

## Assessing the Impact of Climate Change and Natural Disasters on residents in Ayeyarwady Region

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### Abstract

The Ayeyarwady Region experiences regular cyclone impact although such cyclones are smaller compared to Cyclone Nargis. The Region has experienced severe floods in 2011, 2013, and 2015, and many smaller flooding. Most inhabitants within the Ayeyarwady Region rely on agriculture for livelihood, and they usually live under poverty line. Therefore they cannot cope with natural hazards. In recent years, local people are suffering from the impact of storms, intense rain and flooding. This paper assesses the impact of natural disaster on the residents of Ayeyarwady Region. The data for this study were gathered through purposive sampling, which is selected sampling of areas that have withstood natural disasters, such as cyclone- and flood-affected areas. In-depth interviews with local people are also made. As a result, the great impact of natural disaster is found on the rural residents of Ayeyarwady Region.

**Keywords:** Natural Disaster, Flooding, Ayeyarwady Region, Agriculture, living difficulties

### Introduction

The Study area, Ayeyarwady Region, is also known as the Delta region, and it is situated in the southern part of Myanmar, between the Bay of Bengal to the west, and the Andaman Sea to the south. The Ayeyarwady Region consists of 31 townships and sub-townships, which has an estimated area of 35,031.88 km<sup>2</sup> (DPMIP, 2015). As the southernmost part of the Central Basin of Myanmar, it is flat alluvial plain except the western part where the spurs of the Rakhine Yoma are situated (Fig. 1).

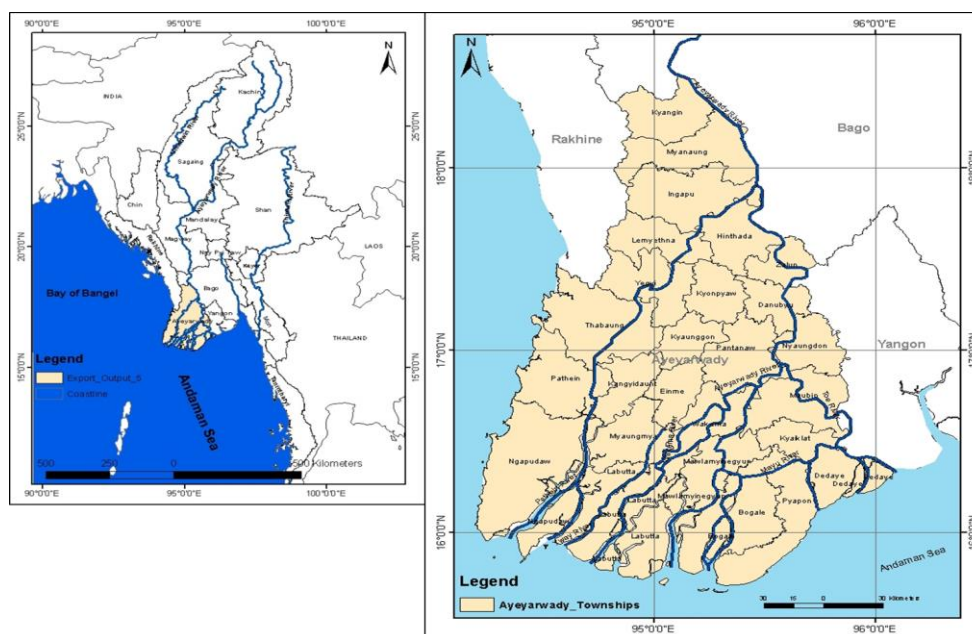


Figure (1). Location of Ayeyarwady Region, (Source: Myanmar Information Management Unit)

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### Rationale behind the study

The Ayeyarwady Region is one of Myanmar's most populated regions, with an estimated population of 6,184,829 (DPMIP, 2015) and population density of 176 people per km<sup>2</sup>. It also has the greatest percentage of people living in rural areas (88%) relative to urban areas (12%). Therefore, the main livelihood in rural peoples are agriculture activities and their income are generated from fishing and paddy cultivation.

