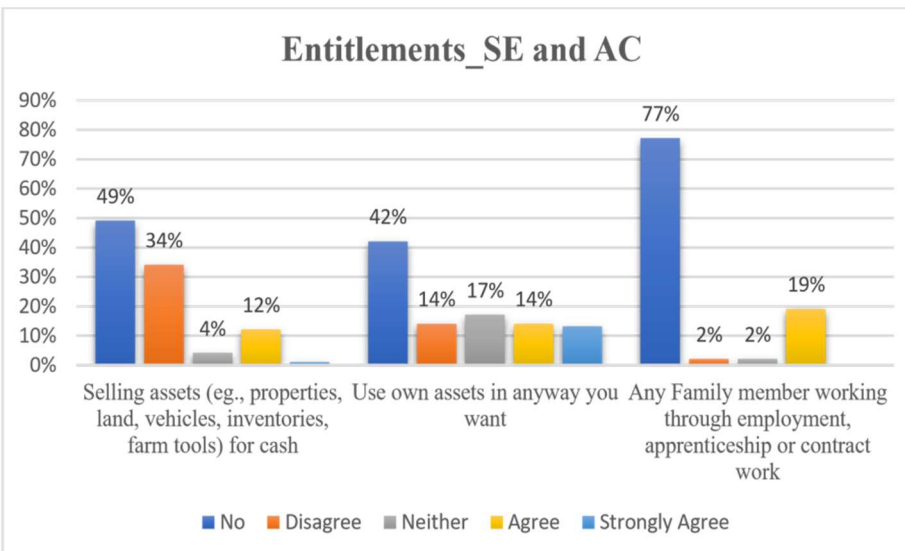
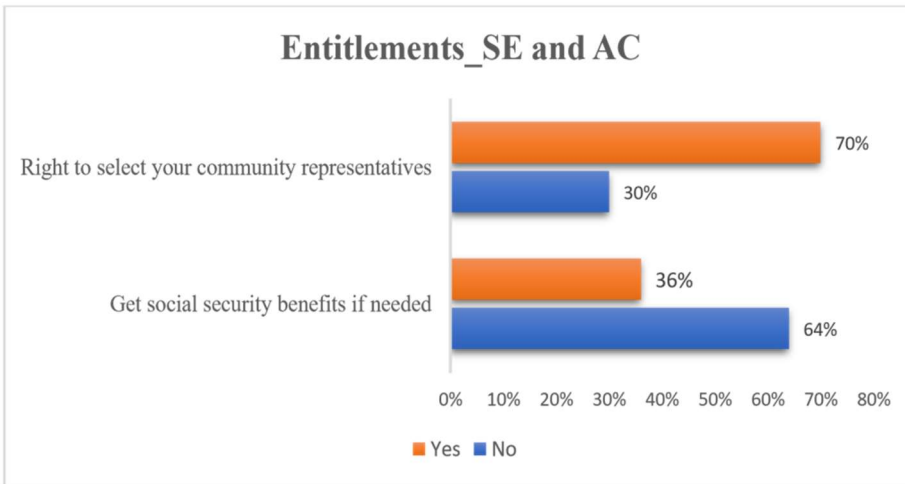
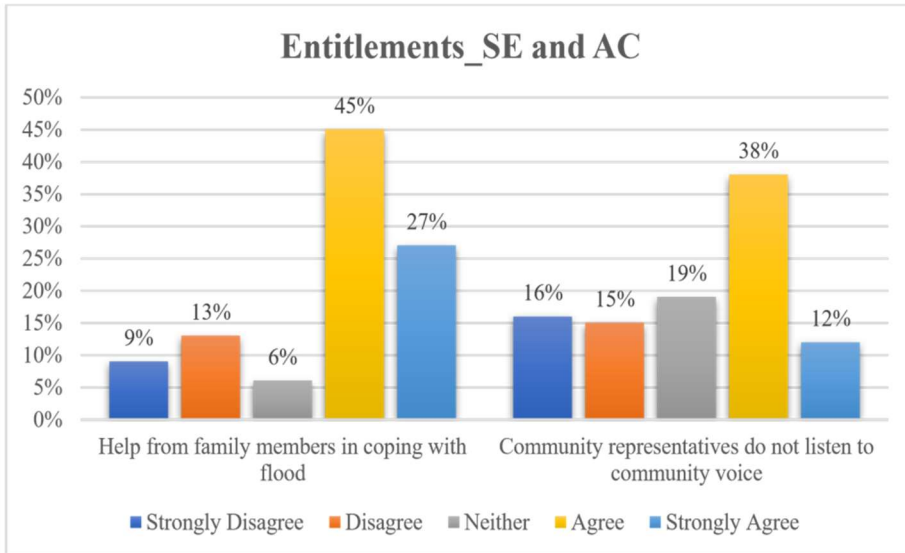


