**YANGON UNIVERSITY OF ECONOMICS**
**DEPARTMENT OF APPLIED ECONOMICS**
**MASTER OF PUBLIC ADMINISTRATION PROGRAMME**

# A STUDY ON FARMER'S PERCEPTION AND ADAPTATION TO CLIMATE CHANGE IN DRY ZONE

## (A CASE STUDY IN PAKOKKU TOWNSHIP)

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# A STUDY ON FARMER'S PERCEPTION AND ADAPTATION TO CLIMATE CHANGE IN DRY ZONE (A CASE STUDY IN PAKOKKU TOWNSHIP)

A thesis submitted as a partial fulfillment towards the requirements for the degree of Master of Public Administration (MPA)

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# ABSTRACT

Climate change has been observed as the major challenges to farmers for agricultural production especially in the Dry Zone since their livelihood rely on rain-fed agricultural production. The objective of the research is to identify local farmer's perception on climate change and to find their adaptation system in accordance with climate change. Four villages in Pakokku Township of Dry Zone were selected as sample study area by using simple random sampling and data were collected with 260farmers of total population 3470 from 4villages by using a structured questionnaire and analyzed using descriptive statistics. The results state that the farmers perceive the causes of climate change are increasing in temperature, decreasing rainfall pattern, increasing unpredictable weather conditions, severe heat and drought because of being deforestation, human behaviors and natural causes. Farmers understand the causes of climate change a little in general and they have no specific weather information. Perception of climate change and adaptation to climate-change has positive relationship; if farmers understand the changes well, can choose the suitable adaptation strategies in accordance with changes. Thus, this study highly recommended that to perform climate-related educational program and share appropriate adaptation strategies by the government and relevant organizations (either internal or external) to adapt the next coming changes and its impacts.

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# ABBREVIATIONS

| | |
|---|---|
| Ar | Argon |
| CH4 | Methane |
| CO2 | Carbon Dioxide |
| FAO | Food and Agriculture Organization |
| H2O | Water Vapour |
| IPCC | Intergovernmental Panel on Climate Change |
| MCCSAP | Myanmar Climate Change Strategy and Action Plan 2016-2030 |
| MNREC | Ministry of Natural Resources and Environmental Conservation |
| N2O | Nitrous Oxide |
| NAPA | National Adaptation Programme of Action |
| O2 | Oxygen |
| O3 | Ozone |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WFP | World Food Programme |
| CSIRO | Commonwealth Scientific and Industrial Research Organization |

# CHAPTER I
# INTRODUCTION

## 1.1 Rationale of the Study

Any long-term variation of the typical weather patterns in a region is referred to as climate change. These alterations persist for a long time (eg, decades to millions of years). Myanmar is one of the top ten nations prone to climate change and extreme events (Kreft, 2014). Over the previous five years, Myanmar has suffered a significant impact from climate change. (DMH, 2010). Myanmar is located in Asia's monsoon zone, even though that much of the nation is located between the Tropic of Cancer and the Equator. The dry zones in central Myanmar, the monsoonal belts in the northwest, west, and south, and the temperate region in the north make up Myanmar's several climate zones. (Nang Ei Mon The, 2020).

Agriculture has been and still is a crucial source of livelihood in Myanmar. The second-largest export from Myanmar is agricultural products, making it one of the most significant sectors of the country's economy. More than 70% of the workforce is employed in the agriculture sector, which accounts for 20 to 30% of all export earning and contributes 38% of GDP. (FAO, Myanmar at a glance). 70% of the country's population lives in rural areas and mostly rely on agriculture, cattle, and fishing for a living; as a result, climate change is the main challenges not only for the country's economy but also for the majority of its citizens' livelihoods. (Lwin Maung Maung Swe, 2015). These days, the nation frequently experiences the climate-related risks such cyclones and storm surges, high heat and drought, and heavy rains and floods (Khin Win Kyi, 2017). Since the 1980s, Myanmar has been experienced the climate change. (Khin Win Kyi, 2017) According to the German watch company's Global Climate Risk Index, Myanmar is one of the nations most vulnerable to climate change due to its high livelihood of experiencing a medium- to large-scale disaster every two years between 1995 and 2014. (Kreft et al, 2014). According to the World Bank (2013), among all countries, Myanmar's agricultural sector contributes one of the highest percentages of the nation's GDP. (Kim, 2013). Therefore, factors related to

climate change are crucial for Myanmar's economy and way of living. (Khin Win Kyi, 2017). As the agriculture is mostly dependent on climate factor, farmers are suffered mostly by climate change impact. The main barriers to climate change adaptation, according to Doughty-Grajales (2013), are related to low people's perception of climate change, inadequate comprehensive scientific information about climate change and adaptation, a lack of financial resources and ambiguous financial mechanisms, poor weather forecasting, especially gender, and a lack of climate - related awareness in preparedness. According to a recent study by Lwin Maung Maung Swe et al. (2015), farmers in the Dry Zone can no longer adequately adjust to the effects of climate change by using their traditional knowledge and present practices. Additionally, Dry Zone farmers require assistance such as regular and accurate weather-related information of broadcasting and effective farming techniques for weed, insect, and disease control (Lwin Maung Maung Swe et.al, 2015). The first step in determining preparedness to adopt appropriate tactical strategies is perception of climate change and awareness of its causes and signs (Tesfhunegn 2016; Nzeadibe, 2011; Speranza, 2010). Thus, this research aims to identify the local farmer's perception on climate change and to find their adaptation system in accordance with climate change.

## 1.2 Objective of the Study

The objective is to identify the local farmer's perception on climate change and to find their adaptation system in accordance with climate change.

## 1.3 Method of the Study

The study conducted in four villages; Hpaung Kwe, Htan Tapin, Phaung Kyaung and Saung Gyum Kone of Hphaung Kwe village tract, in Pakokku township, Magway region. To achieve the objective of the study used a descriptive method that is based on both primary and secondary data. The primary information was gathered by households interview including the lists of farmers in different situations - both smallholder and large farmers that were obtained from Administration office and villages heads of Kamma, Pakokku Township. This survey was conducted by interviewing 260 farmers of four villages. There were totally 3470 rural population in four villages. Random sampling method was used to collect the data of respondents

and this research used quantitative method to analyze survey data and a structured questionnaire consists of three components was prepared.

## 1.4 Scope and Limitations of the Study

This study emphasized on 260farmers of totally 3470 populations from four villages of western part of Pakokku township. The interviews were conducted with 95farmers from Hpaungkwe village, 66farmers from Htantapin village, 60farmers from Phaungkyaung village and 41farmers from Saung Gyun Kone village. This thesis mainly focus on farmer's perception on climate change and their adaptation strategies to climate change.

## 1.5 Organization of the Study

The study is organized by five chapters. Chapter -1 is the introduction of the study. Chapter -2 is focus on literature reviewing of related documents of the study topics; agriculture's role in early development thinking, Myanmar's climate change condition, action of climate change, the impact of climate change on agriculture, sectoral impact of climate change in Myanmar, linkage between perception and adaptation of the farmers to climate change. Chapter-3 is general information of specific area of the study and it will include the brief conditions of Pakokku regarding to the topic. Chapter-4 is the presentation of survey analysis. The last Chapter-5 includes findings, recommendations and conclusion.

# CHAPTER II
# LITERATURE REVIEW

## 2.1 Agriculture's Role in Economic Development of Country

Since the majority of the population in developing countries depends on the agriculture sector for their livelihood, agriculture plays as a major role in the economic development of these countries. Therefore, it is important that it also plays as a role in the economic growth of less developed countries. Further, it has already contributed significantly to the economic prosperity of advanced nations. According to Dr. Bright Singh, "increasing urbanization and industrialization, along with rising per capita income in the rural society, result in higher demand in industrial production." For example, the history of England is clear evidence that Agricultural Revolution is prior to the Industrial Revolution there. In USA and Japan, also agriculture development has greater effort on extending in the process of their industrialization. As a result, industrial and agricultural development are complimentary and mutually supportive rather than being replacements.(Praburaj, 2018).

According to Prf. Kinderberger, Todaro, Lewis, and Nurkese, among others, agriculture contributes to economic development in a number of different ways.

1. By supplying food and raw materials to the economy's non-agricultural sectors.
2. By encouraging rural population to buy commodities produced in non-agricultural industries due to their increased purchasing power from selling marketable surplus.
3. By making investable surpluses available in the form of taxes and savings for non-agricultural sector investments.
4. By generating significant foreign exchange from the export of agricultural goods.
5. Giving jobs to a large workforce of low educated, illiterate, and unskilled laborers.

The agricultural sector is the base of an economy that offers not only the essential foods to man but also the raw materials needed for industrialization today. The following are the contributions that agriculture makes to the growth of an economy:

1. Contribution to National Income

According to the economic histories of many advanced nations, agricultural prosperity made a significant contribution to supporting economic development. The top industrialized nations of today were once predominately agricultural, whereas in developing economies, agriculture continues to be dominant and still accounts for a large segment of national GDP. For instance, this sector still contributes 28% of India's national income (Praburaj, 2018).

2. Source of Food Supply

Agriculture provides the majority of the world's food, whether the nation is underdeveloped, developing, or even developed. The demand for food is rising more quickly as a result of the high population density in undeveloped and developing nations and the rapid growth of those populations. If agriculture is unable to meet the growing demand for food goods, the economy's growth rate would be negatively impacted. As a result, increasing food supply through the agricultural sector is crucial for a country's economic development. (Praburaj ,2018). The equation below shows how food demand will rise in an economy:

$D = P+2g$ where,

D stands for Annual Rate of Growth in Food Demand.

Population Growth Rate is denoted by P.

Rate of Increase in Per Capita Income is known as g.

2 refers for the demand for agricultural products' income elasticities.

3. Pre-Requisite for Raw Material

According to Praburaj's (2018) statement, agricultural advancement is essential for developing the supply of raw materials for the agro-based industries especially in developing countries. The shortage of agricultural goods will impact upon on industrial production and a consequent increase in the general price level. So, it will impede the growth of the country's economy. For example, rice shellers, oil &

dal mills, textile mills, numerous other industries, etc are based on agricultural products.

4. Provision of Surplus

Praburaj ,2018 stated that the increasing of agricultural exports is achieved by the agriculture sector's progress. Because the financing of the imports of fundamental and essential capital goods causes more demand on the foreign exchange situation in the early stages of development, an increase in export earnings is more desired.

5. Shift of Manpower

In agriculture contains a large quantity of labor force. Agricultural progress allows the shift of manpower from agricultural to non-agricultural sector. In the early stage, the transition of labor from agricultural to non-agricultural sector is more important from the point of view of economic development since it reduces the burden of surplus labor force over the limited land. Thus, the release of surplus manpower from the agriculture sector is necessary for the progress of agricultural sector and for expanding the non-agricultural sector. (Praburaj ,2018)

6. Creation of Infrastructure

Praburaj ,2018 stated that Roads, market areas, railway railroads, postal services, and many other types of infrastructure are needed for the development of agriculture in order to create demand for industrial goods and the growth of the commercial sector.

7. Relief from Shortage of Capital

The burden of some developed countries struggling with a lack of foreign capital has diminished as a result of the progress of the agricultural sector. And because the agricultural sector requires less capital to develop, the problem of foreign capital's growth is minimized. (Praburaj, 2018)

8. Helpful to Reduce Inequality

Praburaj ,2018 demonstrated that in a predominantly agricultural and overpopulated country, greater inequality of income exit between the rural and urban areas of the country. To reduce this inequality, agriculture is necessary as priority.