The region has a tropical monsoon climate. In recent years, global warming and the changing pattern of global climate affect the general climate condition of Myanmar. According to Myanmar Climate Change Report (Dr Lei Lai Aung & et.al, 2017), extreme weather events increased after 1980s in Ayeyarwady Region. Normal Values (1960-1990) and New Normal Value (1980-2010) are calculated and compared that show changes in various climatic parameters. The dates of onset and withdrawal of monsoon have significantly changed (Fig. 2). Late onset and early withdrawal cause shorter duration of the rainy season that affect the intensity of the amount of rainfall.

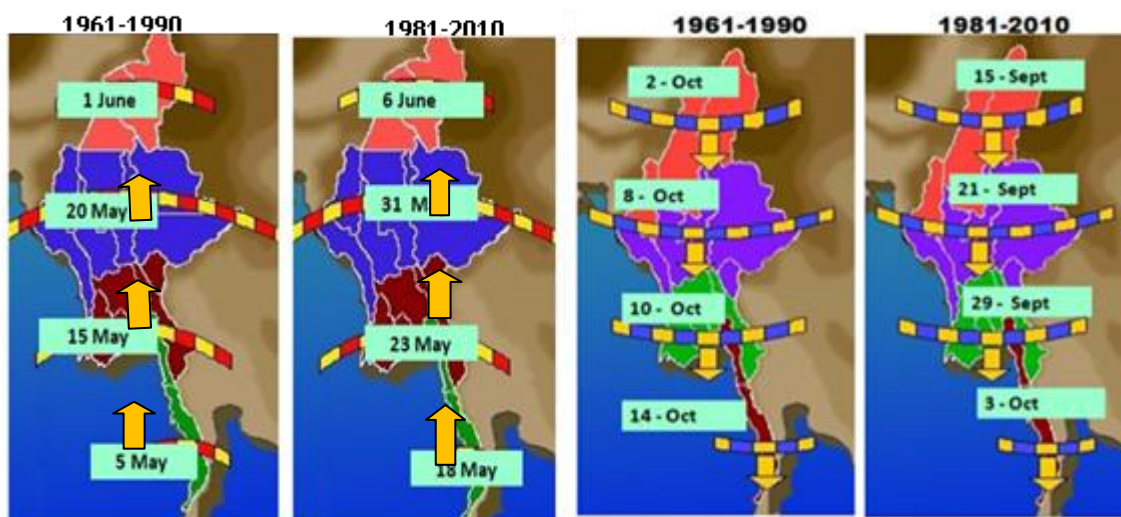
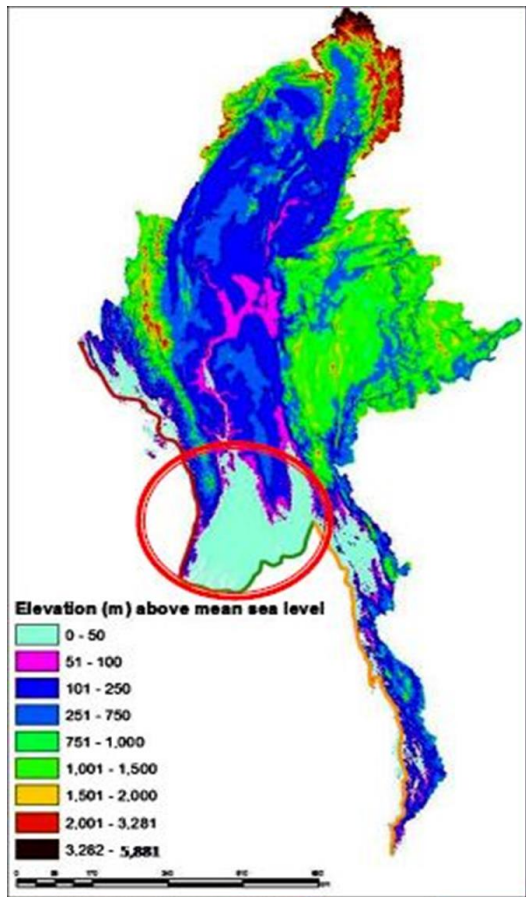