Figure 16: Entitlements_SE and AC

10.2.5 Assets (As)

Table 10 Assets (As)

SE: Sensitivity AC: Adaptive Capacity

	Yes/No (except agency)		Five-point scale	
SE	Does your household own any other property or land that you currently don't occupy? 1	0.2	We know many people in Ba Loat Nyunt 2	4.2
SE	Does your household own the property you currently live in? 3	0.7	Our property has a low market value 4	3.3
SE	Does your household have more savings than five years ago? 5	0.1	We can live on our household savings and maintain our current standards of living for six months, if my household members lose all income sources. 6	1.9
AC	Do you have any acquaintance working in government or village management? 3	0.5	I think we can borrow money from someone if we need money to repair our home 4	2.6
AC	Does anyone of your household visit other family members' home every week? 5	0.5	We have close relationships with other family members 6	4.4

10.2.5.1 Discussions on Assets

Assets in vulnerability assessment refer to the physical, economic social and environmental resources of the community that are susceptible to the impacts of flooding. Since the village is living with extreme poverty, most participants agreed not having much assets and most do not own their homes. However, the community seems to help each other a lot in difficult times and some charities offer frequent donations on the community.

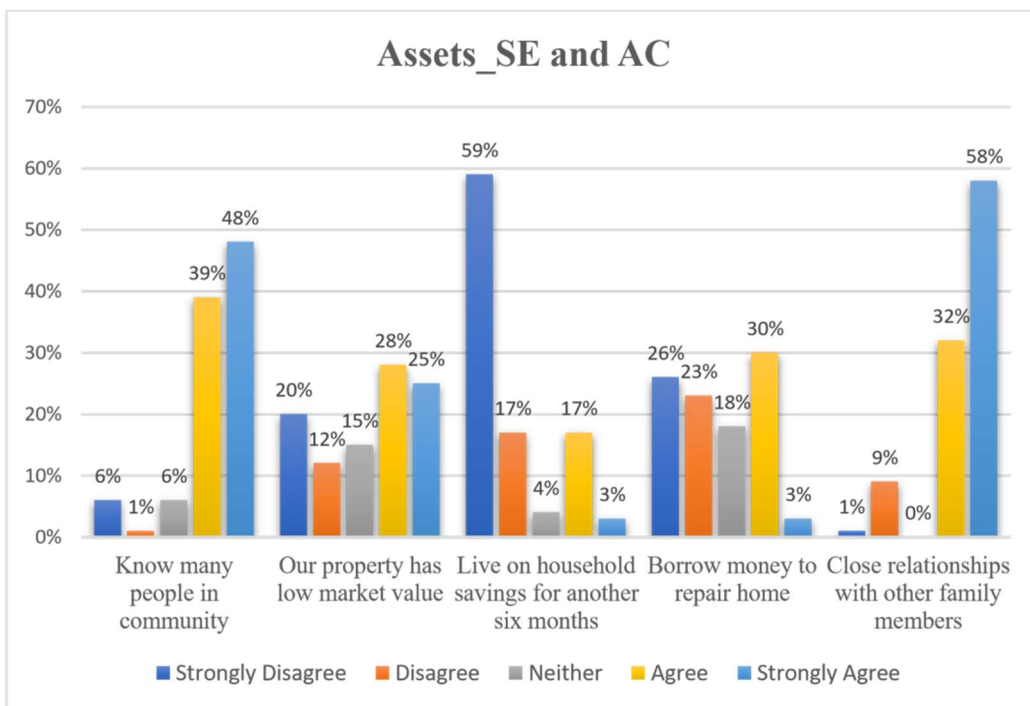
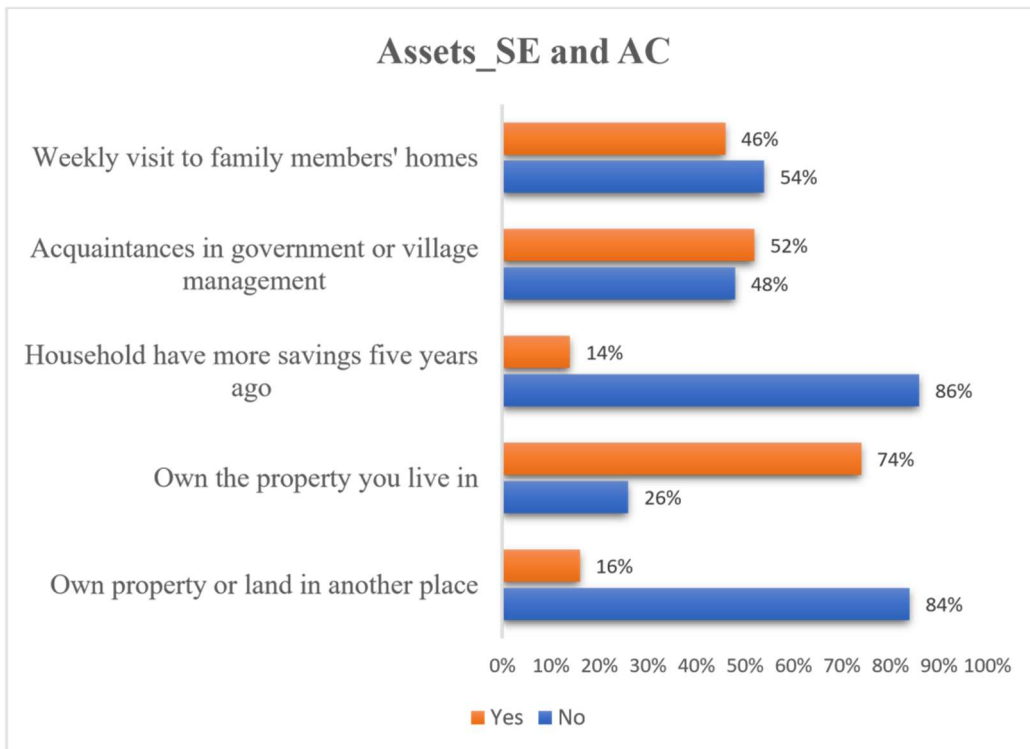


Figure 17: Assets_SE and AC



Figure18: Participatory Vulnerability Assessment

Most participants in the ward live in extreme poverty, with limited assets and property ownership. The community is characterized by mutual support, and some charities offer frequent donations. The community has the capacity to take proactive actions to reduce vulnerability. Many respondents agreed they would need time to adjust to new adjustments if relocated. The community is confident in dealing with unexpected floods and is willing to participate in flood reduction plans. The interconnectedness of social, economic, and environmental factors contributes to understanding flood vulnerabilities. Challenges include joblessness, dependence on one income, and potential challenges in finding jobs if relocated. The community is not highly sensitive to flood and holds adaptive capacity since they are accustomed to living with tidal or seasonal floods. Responses were generally neutral on learning new skills, preparing for worsening tidal floods, and having adequate skills to cope with floods. In a poverty-stricken community lacking infrastructure, establishing flood-resistant infrastructure, early warning systems and community training are the utmost priorities for flood preparedness. In order to achieve that, collaborative efforts involving local authorities, NGOs and community participation are crucial to effectively implement these entitlements and enhance the community's resilience and environmental well-being.