Because agriculture sector would raise the income of the majority of the rural population and so the difference in income may be reduced to a certain extent.

9. Based on Democratic Notions

Slow agricultural sector progress leads to higher public dissatisfaction, which is never good for the smooth functioning of democratic administrations. It is necessary to reduce social and political conflicts for economic progress. Development of the agricultural sector is therefore important for political and social concerns and also. (Praburaj, 2018)

10. Create Effective Demand

Praburaj (2018) reported that development of the agriculture sector tends to boost people's purchasing power; farmers will contribute to the expansion of the non-agricultural sector of the economy by providing a market for more production. By generating a large amount of cash crops, it will then assist in promoting the expansion of the non-agricultural sector and create the way for the progression of the exchange economy. The purchase of industrial goods like farm equipment and insecticides also helps to revive the dying industry.

11. Helpful in Phasing out Economic Depression

During a depression, industrial production may be paused or reduced, but agricultural production continues since it provides the essentials of life. As a way, it will generate consistent, effective demand even when the economy is weak. (Praburaj, 2018)

12. Source of Foreign Exchange for the Country

Praburaj (2018) reported that primary products are exported by many developing nations. These products account for 60 to 70 percent of their overall export earnings. Therefore, it can be said that the ability to import capital goods and machinery for industrial growth critically depends on the agricultural sector's export earnings. These nations will bear the stress of deficit, which will result in a significant foreign exchange problem, if agricultural goods are not produced in sufficient quantities to export at a high rate. Prices for basic products are falling on the global

market. Consequently, large developing nations like India are trying to alter their production structure and encourage the export of manufactured goods, even though early planning requires the adoption of protective measures.

13. Contribution to Capital Formation

The economic growth of developing and underdeveloped nations requires a lot of money. Agriculture is an important source of capital formation in the early stage of economic growth. (Praburaj, 2018), The agricultural sector contributes to capital formation in a variety of ways, including;

i. agricultural taxation,
ii. agricultural exports, and
iii. government collection of agricultural products at low prices and resale at higher prices. China and Russia also use this approach.
iv. Transfer of labor and resources from agricultural to non-agricultural activities, etc.

14. Employment Opportunities for Rural People

Agriculture generates a large amount of employment opportunities for rural dwellers in underdeveloped and developing nations. It is a vital source of income. Marginal farmers and landless workers typically work in non-agricultural fields like textiles, furniture, metalwork, processing, furniture, and other services. For instance, in India, 70.6% of the workforce is employed in agriculture. (Praburaj, 2018)

15. Improving Rural Welfare

Praburaj (2018) stated that in an underdeveloped countries, rural economy and occupations depend on agriculture. Increasing agricultural production cause agricultural surplus tends to improve social welfare, particularly in rural areas. The living standard of rural population will rise and they can start consuming nutritious food –milk, eggs, fruit etc. They will also lead a comfortable life having all modern amenities- a better house, use of better clothes, motor cycle and television.

16. Extension of Market for Industrial Output

As a result of agricultural progress, the market for industrial products will expand. The rural population's income will rise as agricultural productivity rises, and this will increase demand for industrial goods and the growth of the industrial sector. (Praburaj, 2018). Dr. Bright Singh says that "increasing agricultural productivity, rising per-capita income of the rural community, industrialization and urbanization contribute to higher demand in industrial production." By contributing as a supplement to the industrial sector, the agriculture sector ultimately promotes economic growth.

## 2.2 Myanmar Climate Change Conditions

Myanmar is in the Southeast Asia, commonly known as Burma. Due to its shared borders with Thailand, China, Bangladesh, India, and Laos, Myanmar is not a landlocked country. Above the equator, in the hemispheres of the east and north, is Myanmar. Myanmar has a total area of 676,578 square kilometers (261,228 square miles) and a total of 54,073,608 million people who live in Myanmar. When compared to the world's population, Myanmar only makes up 0.71 percent of the total population. Out of 195 nations, the nation has the 26th largest population in the world.

Myanmar has a subtropical/tropical climate with three different seasons: winter (November to February), summer (March and April), and the rainy season (May to October), which is dominated by the southwest monsoon. (Egashira and Aye Than, 2006). The nation is located in Asia's monsoon region, and its coastal segment receives more over 5000mm (196.9 inches) of rainfall annually. The average annual rainfall in the central dry zone is less than 1000mm(39.4inches), compared to the delta region's about 2500mm (98.4 inches). The maximum temperature in the coastal and delta regions is 32°. Temperatures in the central dry zone areas during the hot seasons can reach 40° and higher. (Khin Win Kyi, 2017). Myanmar faces many development challenges, climate change is the greatest of all. Historically, Myanmar is suffered by climate-related disaster flood, long droughts, heat waves, cyclones and storm surges etc. For the period 1998-2007, the country mostly experienced fire-related disasters and numerous storm and floods event. (MNREC, 2017). Over the last 10 years, two devastating cyclones, Nargis (2008) and Giri (2010) destroyed thousands of lives and suffered more than 2.5 million people living along the coastal region. The severe dry spell in the summer of 2010 cause not only food and water

insecurity but also resulted in 260 heat-related deaths. (Climate change adaptation in Myanmar). Nowadays, temperatures are increasing and droughts are becoming more prevalent in the dry zone. The coastal region remains to be at risk from cyclones that are getting stronger. Further, experiencing the change in the rainfall patterns and amount with its resulting is in the form of a late onset and early withdrawal of monsoon events. On the other side, these changes may also have further consequences and impacts, such as melting snow in the mountains, dangers to coastal areas, soil salinity, effects on biodiversity, and disruption of natural ecosystem. The government of Myanmar notices that a clean environment with healthy and functioning ecosystems, is the foundation for sustainable country's social, cultural and economic development. Therefore, the government with the ratification of UNFCC in 1994(United Nations Framework Convention on Climate Change) has obliged to (1) undertake inventory of greenhouse gas emissions from key sectors, makes projections for future emissions of greenhouse gases under different scenarios, and implement climate change mitigation policies, and (2) assess risks posed by climate change and develop adaptation plans. Key advancements to date at a glance;

- 2008, the nation finished its National Greenhouse Gas Inventory for 2000 (used as the base year) in several important industries, including energy, manufacturing, and waste disposal. Specific estimates of national green house gases by sources and reductions by sources for the year 2000 are included in the inventory.
- The UNFCCC's (United Nations Framework Convention on Climate Change) Initial National Communication was presented in 2012.
- The National Adaptation Programme of Action (NAPA) was created by Myanmar in 2012, and it identifies the following eight priority sectors as being the most vulnerable to climate change: agriculture warning systems, forests, public health, water resources, the coastal zone, energy and industry, and biodiversity.
- The goal of MCCSAP 2016-2030 (Myanmar Climate Change Strategy and Action Plan) was to assist key players at the national and local levels in responding to the challenges and taking advantage of the opportunities caused by the climate-change. It was created in 2016.

- The Myanmar National Climate Change Policy is being designed and will offer a long-term vision for climate change mitigation.

## 2.3 Actions of Climate Change

### 2.3.1 The Climate System

The atmosphere, hydrosphere, cryosphere, land surface, and biosphere are the five main components that make up the complex climate system. About 78% of the gases in the atmosphere are nitrogen (N2), 21% are oxygen (O2), 0.9% are argon (Ar), and the other gases include carbon dioxide (CO2), water vapor (H2O), methane (CH4), ozone (O3), and aerosols. Water that is liquid on the surface and underground makes up the hydrosphere. The only elements in the cryosphere are snow, ice, and frozen earth. The land surface of the Earth, which is made up of rocks, soil, plant, water, snow and ice connects with the surrounding atmosphere. It is the area of land where we reside, graze our livestock, and grow our food. All ecosystems and living things in the air, on land, and in the ocean are generally referred to as the biosphere. (Climate Change Adaptation in Myanmar).

### 2.3.2 Weather

Weather refers to a condition of the atmosphere at a certain time and location described by metrological variables such as temperature, precipitation, wind, humidity, atmospheric pressure, cloudiness. (Climate Change Adaptation in Myanmar).

### 2.3.3 Climate

The average weather conditions in a certain location at a given time of the year, measured as a statistical average of local temperature and precipitation over a period of at least 30 years. (Climate Change Adaptation in Myanmar).

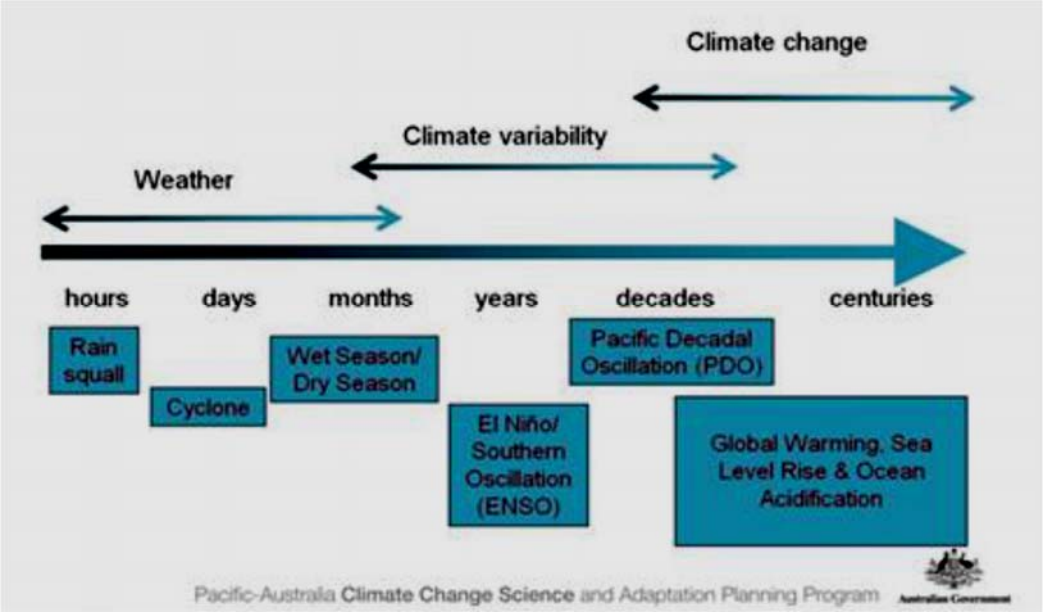
### 2.3.4 Climate variability

The annual fluctuation of the climate above or below the long-term average is referred to as climate variability. A "typical climate" is one with average temperatures and rain during wet seasons, for example. Climate variability, on the other hand, differs from the mean.(Climate Change Adaptation in Myanmar).

### 2.3.5 Climate Change

A long-term change in local or worldwide climate patterns is known as climate change. The increase in global temperatures that has occurred since the middle of the 20th century is commonly referred to as climate change. (Climate Change Adaptation in Myanmar).