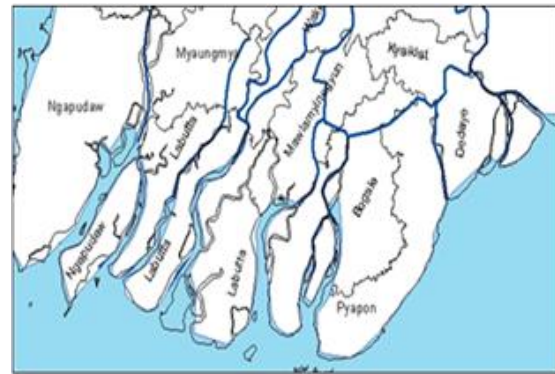
Figure (2). Changing dates of onset and withdrawal of monsoon in Myanmar, (Source: Lei Lei Aung and *et al.*, 2017)

The monsoonal climate in the delta leads to an average annual rainfall of about 1,500–2,000 mm in the north, increasing to 2,500 mm in the southeast and 3,500 mm in the southwest. Over 90% of the rain usually falls between mid-May and mid-November. During the monsoon season, the maximum and minimum temperatures in the coastal zone are about 37°C and 22°C, respectively.

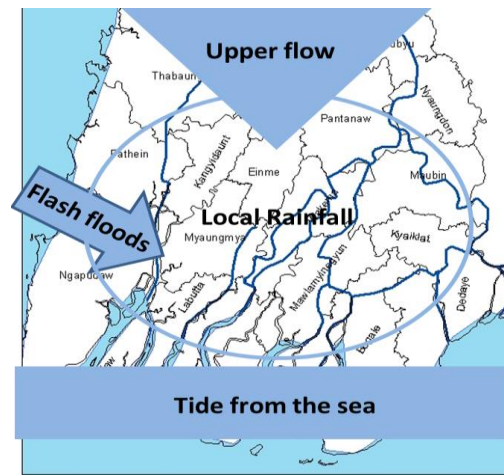
Because the western and southern portions of the region are contiguous with Bay of Bengal and Andaman Sea and because nearly all areas are under 50 meter (Fig. 3.a), the major natural disasters in the Ayeyarwady Region are cyclones, storm surges and flooding events. The whole region is low-lying, and it is crisscrossed by many rivers and streams. Most of these are tidal streams; some of the more important ones are Ngawun (Pathein), Thetketaung, Pyanmalaw, Ywe, Pyinsalu, Ayeyarwady, Bogale, Phyapon, and Yangon River (Fig. 3.b). Flash flood by heavy rainfall from the spur of western Yoma, tides from the sea, cumulative upper flow combined with local rainfall (Fig. 3.c) cause flooding in some riverine areas of the Region. Riverbank erosion occur due to natural and man-made processes in some areas. Cyclone and storm surge events are of low frequency and high impact relative to the coastal area of Rakhine. However, flooding is high frequency and a significant impact in the Region.



(a) Elevation (m) above mean sea level, Source: Htay Htay Than 2016



(b). The river mouths of Ayeyarwady



(c). Causes of flooding

Figure (3). Locational situations and causes of flooding in Ayeyarwady Region

The Pathein Cyclone 1974, the 2004 Tsunami (10,000 houses destroyed, 40,000 acres of paddies flooded), the 2006 Cyclone Mala (37 people dead, damages of 428.56 million kyat), the 2008 Cyclone Nargis (138,373 people missing or dead, 300,000 cattle killed, houses and over 4,000 schools in more than 6,000 villages destroyed, damage cost 13 trillion kyats), regular cyclones although their effects are usually smaller in scale than those of Nargis are the history of climate related natural disaster that impact the livelihood and socio-economy of local people of the Region. The following two images (Fig. 4); the upper one was from April 15, 2008 and the lower was from May 3, 2008, shows the affected areas of the deadliest Cyclone Nargis.