10. Module 4 Community-based Risk Reduction Planning

As part of Module 4 activities, the team undertook an examination of the coding and data cleaning procedures pertaining to the survey questionnaires featured in Module 3, while concurrently finalizing the overview of study and flood exposure assessment maps for Module 2. Subsequent endeavors encompass the visualization of data encapsulated within Module 3, and the formulation of preparations for the community risk reduction strategy. This strategic framework for Module 4 Community Based Risk Reduction Plan will be based on the results of the water quality test from

Module 1 and final evaluation and assessment from Module 2 and Module 3.

11.1 Module 4: Community Based Risk Reduction Plan

11.1.1 Problems of the Case Study community related to Flood and Disaster Risk

Although this case study area, Ba Loat Nyunt Ward, experiences frequent flooding during

Monsoon Season, Warso, and Warkaung (the months of the Myanmar Lunar Calendar), it appears that residents have become accustomed to this yearly flooding, which has seemingly become customary over time. In this context, flood mitigation protocols and related training must be carefully tailored to a specific target audience. In order to successfully implement flood-related training, it is important to consider stakeholders collaboration and participation in flood risk management, such as the Myanmar Red Cross or other organisation, non-profit government organisation, or institution that has been intensively working on these water and flood related issues, so that a specific plan must be implemented to reduce flood risk of this area.

11.1.1.1 Community's Challenges

As per the findings of the conducted surveys in Modules 2 and 3, it has been discerned that the community exhibits a willingness and enthusiasm towards acquiring capacity building and education training on the subject of flooding. However, they merely get a chance to obtain this proper hand-on practical training as most organisations did not reach out to those sub-urban areas due to transportation barriers. Given its geographical location, situated alongside the river bank, transportation is only possible by boat.

11.1.2 Risk Reduction Strategies and Plan Based on the Assessment and Findings from Module 1, 2, and 3

The finding and results from training modules highlight the difficulties faced by the local community in obtaining clean water during and after flooding, which is linked to health and environmental issues. According to result data from Module 1, inadequate waste management practices are the main cause of water pollution, which can also lead to the spread of waterborne diseases when the community faced with severe flooding. A comprehensive action plan is needed to procure uncontaminated water sources in flood-prone areas. The establishment of a **Flood Community Awareness Network (Flood-CAN)** as well as pre-flood preparations, flood safety measures, and other flood-related awareness-raising initiatives are essential. With a focus on including women, this network strives to spread flood-related information while assuring community members' attention and responsiveness. For disaster preparedness and management capacities, community-based **education and advocacy campaigns** are crucial. For flood-induced scenarios to be successful, tailored grassroots capacity development training is essential.



Figure19: Poor infrastructure makes people vulnerable to flooding and water pollution, and water-related public health issues can be urgent issues due to improper waste management systems and frequent flooding.

11.1.1.1 Immediate Action Plan Recommendation for Waste and Water Pollution Risk Reduction Strategy

<p>Problem</p>	<p>Risk</p>	<p>Present Situation</p>	<p>Barriers</p>
<ul style="list-style-type: none"> • Water Pollution, Water Quality issues after flooding 	<ul style="list-style-type: none"> • Eutrophication, groundwater contamination, it can also affect the public health as well. 	<ul style="list-style-type: none"> • Poor waste management system • Local does not have environmental awareness and knowledge on waste • Still throwing trash into the water 	<ul style="list-style-type: none"> • Lack of awareness and access to environmental education • Struggle for livelihood
<p>Needs</p>	<p>Strategy</p>	<p>Objectives</p>	<p>Expected Changes and Result in the implementation of Plan</p>
<ul style="list-style-type: none"> • Systematic Waste management System • Awareness Raising and Capacity Building Training 	<ul style="list-style-type: none"> • Community based Education and Advocacy • Implement grass-root level capacity building training about waste management 	<ul style="list-style-type: none"> • To inform water related diseases caused by improper management system and cause water pollution 	<ul style="list-style-type: none"> • Improve public health and water quality, water sanitation in this flood prone communities