**Figure (2.1) The Timescales Applicable to Weather, Climate Variability and Climate Change (CSIRO, 2017)**




Source: (CSIRO, 2017)

## 2.4 The Impact of Climate Change on Agriculture

The main source is agriculture, which is mostly dependent on the climate. However, agricultural production is affected by the climate's progressive change, which will continue to have a problem for future food security. Both adequate food production and accessibility to food are vital for global food security. All people, at all times, have physical and financial access to enough food that is safe, nourishing,

and meets their dietary needs and food choices for an active and healthy life, according to FAO 1996. Access to food is currently a barrier to food security. Food is produced in sufficient quantities to feed the world's population since it is, but more than 10% of the population remains to be undernourished. Future climate change will have a significant impact on food security since it will decrease food production, which will raise food prices. Due to increased crop water demand and drought, water needed for food production may become more scarce. Due to some locations' unfavorable climates, there may be more competition for available land. Extreme weather occurrences linked to climate change cause sudden drops in agricultural productivity, which in turn causes rapid rising prices. The locals are becoming poor as the result of these rising prices. (Future of Farming)

The Intergovernmental Panel on Climate Change (IPCC) claims that significant climate change has already happened since the 1950s and that the increase in global mean surface air temperature in the second half of this century would be from 0.4 to 2.6Ċ(depending on future greenhouse gas emissions). A significant source of greenhouse gas emissions is the wider food production systems as well as agriculture. Extreme heat temperatures are likely to occur more frequently in the future, which will be a significant challenge for agriculture. Heat waves can harm food production by causing heat stress in both plants and animals. When plants are blossoming, extreme heat waves are very harmful to crop production because if this one crucial step is disrupted, there may be no seeds at all. Animals that suffer heat stress may become less fertile and productive. It can also negatively impact their immune systems, increasing their susceptibility to certain diseases. (Future of farming).

Both human-caused greenhouse gas emissions and the conversion of non-agricultural areas like forests into agricultural land cause agriculture to contribute to climate change. Agriculture, forestry, and changes in land use were accounted for 20 to 25% of yearly global emissions in 2010. (FAO, 2000-2018). Weather continues to play a significant role in agricultural production as well as soil characteristics and natural communities, even with technological advances like improved varieties and irrigation systems. Rather than global climatic trends, the impact of climate on agriculture is more closely tied to variations in local climates. Since 1880, the average temperature of the Earth has risen by 1.5°F (0.83°C). (Aondoakaa, 2012).

In the most of tropical and subtropical regions, agricultural output would reduce due to a lack of availability of water and the appearance of new or different insects, with the poorest nations having been the most seriously effected, according to the IPCC Third Assessment Report, which was published in 2001. According to the Intergovernmental Panel on Climate Change's 2014 report, the world may have hit "a threshold of a global warming beyond which crop cultivation systems can no longer feed massive human civilizations" by the middle of the twenty-first century. According to statistics released in 2019, millions of people currently experience food insecurity as a result of climate change, and it was expected that agricultural production will decline by 2% to 6% over the period of the next ten years. Long-term climatic change could have a variety of effects on agriculture, including

- productivity, as measured by crop yield and quality
- changes in agricultural techniques, including irrigation and the use of agricultural inputs like herbicides, insecticides, and fertilizers
- The impact on the environment, particularly in regard to the frequency and intensity of soil drainage (which results in nitrogen leaching), soil erosion, and decreased crop diversity
- rural space as a result of cultivated land loss and gain, land speculation, renunciation of land, and hydraulic amenities.
- As a result of adaptation, organisms may become more or less competitive, and people may feel pressure to create organisms that are more competitive, such as rice varieties that are salt- or flood-resistant.

They include the uncertainties regarding the pace of climate change, the effects of technological advancements on productivity, the demand for food on a global scale, and the numerous adaptation measures. These uncertainties are particularly difficult to identify because there is a lack of information on many specific local regions.

## 2.5 Sectoral Impact of Climate Change in Myanmar

All of Myanmar's economic, social, productive, and environmental sectors are affected by the past, present, and future changes that have been observed. (Khin Win Kyi, 2017). For example, due to changing rainfall patterns and pest infestations, the rising temperature has had a significant impact on sectors like agriculture in the dry

zone, driving many people to migrate and find other sources of income. (Khin Win Kyi, 2017). The following effects, if climate change estimates are accurate, are either now obvious or predicted;

- Agriculture, Livestock and Food Security
- Environment, Natural Resources and Biodiversity
- Energy, Industry and Transport
- Human Settlements and Cities
- Public Health

### 2.5.1 Agriculture, Livestock and Food Security

The economy and society of Myanmar are still mainly dependent on its rain-fed agriculture. This crucial sector is largely impacted by climate change. (Khin Win Kyi, 2017).

**Impact on Agricultural Output**

Three categories of effects are possible: (1) influence on the productivity of current farming methods and crops, (2) rapid destruction of crop cultivation by severe dangers or droughts, (3) Long-term erosion of soils. (Khin Win Kyi, 2017).

Example are-

- Agricultural productivity and food security in Myanmar are predicted to suffer as a result of the country's rising temperatures.
- Increased salinity, coastal erosion, and flooding will affect the highly productive deltaic and low-lying coastal rice growing areas.
- The Dry Zone is already experiencing issues as a result of a rise in extremely high temperatures, such as the extreme drought that destroyed key cereal crops in 2009. (WFP, 2009)
- In 2010, a severe drought reduced village water supplies across the nation and damaged the rice, tomato, sugar cane, and pea crop yields.
- Approximately 1.7 million tons of rice were lost as a result of excessive rain and flooding in the Ayeyarwady, Bago, Mon, and Rakhine Regions/States from July to October 2011.
- Crop damage from the October 2006 Zawgyi River floods was significant.

- In 2007, widespread record-breaking flooding submerged 809,384 hectares of cropland, causing more than 50% of the crops to suffer damage.
- Rice seedlings were harmed and harvests were decreased in 2010's Rakhine State due to high sedimentation, which cost a total of USD 1.64 million in damages.

## 2.6 Linkages between Perception and Adaptation of Farmers to Climate Change

Any actions or adaptations to risks must originate with the awareness or perception of risk. Risk perception is shaped by the sensory perception that comes from being engaged with reality via practice and experience, as well as the cognitive capacity to comprehend the past and foresee the future. Regarding climate change, cognitive belief and experimental risk perceptions are notably disjointed. (Makate, 2017). Non-scientists rely on base judgments and conclusions even though scientific understanding of climate change is primarily based on analytical evidence of vast amounts of data. (Weber & Stern, 2011 and Marx & Weber, 2012). As a result, this notion differs greatly depending on what many people decide. (Maibach, 2009). Because these causes are unseen and the signs and effects are unclear and challenging to predict or interpret correctly, understanding climate change is extremely challenging. (Weber & Stern ,2011 and Gleick ,2012). According to some authors, farmers concentrate their adaptation and mitigation efforts on the agricultural sector (Berry, 2006). Farmers definitely need to adjust to climate change as well as minimize emissions. Farmers won't implement an adaptive approach or take mitigation measures if they don't believe that climate change is occurring (Arbuckle, 2015). It describes that their reactions and adaption strategies mostly concentrate on their perceptions. The level of education, socioeconomic status, and access to knowledge about climate change, as well as the operation of local extension services, all alter risk perception. Therefore, it must be taken into account that perceptions and attitudes have a significant impact on how farmers adjust to environmental and climate change.

# CHAPTER III
# CLIMATE CHANGE IN DRY ZONE

## 3.1 Area Context of Dry Zone

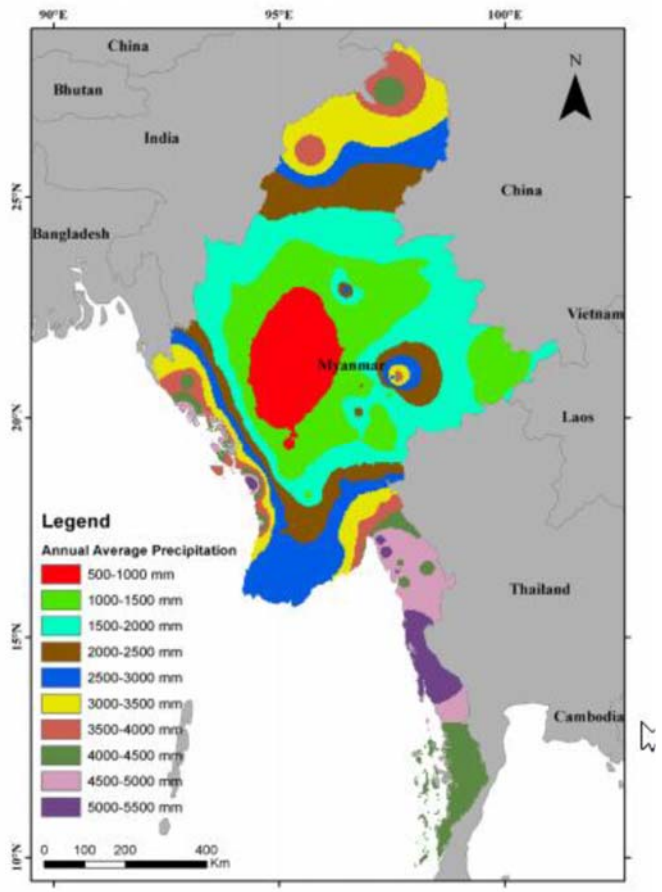
The majority of the three regions (Magway, Mandalay, and Sagaing) that form Myanmar's central dry zone-which makes up around 17% of the country's total land area to form the Central Dry Zone. (Myanmar Dry Zone Development Programme Scoping Report, 2014). The Dry Zone of Myanmar, which includes 58 townships in 13 districts in the Sagaing, Mandalay, and Magway Regions, is located in the middle of the nation. This region belongs to about a quarter of the nation's people. (Myanmar Information Management Unit, 2022). More than 54,000km (or 13%) of the land is covered by the Dry Zone. (ADB, 2013; Mercy Corps, 2015; UNDP, 2015).

**Figure (3.1) Map of Dry Zone (Magway Region)**


Source: (Myanmar Population and Housing Census, 2014).

The rainfall pattern in the Dry Zone is irregular, with many years having rainfall that is much lower than average (700-960 mm), which is already lower than in other regions of Myanmar (Figure (3.2)). (Waimar, Tun. 2012; Tin Yi, 2012; Khin Moe Kyi, 2004). Most precipitation occurs from May to October, with an occasional dry spell in June or July (United Nations Human Settlements Programme, 2016). Rainfall in the CDZ is slightly declining each year, reaching 765 mm in 2007 after being -17.35 mm below average between 1991 and 2000. (Waimar, Tun. 2012). Since the seasonal and drying climate of the Central Dry Zone is made worse by rising temperatures and growing rainfall unpredictability, the region is vulnerable to low water supply and quality (United Nations Human Settlements Programme, 2016). Water shortages for cattle, drinking water, and crops occur from a shorter monsoon season. (United Nations Human Settlements Programme, 2016).

**Figure (3.2) Annual Average Precipitation of Myanmar**
**(Win Win Zin & Rutten, 2017)**




Source: (Win Win Zin & Rutten, 2017)

About 30 kilometers (km) northeast of Bagan on the Ayeyarwaddy River is the Pakokku district, which is part of the Magway region. Pakokku township is with an area of 8,310 km2 and a population of 1,000,5545. (Myanmar Population and Housing Census, 2014) Pakokku has a tropical savanna climate with year-round high temperatures. Prior to the monsoon, the months of March through May are particularly hot. The summer wet season, also known as the rainy season, lasts from May to October. The November until April period is the winter dry season. The average annual temperature in Pakokku is 30.37Ċ, which is 3.35% higher than the country's average. The warmest month of the year, April, is a temperature of 41.76°C (107.17°F), as well as 247.34 no-rainy days per year (32.24% of the time). In Pakokku, yearly precipitation is 2.18 inches, with 117.66 rain days (32.24% of the time). This area is severely affected by food insecurity and scarcity of water due to the low and inconsistent rainfall regime and high population density. Agriculture productivity and cattle health are both impacted by extreme heat. (United Nations Human Settlements Programme, 2006).