In the year 1974, a flood at Hinzada on the left bank of Ayeyarwady occurred and a vast area of land and a number of towns along the river were flooded and many crop areas in the delta were inundated. Again in the year 1991, the Hteinngu embankment which was constructed in the year 1872 on the Ngawun River, a branch of Ayeyarwady River, was breached between mileage 19/6 and 19/7 near Hteinngu village. The impact of the damage was disastrous: 1,146,000 ha of paddy land, 68,000 ha of other crops and 74,740 houses flooded, 74,674 animals drowned and 326,926 people from 269 villages from 8 townships affected (Delta Alliance 2015).



Figure (4). Overview of Ayeyarwady Delta before and after Cyclone Nargis, (Source: Delta Alliance, 2015)

Some areas of Ayeyarwady Region, however, is extremely flood-prone, and in recent years, the effects of the flood are becoming more severe with longer duration of inundation. It is highlighted severe floods in 2011, 2013 and 2015, as well as smaller flooding events in 2012 and 2016 (Foster, 2017). The following picture was the flood inundated areas in Ayeyarwady Region in 2012 (Fig. 5). Floods damage houses and furniture, paddies, water sources, roads, schools, and monasteries, and it also has impact on tangible and intangible cultural heritage in the region.

### **Purpose of Study**

To assess the impact of natural hazards on the agriculture practices, traditions and living condition of the community within the specific areas of the Ayeyarwady Region.

### **Research Methodology and Areas Surveyed**

Primary data is mainly used in this study. The impact of climate change and natural disasters are has multi causality and layers complexity. To understand participants' perspective through interview was critical. Within the study area, discussions with local people, in-depth interviews with key informants and focus groups were conducted. The data for this study were gathered through purposive sampling, which is selected sampling of areas that have withstood natural disaster, such as cyclone- and flood-affected areas. Some parts of the Ayeyarwady Region are almost always experiencing flooding; therefore, general surveys were first conducted in selected villages of the townships; Thabaung, Kyaung-gon, Laputta, Ngaputaw, Kangyidaung and Mawlamyinegyun. Laputta and Mawlamyinegyun were

affected by Cyclone Nargis in 2008. After a preliminary survey in these selected townships, Thabaung, where flooding takes place every year, was selected for in-depth study. In-depth interviews and focus groups interviews were conducted at the village tracts (a village tract is a rural administrative division in Myanmar equivalent to an urban ward; a village tract can be contained tens to hundreds of villages) Okeshit, Gonhnyintan and Mazalikwinpauk, all in the township of Thabaung. An interview with a key informant and a focus group were also held at Nargis-affected areas of the village of Aleykyaw in the township of Mawlamyinegyun and the village of Thin-gan-gyi in the township of Laputta (Fig. 6).