11.1.1.2 Long-Term Actional Plan Recommendation for Flood Risk Reduction Strategy

<p>Problem</p> <ul style="list-style-type: none"> • Seasonal Flooding and no preparedness for this issue 	<p>Risk</p> <ul style="list-style-type: none"> • Construction of high plinth levels for houses located in flood-prone areas 	<p>Present Situation</p> <ul style="list-style-type: none"> • No early warning systems and adaptation measures • No emergency rescue squad for floods and disasters 	<p>Barriers</p> <ul style="list-style-type: none"> • Lack of training skills how to cope with Flood • Community Led-flood Rescue team had not organized yet
<p>Needs</p> <ul style="list-style-type: none"> • Early warning Campaign • Water related institutional support, provide information and involvement developing the campaigns • information and resources of flood related training and skills • building cyclone shelters 	<p>Strategy</p> <ul style="list-style-type: none"> • Meeting with local community to implement this proposed plan • establish Flood - CAN), or Flood rescue team • Community tree planting to boost nature-based solutions for the flood community 	<p>Objectives</p> <ul style="list-style-type: none"> • Strengthen early warning device • Activate Youth Organizations • Foster local awareness-raising • establish Flood-CAN or community flood action groups 	<p>Expected Changes and Result in the implementation of Plan</p> <ul style="list-style-type: none"> • Skill development of the community, family level awareness or preparedness increased • People would be able to explain about flood risks and early warning sign • Voluntary emergency team at community level

12. Conclusion and Recommendation

Ba Loat Nyunt ward is adjacent to the Mottama Gulf entrance, which similarly experiences the effects of high tidal floods during monsoon seasons, however the duration of an entire day of flooding was only about 2-3 hours. Annual monsoon flooding became their most frequent issue.

Relocating their residences to high ground should be as part of the annual action plan. As resettlement in the current situation is very difficult for them. For residential areas, the establishment of early warning systems and adaptation measures, such as construction of high plinth levels for houses located in flood-prone areas are recommended to use. Planting mangroves along their riverbank will be a good answer as not only a part of community-based risk reduction but also a type of ecosystem-based adaptation.

Moreover, in the study area of an impoverished community with absent municipal services, sprawling suburban living conditions, and the dual specters of coastal inundation and contagious health issues, it is imperative to put forth the following essential efforts in Kyimyindine (west):

1. Prioritize the establishment of fundamental municipal amenities encompassing clean water access, waste management systems, electricity, and sanitation provisions to uplift living standards and curtail disease propagation. Educational campaigns related to waste management and clean water are needed to reduce pollution and flood risk. Regulation Enforcement must be initiated by local authorities to enforce regulations on waste disposal and pollution control while improving infrastructures on proper waste disposal sites and drainage systems, as well as encouraging community participation in forming waste management initiatives.
2. Develop a comprehensive disaster management strategy that encompasses evacuation routes, preemptive alert mechanisms, and construct emergency shelters to ameliorate the impact of coastal flooding.
3. Establish localized healthcare facilities or mobile medical units to deliver primary health services, vaccinations, and treatments targeting communicable diseases, thereby minimizing contagion risk. Moreover, launch informational campaigns to foster health awareness, enlightening the community about sanitary practices, infection prevention, and hygiene protocols. Encouraging community involvement in decision-making processes ensures that interventions are tailored to their unique needs.

Collectively, these recommendations are indispensable, as they tackle immediate health and safety concerns while simultaneously establishing the groundwork for enduring progress, fostering a community oriented to confront future climate change driven risks and disaster

13. Appendix (Field Photos)



Day 1 Site Observation Activities : Talking with Local Communities and identifying key local spots of Flood Prone Area.



Module 1: Water Sample Collection for Water Quality Assessment Laboratory Test- Collected from Ground water and Surface Water





Module 2: Flood Exposure Measurement and Assessment, Conducting Qualitative Survey Questionnaire about recent and previous flood experience



Module 3: Partial Vulnerability Assessment: Interviewing locals about their livelihood activities during flooding and their experiences coping with severe flooding twice in a year



Module 4: Risk Reduction Planning - finalizing and evaluating and the data collected from Module 2 and 3 and discuss about strategies for flood risk reduction and adaptation strategies.