### 3.2 Agriculture Sector of Dry Zone

In Dry Zone, farming is the main base for the livelihood of the communities. According to the JICA (2010) report, the livelihoods in the Dry Zone are majorly based on agriculture, with 58% of cash flowing from crop production, 25% from agricultural work, and the remaining 17% from the production of livestock, industrial operations, regular public sector jobs, buying and selling, and money transfers. (JICA, 2010). The average farm size in the Dry Zone is smaller than the national average but still higher. 54 percent of farms are smaller than five hectares, and 83% are smaller than ten hectares (FAO, 2010). Rice is the predominant crop in areas with irrigation, while production is typically based on pulses (chickpea, grams, and pigeon pea), oilseeds (sesame, groundnut, and some sunflower), and sorghum in other areas. These dry-land crops are mostly produced in the CDZ in Myanmar. Additionally, cotton, tobacco, and palm sugar (jaggery) are significant crops in some regions. Small household plots are typically the only places where fruit and vegetables are grown, while certain villages do have commercial-scale onion and chili farms. Whereas rice cannot be produced in adequate quantities, households must purchase it for

consumption needs from the sale of pulses, oilseeds, and cattle. (Myanmar Dry Zone Development Programme Scoping Report, 2014).

Sesame was the most common monsoon crop in the table below, being cultivated by 35% of all landowners. Rice and groundnuts are grown as a second crop by the 20% of farmers. Nearly 18 percent of farmers also grew pigeon peas. The most significant post-monsoon crop was groundnut, followed by green gram, onion, and chickpea. (Myanmar Dry Zone Development Programme Scoping Report, 2014).

**Table (3.1) Dry Zone-Frequency and Average Sown Area of Major Dry Zone Crops**

| Crop | Monsoon | | Post-Monsoon | |
|---|---|---|---|---|
| | % of Growers | Average Area | % of Growers | Average Area |
| Rice | 20.4 | 2.6 | 5.9 | 1.4 |
| Sesame | 34.7 | 5.0 | | |
| Groundnut | 19.7 | 5.9 | 28.0 | 3.6 |
| Pigeon pea | 17.5 | 3.3 | 9.9 | 3.6 |
| Chili | 3.2 | 2.2 | 2.0 | 2.1 |
| Green Gram | | | 13.5 | 5.0 |
| Chickpea | | | 11.2 | 2.4 |
| Onion | | | 12.2 | 1.2 |

Source: LIFT Baseline Survey, 2012.

### 3.3 Overview of Climate Change Impact in Dry Zone

Increasing climate threats, including those that are strongly attacking, like tropical cyclones and floods, and some that are progressively damaging, like drought, are just some of the ways that climate change is apparent in numerous patterns of climate variables and physical phenomena (Waimar Tun, 2012). The patterns of precipitation in Myanmar are reportedly altering as a result of climate change. While the temperature is rising, the total amount of rainfall each year is falling. (Tin Yi, 2012). Since 1977, there have been increased occurrences of delayed monsoon onset, early monsoon withdrawal, and shorter monsoon length, according to the Department of Meteorology and Hydrology (Tin Yi,2012). The Central Dry Zone of Myanmar is defined by low annual precipitation with great unpredictability, and there are

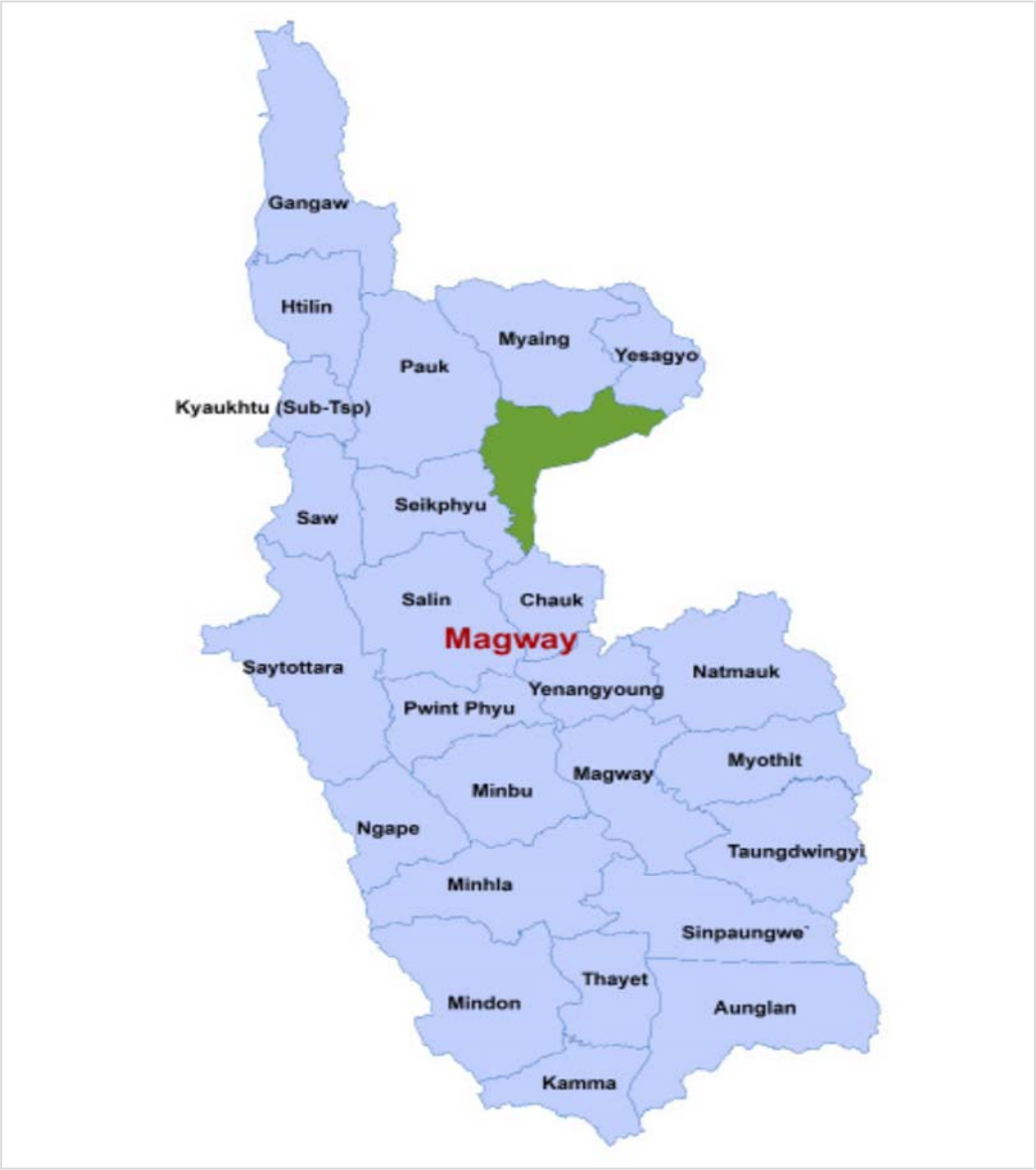
significant hazards and uncertainties related to rain-fed agriculture. In the twenty-first century, the amount of yearly rainfall in the Central Dry Zone has declined by 45%. Even if the temperature in Myanmar is rising by roughly 0.5C on average, the Dry Zone region will experience a rise of 0.7 to 1.2C. (Tin Yi, 2004). The majority of farm-households in the Dry Zone grow a range of crops, including cotton, tobacco, pigeon peas, sesame, and groundnuts. However, the short farming seasons and low yields are a result of the dry climate and irregular rainfall. The amount of yearly rainfall and the availability of irrigation, particularly in Myanmar's Central Dry Zone, limit agricultural productivity, which lowers growth rates.

# CHAPTER IV
# SURVEY ANALYSIS

## 4.1 Survey Profile

Pakokku Township, in Pakokku district is located in the northern part of the Magway Division and on the west bank of Ayeyarwaddy river. Pakokku Township is bordered by Myaing Township to the north, Nyaung-U Township to the southeast, Seikphyu Township to the southwest and Pauk Township to the northwest. Pakokku Township is structured by 16 wards, 58 village tracts and 262 villages The total population was 1,005,545. (Myanmar Population and Housing Census, 2014). In Pakokku, there were many development areas - Pakokku industrial zone, private industries, oil and gas production, cigarette factory, tobacco factory, hospital, railway station, airport, primary schools, high schools and Universities such as Pakokku University, Computer University, College of Education, and Technological University

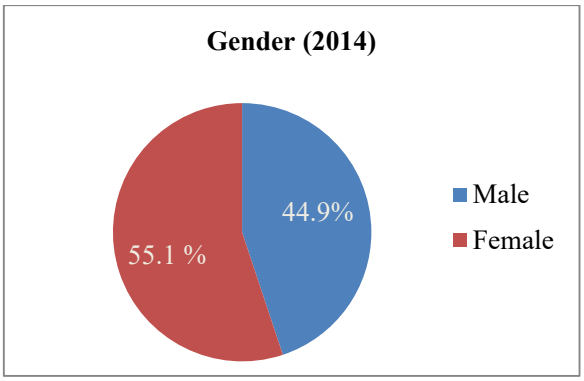
**Figure (4.1) Map of Pakokku**




Source: (Myanmar Population and Housing Census, 2014).

**Further Information about the Population Structure**

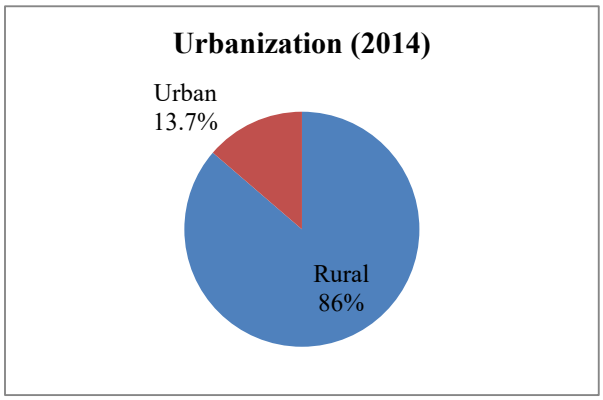
**Figure (4.2) Gender Description of Pakokku Township**




| Gender (2014) | |
|---|---|
| Males | 451,887 |
| Females | 553,658 |

Source: Myanmar Population and Housing Census (2014)