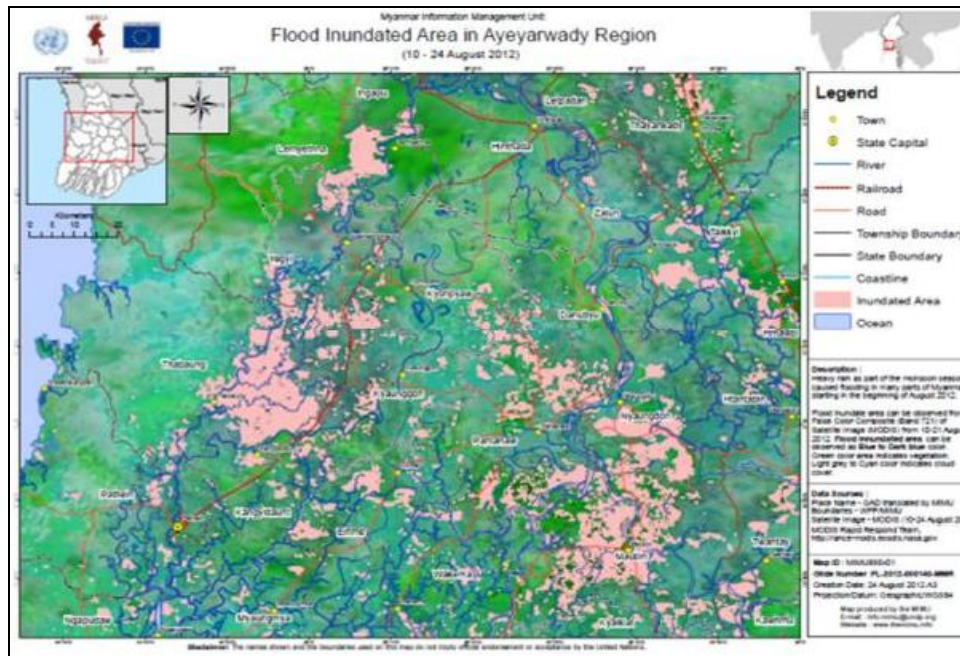


Figure (5). Area flooded, August 2012, (Source: Myanmar Information Management Unit, 2012)

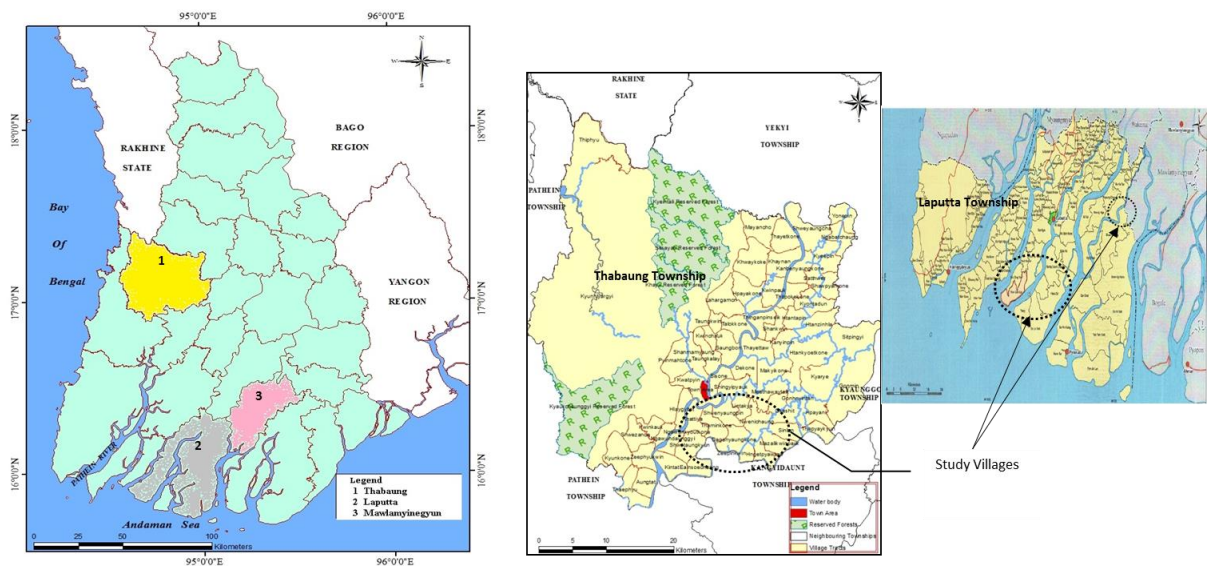


Figure (6). Location of the townships of Thabaung (1), Laputta (2), and Mawlamyinegyun (3) and Study villages in the townships of Thabaung and Laputta, in the Ayeyarwady Region.

A semi-structured focus group was conducted in the locales shown in Table 1, with the profiles of the interviewees. All interviewees and focus group participants of this study are of the Kayin and Bamar ethnic groups, and almost all were over 45 years old and native to the area. The villagers interviewed, and participating in focus groups included farmers, religious leaders, retired teachers and NGO employees. They knew their villages well and had experienced a series of natural disasters in this area. Semi-structured questions related to natural hazards and disasters as well as to their religion, beliefs, customs, traditions and lifestyles were employed to interview the local people. More than 10 people actively participated in the interviews, and an average of almost 6 responded to questions in each sample village. During all interviews and focus groups, notes were taken, and digital recording devices were used to record information, facts and figures. Some recorded photos of focus group interviews are shown in figure (7).

Table (1). Interviewee profiles

Study area	Name of Villages	Total number of Interviewees	Gender of Interviewees		Ages
			Male	Female	
1	Panpin-seik	6	5	1	67, 70, 61, 69, 61
2	Miguaung-kike	4	3	1	65, 54, 42
3	Hpan-ngar-gone	5	3	2	56, 59, 60
4	Thin-gan-gyi	7	5	2	55, 60, 60, 40, 48
5	Aleyekyaw	3	3	-	72, 45, 50



Interview with villagers of Thabawtngu Village Kangyidaung Township, Ayeyarwady Region, Myanmar (photo© Khin Kay Khaing, 9/3/2017



Focus group interview at Migaung Kike Village, Gohnnyintan Village tract, Hpan-Ngar-gone Village (upper), Mazalikwinpauk Village Tract, Thabaung (lower) (photo © Khin Kay Khin 2017)



Interview with villagers of Thone mile sub-township Laputta Township.

Figure (7). Recorded photos of Survey during study period

### Natural Hazards and Disasters in Study Area

In Thabaung Township, the tropical Patheingyi Cyclone in 1974 and Cyclone Nargis in 2008 have been the major events in locals' memory; a severe storm wind of the latter of these killed a person. An earthquake occurred in 2006, and a person was killed in the township, crushed by a house. There have been no severe disasters in this area, beyond these. However, flooding occurs every year since 1988, and its effects are becoming more and more severe year after year. Local residents estimate that Thabaung Township has been experiencing flooding for 30 years. Due to its location in the lower portion of the delta region, near many streams, this flooding is not unusual. After 1988, however, flooding there has worsened, and it is becoming more and more of a disaster (Figs. 8 & 9).



Figure (8). Schools in Setdaunggyi Village, Thabaung Township in the 2016 flooding period (Photo from Basic Education High School, Setdaunggyi Village, Thabaung Township)



Figure (9). Pagoda and monastery in Htanzinhla Village, Thabaung in the 2016 flooding period (Photo ©Administrative Department of Thabaung Township)

The lower part of the Thayat Chaung and Akai Chaung, both of which are small streams flowing across the Kangyidaung Township (once named Patheingyi East), was blocked for agricultural purposes by local residents living upstream. They built a small dam to protect the flooding in their agricultural land to intensify cultivation. Developments in infrastructure, such as the construction of road networks and flood-protection embankments may also be an issue for increased flooding in the Ayeyarwady Region. Flood-protection embankments in the northern villages of Thabaung have caused flooding in some areas in the lower part of that Thabaung. After 1988, the floodwater began to rise about two or three feet above the banks of the river and reach settlement and cultivation areas. The degree of flooding gradually

increased, regularly reaching 2 meters in recent years, and even 3 meters. In the early 1990s, local residents faced 2 weeks of flooding, but over 30 years, flooding began to last for longer periods, from 3 weeks to even a month, and now flood durations reach 2 months. The most serious flooding occurred in 2004, 2012 and 2016. In those years, flooding occurred twice or three times a year. Such flooding is not only related to the local rainfall but also to the climatic conditions in the upper Ayeyarwady River. If the northern part of Myanmar has heavy rainfall, the lower Ayeyarwady Region experiences flooding.