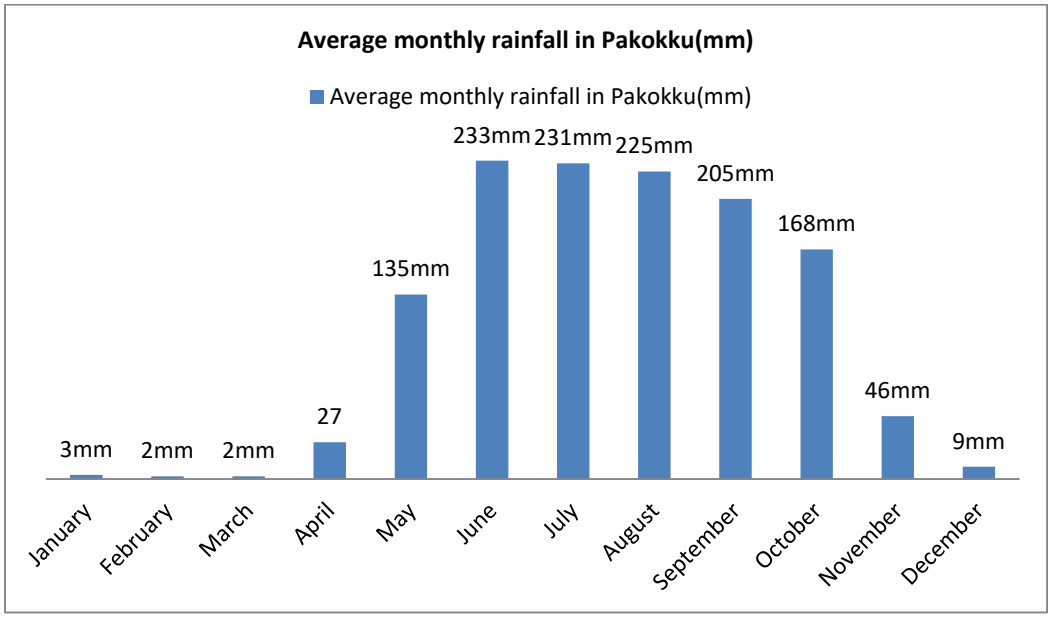
**Figure (4.3) Urbanization of Pakokku Township**




| Urbanization (2014) | |
|---|---|
| Rural | 867,301 |
| Urban | 138,244 |

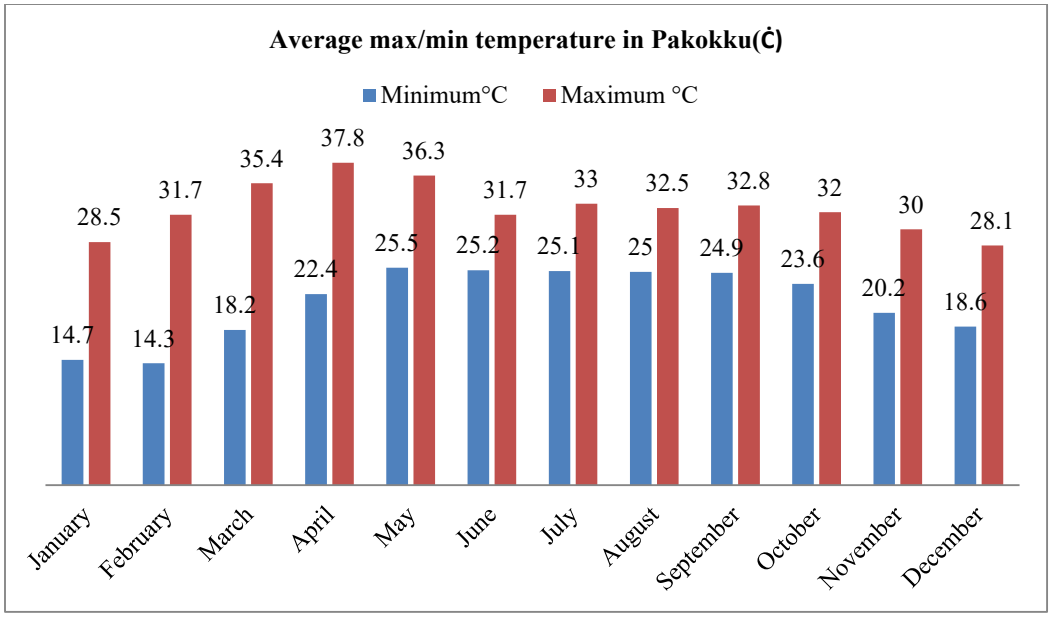
Source: Myanmar Population and Housing Census (2014)

**Figure (4.4) Average Monthly Rainfall in Pakokku**




Source: Weather2visist

**Figure (4.5) Average Maximum/ Minimum Temperature in Pakokku**




Source: Weather2visist

## 4.2 Survey Design

The study areas were selected especially from western part of Pakokku Township since they are among the most vulnerable areas to climate change, poor soil fertility and a high proportion of rain-fed agriculture in Central Dry Zone of Myanmar. Both primary and secondary sources of data were used in this study. The primary information was gathered by household's interview including the lists of farmers in different situations –both smallholder and large farmers that were obtained from Administration office and villages heads of Kamma, Pakokku Township and analyzed using descriptive statistics. The four villages of Hpaungkwe village tract were selected as survey area of this study and shown in below table. This survey was conducted by interviewing 260 farmers of total population 3470 from four villages. Random sampling method was used to collect the data of respondents and the survey was carried out from 22$^{nd}$ to 28$^{th}$ of February, 2020.This research used quantitative method to analyze survey data and a structured questionnaire consists of three components was prepared. First, the socio-demographic characteristics of farmers such as gender, age, marital status, education level, number of household members and land ownership etc, were conducted. The second component consists of the perception of farmers experienced the climate changes and the impact on their agricultural production. The final part of the questionnaire focused on farmer's adaptation strategies to climate changes.

**Table (4.1) Description of the Sample Villages and Size of Farmers**

| **Village Tract** | **Hpaungkwe** | | | |
|---|---|---|---|---|
| **Village Name** | **Hpaungkwe** | **Htantapin** | **Phaungkyaung** | **Saung Gyan Kone** |
| Total Population | 1058 | 925 | 887 | 600 |
| (Males; Females) | (474; 584) | (420; 505) | (411; 476) | (275 ; 325) |
| Total Household | 223 | 178 | 189 | 130 |
| Number of Farmers | 95 | 66 | 60 | 41 |

Source: Survey Data (2020)

The interviews were conducted with 95farmers from Hpaungkwe village, 66farmers from Htantapin village, 60farmers from Phaungkyaung village and 41farmers from Saung Gyun Kone village. The total number of 260farmers were interviewed by about 15 minutes per farmer for this study.

### 4.3 Survey Result

This section presents the results of the data collection of respondents. Survey results consisted of three sectors: demographic characteristics of the respondents, perception of farmers on climate change factors by analyzing and describing their understanding by its meaning and trends and farmer's adaptation strategies to climate change impacts in their farming based on their traditional knowledge, their experiences and access to resources.

#### 4.3.1 Demographic Characteristics of Respondents

**Table (4.2) The Gender of the Farmers by Age Groups**

| **Age group** | **Number of Farmers** | **Percentage of Farmers** |
|---|---|---|
| Young farmers (less than 35years old) | 2 | 0.8 |
| Middle-aged farmers (between35-60 years old) | 111 | 43 |
| Elder farmers (above 60 years old) | 147 | 56 |
| Total | 260 | 100 |
| **Gender** | **Number of farmers** | **Percentage of farmers** |
| Male | 177 | 68 |
| Female | 83 | 32 |
| Total | 260 | 100 |

Source: Survey Data (2020)

There are 260farmers from four villages of Hpaungkwe village tract in Pakokku Township. Their experiences, thoughts and understandings of climate changes may be differed by the age. Thus, farmers are divided into three categories; young farmers (less than 35years old), middle-aged farmers (between 35-60years old) and elder farmers (above 60years old). According to this research, elder farmers

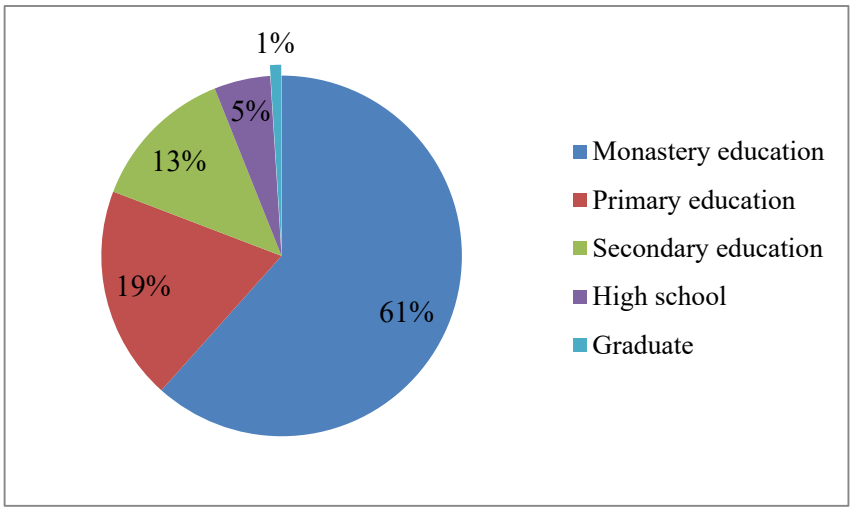
(56%) are the most followed by the middle-aged farmers (43%). Male (68%) is found as the most respondents in this study.

### 4.3.2 Literacy and Education Status of the Farmers

Literacy and education levels are taken into consideration as crucial factors when assessing how well people understand how to adapt to climate change. Higher education improves a farmer's capacity for information absorption and invention, and vice versa. About 56% of people in Myanmar have finished primary education. In examining the literacy and education status of farmers, respondents were classified into five groups.

1. Monastery education, taught by monks
2. Primary school, from Grade1 to Grade 4
3. Secondary school, from Grade 5 to Grade 8
4. High school, who studied or passed from Grade 9 to Grade 10 and
5. Graduate, who studied or finished university education.

**Figure (4.6) The Literacy and Education Status of Farmers in Study Area**




Source: Survey Data (2020)

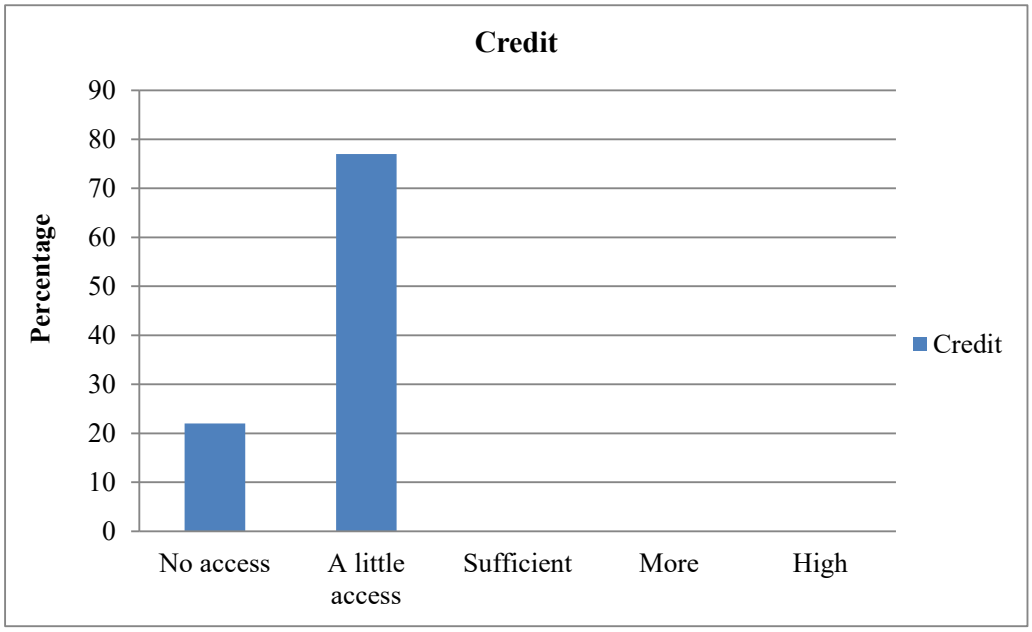
In accordance with result, farmers have the most monastery education (61%), primary education (19%), secondary education (13%), high school (5%) and graduate (1%). It is notable that, farmers with no education are (1%). The results showed that most of farmers have at least monastery education thus they are able to read and write.