In 2004, the Hteinngu embankment broke, and the resultant prolonged flooding caused the complete displacement of the cattle owned by some farmers and killed 60% of cattle in the village of Hpan-ngar-gone; all the grazing lands were covered with water, and there was no food left to support the animals. Currently, farmers in this area cannot raise cattle because of the shortage in grazing land. Due to the necessity of preparing their houses for flooding and repairing them again when the water levels drop, cultivation is practised once per year, which has slowed the socio-economic development of the area. In some years, the flood plains have been entirely covered with sand, rendering it impossible to cultivate crops on it.

After the period of flooding, diseases, such as dengue fever, break out almost every year, because of the growth of the population of mosquitoes. In 2016, there was a mosquito outbreak, affecting some domestic animals (pigs and dogs). According to interviews with the locals, mosquito outbreaks can kill their pigs, so they used mosquito coils to protect them, sometimes placing their pigs inside mosquito nets. Local residents secured themselves from diseases using traditional ways (burning turmeric powder for getting mosquitoes out) and using medicines from the healthcare centre.

### **Perceptions of local people on natural hazards**

#### **Increased expense for living and living difficulty**

As local people in this area have had 30 years of experience of flooding, they are aware of how to adapt to it. They pay attention to the weather forecasts from the Meteorological and Hydrological Department over radio and television. If they learn that they can expect a flooding year, they prepare drinking water, purifying it in the traditional way, using alum and harvesting rain water. People living in flooding areas rebuild the floors of their houses and raise the floors of other buildings to a higher position, as flood levels have been gradually rising over the last 30 years. They use water-resistant materials like bricks in their buildings, instead of using traditional wood and bamboo (Fig. 10). Some schools, monasteries and churches must often be upgraded where necessary due to flooding. At the flood time there are many difficulties for livelihood in some rural areas because they have trouble to get food and shelter, transportation and education. As the waves hit the houses with strong force, some of the old and small houses collapsed. Sometimes they cannot live at their home (Fig. 7). At that time, people went to safe places such as schools and monasteries and their living is very difficult. They had to rely on the dry food and purified drinking water donated by the flood victim aid organizations. But there was not enough food. The flood in Ayeyarwady region has great impact on rural villages.

#### **Higher input for cultivation**

The paddy fields grown before flooding usually suffered damage when the fields are inundated again in this growing season. Farmers have to grow immediately after inundation; however, if the year experienced three times of flooding, the rice fields are destroyed again. Re-cultivating again and again in one growing season is a reason for high input.





Figure (10). Photos showing the present house style in Thabaung Township. People in flood-prone villages build their homes upon a higher platform. If they cannot afford to build a higher floor, they have to relocate their houses to safer areas (Photo ©Khin Kay Khaing 2017)

### Lowering rate of income

The main occupation of the villagers in this area is paddy cultivation. Some areas within the Ayeyarwady Delta can harvest twice per growing season and even thrice in some areas. In the former times, beans, pulses, chilli and other vegetables, were cultivated during the late monsoon period, after the rice was harvested in October or November. At present in most areas, only rice can be grown, because the duration of flooding is getting longer, and the ground is totally covered with water from July to mid-September, leaves insufficient time for the cultivation of secondary crops. Black sticky rice is usually first cultivated in September or October and harvested after 3 to 4 months. Its cultivation enables traditional special snacks to be made for the locals and to get extra earns. At present, they cannot grow black sticky rice due to the prolonged flooding, and it is a long-duration species that takes about 3 to 4 months to be cultivated. After harvesting paddy, they have no more time to cultivate this sticky rice species again.

For instance, Thabaung Township which is situated on both sides of the Ngawun River which floods every year, has good soil suitable for cultivation due to the alluvial depositions that were left over after the flood. The time for growing paddy coincides with the time of flooding period in June, and July. 40 years ago, the flooding period was not so long and people can grow in time on good nutrient soils. Now, the paddy fields grown before flooding usually suffer damage when the fields are inundated again in this growing season. Farmers have to grow immediately after inundation; however, if the year experiences three times of flooding, the rice fields are destroyed again. Re-cultivating again and again in one growing season is a reason for high input. In one of the interviews, farmers said that they sometimes, cannot effort to buy seeds. Therefore, farmers have to grow paddy after the flood is over and their growing season is shorter and shorter.

### Cropping Calendar Change

Figure (11) illustrates the cropping calendar in flood-affected areas and the non-flooding areas in the Ayeyarwady Region. Black sticky rice is usually first cultivated in September or October and harvested after 3 to 4 months. Its cultivation enables traditional special snacks to be made for the locals and to get extra earns. At present, they cannot grow black sticky rice due to the prolonged flooding, and it is a long-duration species that takes about 3 to 4 months to be cultivated. After harvesting the paddy, they have no more time to cultivate this sticky rice species again.

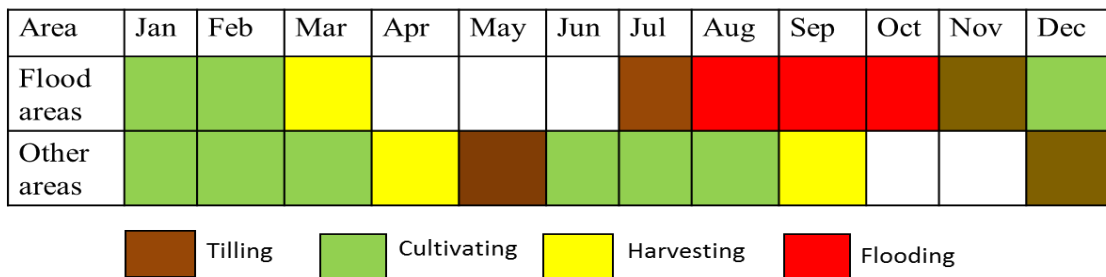


Figure (11). Cropping calendar for some flooding areas in Ayeyarwady Region

**Delaying People and Commodities Flow**

Although the transportation of inter-townships is good, there are difficulties for travelling in the rainy season resulting from flood water over the road. Since roads are usually inundated and destroyed every year, transportation for both people and commodities has to face delay.

**Drinking Water Difficulties**

In every rainy season due to the flood water and heavy rain, it is necessary to cut out the electricity as a protective measure. Therefore, lack of electricity causes difficulty to get drinking water in some areas.

**Social Activities and Culture Affairs Appear to Diminish in Value**

Buddhist people and Christian people have different festivals, activities, practices, and beliefs to some extent. Results of the survey suggests that some of the cultural festivals such as Outh-bote or Thi-la Pwe, and Ah-lu for Buddhist people and Su-taung Pwe or Sunday schools for Christian people have been gradually diminishing its value, due to prolonged and intense flooding, although they have not totally disappeared.

Buddhist people gradually lessened their social cohesion in religious activities like taking Sabbath and offering flowers together in monastery or Dammayone. Moreover, going to the monasteries and a traditional practice of paying homage to the spirit is gradually waning today due to combined impacts of modernization and natural disasters. The most challenging events during flooding are funerals, because the entire cemetery is under water. This is a serious problem. They cannot do this as usual during flooding, as there is no ground space available, so they preserve the dead bodies until the flooding season is over, After the flooding period, they bury the body in the cemetery, and this can be stress inducing. This problem remains to be solved.

**Conclusion**

In conclusion, the Ayeyarwady Region experiences natural hazards such as cyclones (and storm winds) and floods and river bank erosion, which have had prominent effects on the local people especially rural residents. Changing agriculture practices, crop varieties, lifestyle, is difficult to relate with the impact of natural disaster. But detailed study on long term duration can highlight the relationship between the impact of natural disaster and changing condition on socio-economy of local people in the Region. This paper was only able to assess the impact of natural disasters on the people of Ayeyarwady Region in Myanmar. With a more detailed study and with a long-term perspective, the mitigation on these impacts could be served for the locals.

### Acknowledgements

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