This finding indicate that the education level of farmers are low and their ability to absorb advanced farming technology and their knowledge level regarding with climate change can be expected to be low.

### 4.3.3 Farmer's Property and Access to Resources

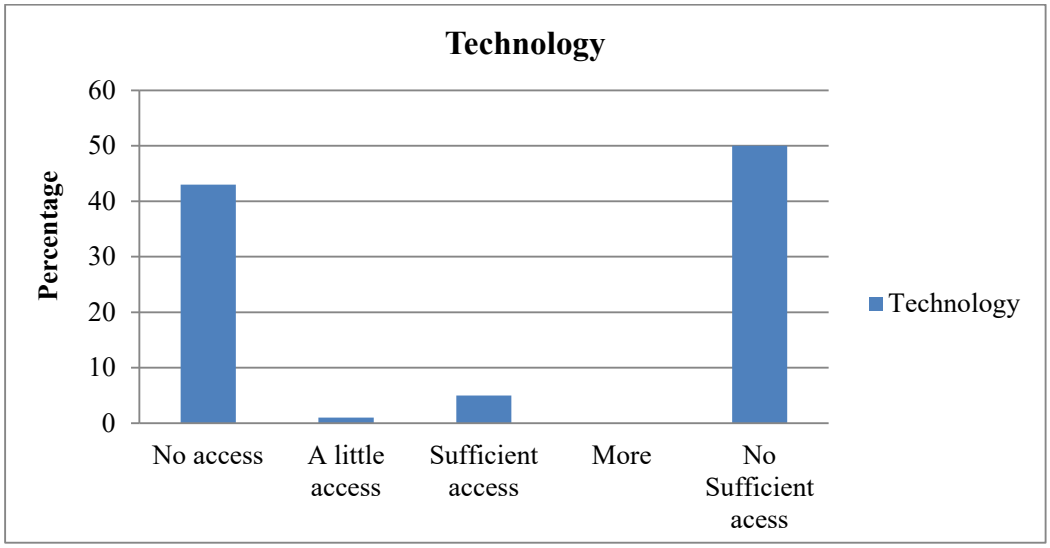
In this study area, the findings show that the average farm size are less than 5 acres per households with (20%), between 5 to 10 acres (50%), between 10 to 15acres (19%), between 16 to 20 acres (5%) and above 20 acres (6%) per households respectively. The average farm size in the Dry Zone is smaller than the national average but still higher. 54 percent of farms are smaller than five hectares (1 ha = 2.5 acres) and 83 percent are smaller than ten hectares (FAO, 2010).Then, the farmer's differential access to resources- credit, technology, and information between farmers are presented by figure.

**Figure (4.7) Access to Credit in the Study Area**



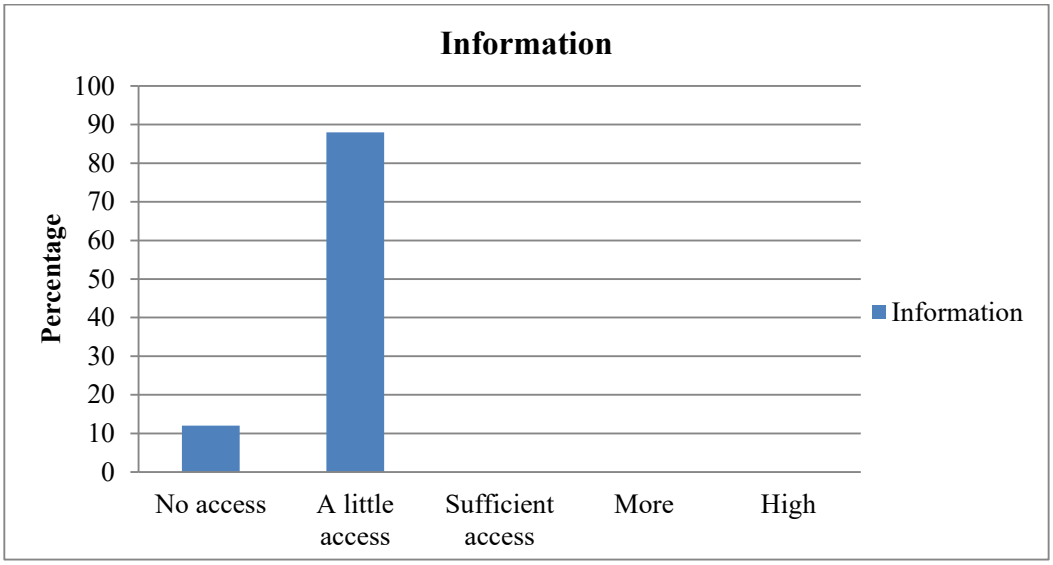

Source: Survey Data (2020)

**Figure (4.8) Access to Technology in the Study Area**




Source: Survey Data (2020)

**Figure (4.9) Access to Information between Farmers**




Source: Survey Data (2020)

The amount of 58farmers (22%) have no access to credit although 200 farmers (77%) have a little access to credit. Around (43%) have no access to technology and (50%) have no sufficient access to technology. Almost (88%) get a little access to information between farmers regarding with their cropping strategies. Thus, it must be considered that farmer's adaptation strategies to environmental and climate changes

are strongly influenced by perceptions and opinions, as well as belief. (Arbuckle et al, 2015 and Makate et al, 2017).

### 4.3.4 Perceptions of Farmers on Climate Change Factors Within 10 Years Ago (2010-2020)

In terms of climate change and variability, particularly for changes of temperature, a study by Lwin Maung Maung Swe et al. (2015) stated that 90% of the surveyed population in the country perceived the changes of climatic patterns in Myanmar. NCEA (2010) stated that the impacts of climate change in Myanmar are inevitable with increasing temperatures and decreasing precipitation trends. Thus, this section presents the perception of farmers on climate change factors in past 10 years ago. According to the farmer's responses, almost 83% have noticed the changes and 17% have not. But, when asked how much they understand about and which factors caused this changes, only 69% understand somewhat, 31% did not understand and there was no one understand well about the climate change. They (55%) have remarked that climate change has occurred within 5to20 years. Only 25% stated that climate change has occurred within recent 5 years whereas 3% thought that it has occurred since more than 20 years. A study also stated that the causes to climate change; for deforestation causes to climate change statement (41% do not know it, 58% agree it and 0.4% disagree it). For natural causes (77% do not know it, 22% agree and 0.8% disagree) and for industrial and related causes (47% do not know, 53% agree and 0.4% disagree). For the last causes, human behaviors (41% do not know, 58% agree and approximately 1.5% disagree). Most of farmers realized that the climate change as changes in rainfall pattern, changes in temperature trends since these factors are mostly happened in their area and significant in their daily lives. The perceptions of farmers on trends of climate are presented with table.

**Table (4.3) The Perception of Farmers on Climate Change Trends**

| Climate Variables | Trend | | |
|---|---|---|---|
| | Increase | Usual | Decrease |
| Rainfall | 2 | 11 | 247 |
| Dry spelling | 150 | 90 | 20 |
| Onset of monsoon | 11 | 51 | 198 |
| Withdraw of monsoon | 11 | 10 | 239 |
| Unpredictable weather condition | 90 | 163 | 7 |
| Temperature | 260 | 0 | 0 |

| | | | |
|---|---|---|---|
| Temperature in winter | 250 | 8 | 2 |

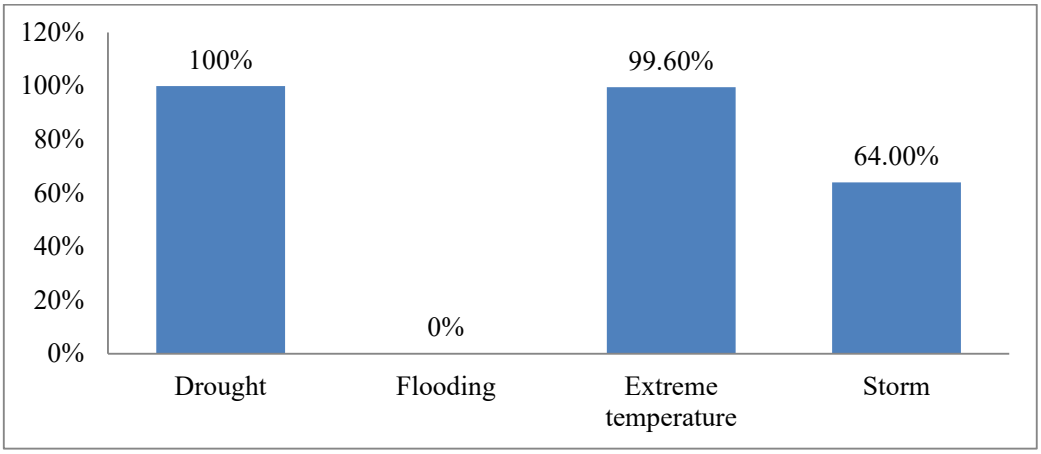
number of farmers (n = 260)
Source: Survey Data (2020)

Concerning with trends on climate change variables, all respondents well know about the fluctuations of rainfall and temperature. Most of farmers (95%) stated that annual rainfall distribution has changed to a decreasing trend;58% answered that the dry spelling within the monsoon became longer and 35% answered usual. 76% thought the onset of monsoon is decreasing and 92% of the farmers perceived that the decreasing withdraw of monsoon in study area. 63% of respondents answered that the unpredictable weather condition is normal. Regarding with temperature, all of farmers (100%) perceived that the temperature is increasing and 96% in winter. The late of pre-monsoon and early withdraw of the monsoon has been observed. Rainfall patterns have become more irregular and unpredictable in terms of intensity and seasonality, for instance shorter rainfall duration combined with heavy rains.

**Farmer's Experience of Living with Natural Disasters**

Myanmar has faced an increase in heat-related hazards since 1980s (MNREC, 2017). The most recent severe droughts occurred in 2010. Extreme high temperatures and heat waves affect mostly the Central Dry areas. (Climate Change Adaptation in Myanmar). The natural disasters are storm, extreme temperature, severe drought and flooding. Among them, most of farmers frequently mentioned hazards are drought and extreme temperature in the study area because they felt hotter and found a prolonged dry spell during the rainy season. The years 1954, 1957, 1961, 1972, 1979 and 1991 were most affected by drought and significant drought happened in 2009 (INC, 2012). In addition, droughts mostly occurred in the dry zone area during the pre and peak monsoon period of 2010. In 2011, 2012, and 2013, Myanmar experienced a slight drought across the country, but the dry zone area, some areas, and states experienced severe and moderate droughts, and other regions and states experienced a mild drought (Yi, 2015).

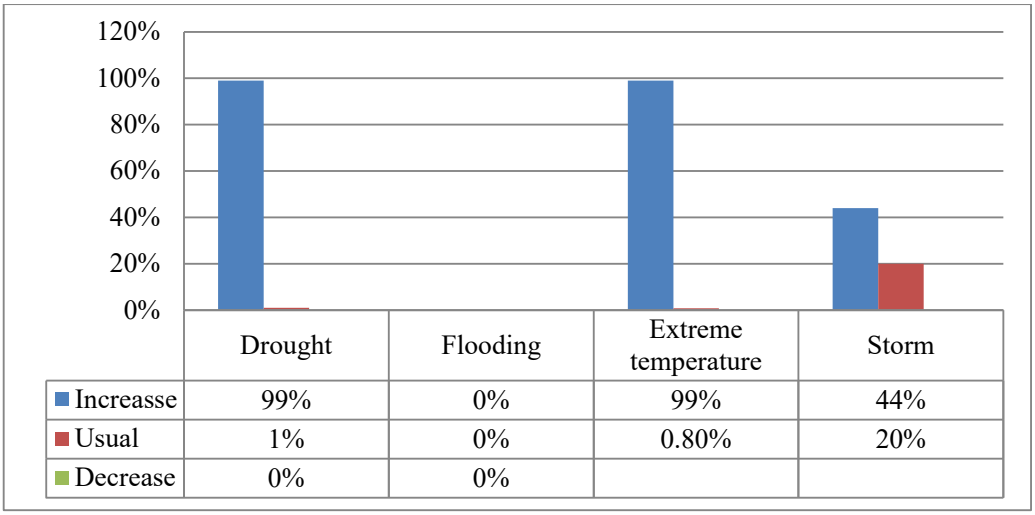
**Figure (4.10) Percentage of Farmers Experiencing Natural Disasters**




Source: Survey Data (2020)

All of farmers (100%) noticed that drought has occurred during in past 10 years ago and faced. 99.6% of farmers answered that also extreme temperature has happened and storm with 64%. It is notable that, flooding has not occurred in the study are because villages are far away the river. The majority of farmers perceived that the frequency of climate related disasters increased within the past 10 years. Among them, 99% of farmers perceived both increasing drought and extreme temperature. Regarding with storm, 44% stated that increasing and 20% is usual trend. Frequency of disasters are presented in below figure.

**Figure (4.11) Perception of Farmers on the Frequency of Disasters**




| | Drought | Flooding | Extreme temperature | Storm |
|---|---|---|---|---|
| Increasse | 99% | 0% | 99% | 44% |
| Usual | 1% | 0% | 0.80% | 20% |
| Decrease | 0% | 0% | | |

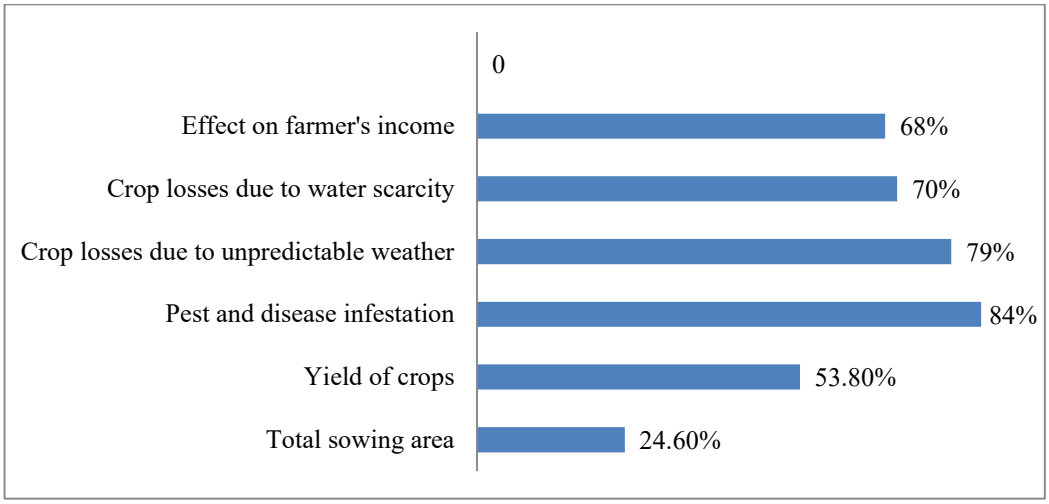
Source: Survey Data (2020)

Noted that: For extreme temperature (0.2%) and storm (36%), famers have not perceived the changes.

**Climate Change Impacts on Crop Production**

In central Dry Zone, four main crops are grown such as paddy, sesame, groundnut and sunflower (Aung Tun Oo Aung,et al. 2017 and McCartney, 2013). As Myanmar highly depends on rain-fed agriculture, getting worse vulnerable family and a higher rate of lacking food security is closely linked to low and declining levels of agricultural productivity. The farmers in rain-fed areas of developing countries are among the most vulnerable and face more severe consequences to the impact of climate change (Gohar and Cashman, 2016). Crop failure and low yields, severe water scarcities, including limited consumable water and declining water sources, and a drop in efficient use of water are the effects of drought. (MoNREC, 2016). Regarding with the study area, the impacts are reported in below figure.

**Figure (4.12) Perception of Climate Change Impacts on Crop Production**



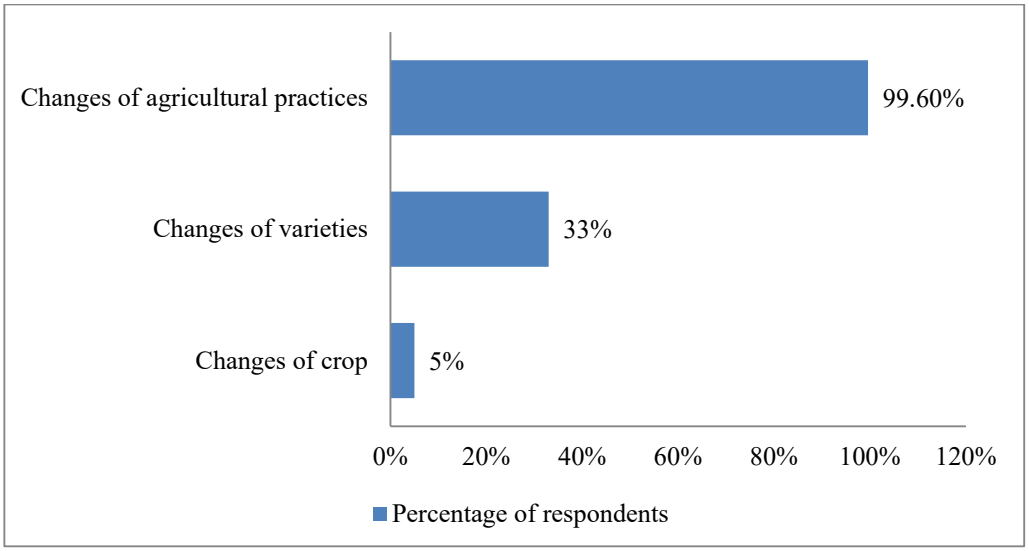

Source: Survey Data (2020)

As the results, most of the study farmers face the kinds of impacts of hazards for agriculture in the past 10 years. The common types of impacts are found in crop losses due to unpredictable weather as well as in pests and diseases infestation increasing input demand such as fertilizer. The impacts on total sowing area in turn cause a decreasing yield of crops. The hazards resulted in impacts such as a decline in farmer's total income

### 4.3.5 Farmer's Adaptation Strategies to Climate Change Impacts in Agricultural Production

This section presents the adaptation strategies, how the farmers handle the impacts of climate change on the farming combined with their experience, traditional knowledge and the access to resources. Adaptation strategies can be either reactive or proactive depending on whether it happens before or after climate change. While proactive adaptation techniques are anticipated to address climate change, reactive adaptation strategies address issues after they have been affected by it. (Bruin, 2011). In the study area, most of farmers use the adaptation strategies they can able. The percentages differ with various perceptions and changes. (Figure 4.13).

**Figure (4.13) Percentage of Farmers Applying Adaptation Measures to Climate Change Impacts**




Source: Survey Data (2020)

Most of the survey respondents have heard about the strategy of "crop changes" but a little of farmers used it. Because most of farmers in study area are mainly focused on oilseeds such as (sesame and peanut) and farmers are lack of money, lack of knowledge and manpower and significant fact is difficult to make new changes (conservative). Thus, in the study area around 5% of farmer made changes in the cultivation of crops whereas 91% of farmers keep the growing of regular crops. Changes of varieties are used by 33% of farmers in the study area. The most significant applied strategy among farmers in the study area is changes in agricultural practices, 99.6% (shift from transplanting to broadcasting, use of chemicals, fertilizers

and pesticides. As a result, farmers in the dry zone use also animal manure to maintain soil productivity and to lessen the high cost of input needed. Farmers also use mixed cropping system and multiple cropping system.

For instance, farmer cultivate by mixing two or more crops-sesame in early rainy season together with pigeon-pea as mixed crop, groundnut together with pigeon-pea, cotton together with sesame, cotton, pigeon-pea with groundnut etc to cover the high costs of input needed.

**Description of Farmer's Cropping Patterns**

**Table (4.4) Cropping Patterns (10 years ago)**

| Cropping Patterns | Respondents | Percentage |
|---|---|---|
| Single cropping | 4 | 1.5% |
| Double cropping | 250 | 96% |
| Triple cropping | 6 | 2% |
| Total | 260 | 99.5% |

Source: Survey Data (2020)

**Table (4.5) Cropping Patterns (current, 2020)**

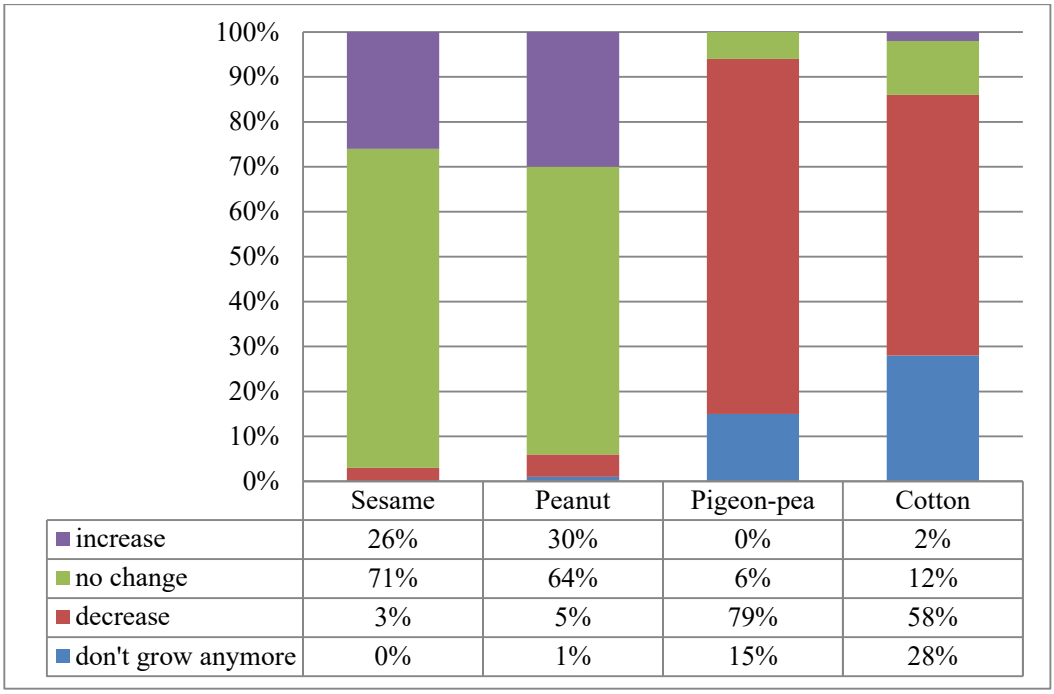
| Cropping Patterns | Respondents | Percentage |
|---|---|---|
| Single cropping | 134 | 51% |
| Double cropping | 119 | 46% |
| Triple cropping | 7 | 3% |
| Total | 260 | 100% |

Source: Survey Data (2020)

There are generally three types of cropping patterns in the Dry Zone area – triple cropping, including summer or pre-monsoon, rainy and winter crops. Double cropping consists of rainy season crop and winter crop and single cropping mean that grow only one crop per year. Comparing of the study year (2020) and past (2010), significant fact is single cropping pattern is increasing and double cropping pattern is decreasing. But, triple cropping is rising a little. As a result, most farmers turn from double cropping pattern to single.

**Changes in Crop Production (2010-2020)**

**Figure (4.14) Descriptions of Changes in Crop Production (2010-2020)**




| | Sesame | Peanut | Pigeon-pea | Cotton |
|---|---|---|---|---|
| increase | 26% | 30% | 0% | 2% |
| no change | 71% | 64% | 6% | 12% |
| decrease | 3% | 5% | 79% | 58% |
| don't grow anymore | 0% | 1% | 15% | 28% |

Source: Survey Data (2020)

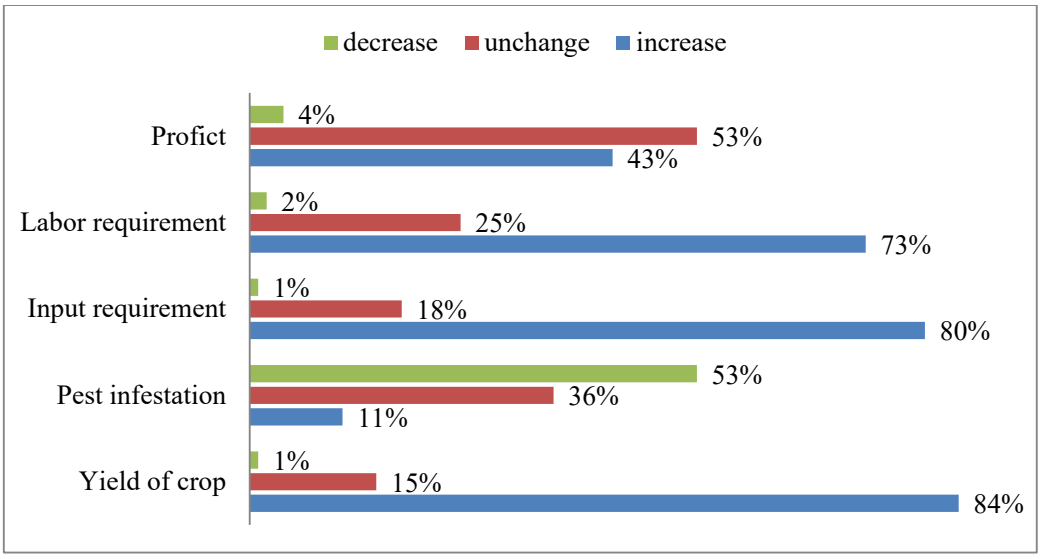
The findings show that farmers in the study area are mainly focused on the production of oilseeds. It can be seen that sesame and peanut are the main crops because 71% of farmers keep the growing of sesame and 64% of peanut. In sesame cultivation, 26% of farmers increased whereas about 3% decreased. Although 30% of farmers increase the cultivation of peanut, 5% of farmers reduce. Pigeon-pea and cotton cultivation are decreased by 79% and 58% of farmers. Around 15% of (pigeon-pea) and 28% (cotton), farmers don not grow anymore because of the market demand for cotton in not sure.

**Adaptation; Outcomes and Inputs Needed**

Many various outcomes are resulted from different types of farmer's adaptation strategies. There is a positive outcome with 84% farmers reporting an increased yield of crop after applying the adaptation measures by comparing with 1% of declining and 15% of no changing yield of crops. Regarding with pest infestation, 53% of farmers reported less while 36% with no change and 11% of farmers found that pest infestation has occurred more. Because of using adaptation strategies, the

requirements of input and labor are increased by 80% and 73% respectively. 43% of farmers earn from an increased profit while 53% of farmers feel no change and 4% of farmers suffer a lost in farm profits.

**Figure (4.15) The Outcomes of Adaptation Strategies Applied within Past 10 Years**



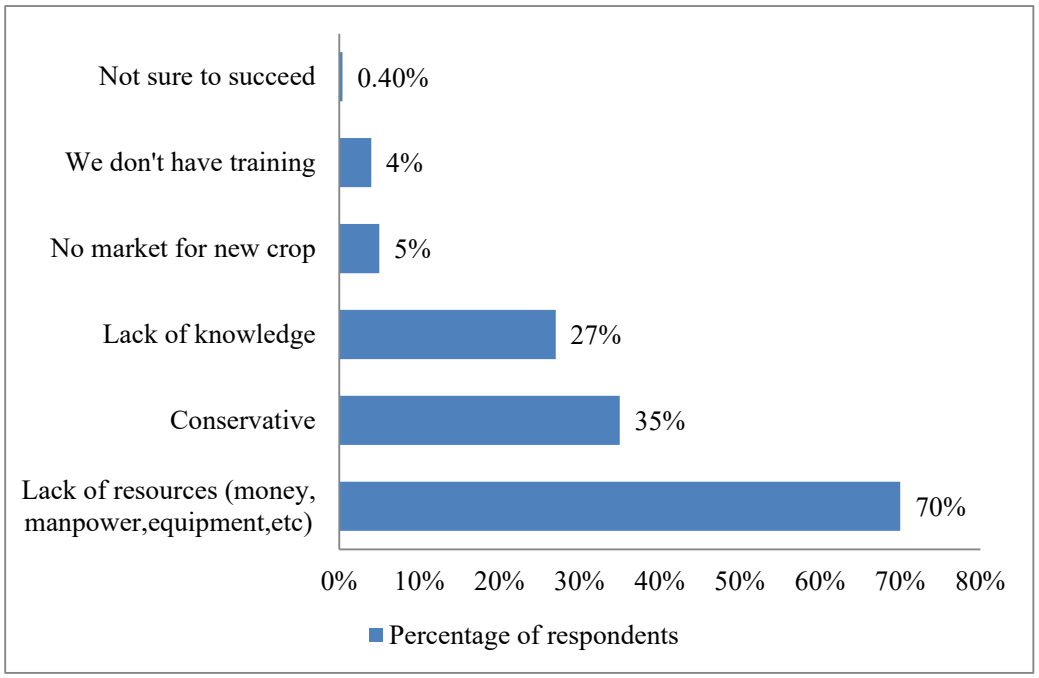

Source: Survey Data (2020).

**Reasons for not Adapting**

As the dry zone area is economically hardship and the incidence of extreme climate related event particularly for drought, the local people are hard to survive for their livelihoods with low adaptive capacity (Vaughan and Levine, 2015). There are many reasons for not using adaptation strategies by the farmers in the study area. Among them, the most stated reasons are lack of money, manpower or other resources-equipment, seeds, etc for implementing adaptation (70%) and (35%) of farmers report that they are conservative (difficult to make new changes and to understand new technology method) and they are willing to use traditional farming practices, cultivate their regular crops. About 27% of farmers report that lack of knowledge about advanced technologies because most of farmers in study area are elder farmers above 60years old (56%) and most are with monastery education (able to read and write). A small number of 5% farmers report that the market demand for new crop and livestock varieties is not sure while 4% of farmers state that lack of training / demonstration for cropping. Farmers (0.4%) feel not sure enough to succeed

if they change since they have no sufficient information about changes. The reasons for not adapting are presented in below figure by percentage.

**Figure (4.16) Unaccomplished Adaptation: Reasons for not Adapting**




Source: Survey Data (2020).

# CHAPTER V
# CONCLUSIONS

## 5.1 Findings

This research studied mainly based on the farmer's perception to climate change and their most common adaptation strategies in the Dry Zone, drought-prone area of Pakokku Township, Magway Region. Farmers in the study areas are mostly with low education levels but their farming experiences are above two-decades are founded as a result. And farmers also believed that the causes of climate change are driven from deforestation and human behaviors thus climate changes are worsen more and more. Most of farmers from the study villages perceived the climate changes- it is significantly notable that increasing in temperature, erratic rainfall variability, unpredictable weather conditions and drought can cause impacts on the agricultural productivity, pest infestation, etc. Yet increasing in climate change variability and impacts, farmers are keep working in farming combined with adaptation strategies since their primary income is mainly based on rain-fed agricultural productivity. Thus, studied and collected their local adaptation practices to climate change and most are previously expressed. Changes in cropping practices (including cropping time and cropping pattern) and changes in crop varieties (resistant to drought, good at yield and market-demand) are used widely spread in study area. Also chemical fertilizers are used to protect pest infestation. The main crops in the study area are sesame and groundnut, followed by pigeon-pea and cotton, etc. Most of farmers cultivate with double cropping pattern while some farmers turn from double to single cropping. The small amount of farmer with triple cropping in the study area is previously highlighted in detail. In past five or seven years ago, farmers cultivated sesame-groundnut, traditional cropping pattern. Sesame is sown firstly as pre-monsoon crop, generally in the month of Kasone-Nayone (May-June) after raining has occurred by 2 or 3 times also known as Thet Yin or Hnan Yin. Then, groundnut is used to cultivate as second crop. But nowadays, the occurrence of pre-monsoon is uncertain and becoming more later and later. In fact, it used to start in late of April but

now it occurs in the late of May, sometimes in the middle of June. That is why, farmers stopped growing Thet Yin and irregular rainfall cause water shortage for groundnut in its later crop development- poor yield in both crops. As a result, farmers cultivate Hnan Gyee also called Samone Nat instead of Thet Yin in September before post-monsoon withdraw. Farmers stated that Hnan Gyee need no rain too much and can grow well with snow. Now, groundnut is sown as first crop after it rains in Kasone-Nayone. In the study area, groundnut is classified into two types; Pegyee (6months) and Pelay (3months). Most of farmers sown Pegyee and either pigeon-pea or cotton are sown simultaneously with groundnut. First crops are harvested before September and then sesame, Hnan Gyee grown. Generally, Tazaungmon and Nadaw are their harvest periods. In conclusions, the choices of cropping patterns by farmers are absolutely relying on the occurrence of pre-monsoon, can be seen as the most important factor. Another important fact is that farmers prefer to choose the crops based on the market demand since their livelihood in the study is mostly relying on agriculture. This study has found that farmers are likely to respond the impacts of climate change by using their traditional knowledge and they have no specific weather information. Farmers mostly predict the weather conditions based on strange behaviors of animals and insects. They are not willing to make new changes since may be conservative or poor access to advanced technology or financial supporting or manpower, etc. Their traditional knowledge and current using strategies are not able for long-period to climate change. Thus, this study significantly highlighted that must need to combine farmer's traditional knowledge and expert knowledge in order to able to adapt the next coming climate change and its impacts.

## 5.2 Suggestions

Understanding the perception of climate change well and clearly is essential needs for farmers who make decisions to adapt to climate changes. Farmers in this study perform by using some of adaptation strategies and the reasons for unaccomplished adaptation strategies, inputs needed are described in previous. All of them, the reality needed for farmers in this study is that supporting from government (internal) or international community (external) which can able to transfer advanced technology, share up-to-date weather information, improve their traditional knowledge combined with more adaptable strategies, support sufficient access to financial and stable market prices. Farmer's perception and adaptation strategies are

varied from region to region and inputs needed cannot be the same. Finally, this research is the first step of thousands of miles and collects data of farmer's perception and adaptation strategies as they expressed. This study suggest that the current using adaptation strategies of farmers in survey area, Dry Zone should be strengthened and combined with further efficient and effective strategies guided by relevant organizations in order to adapt to upcoming climate change and it's impacts.

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# APPENDIX

A Study The Farmer's Perception And Adaptation To Climate Change
In Dry Zone
(Case Study in Pakokku Township)

I am Khin Thazin and doing Master of Public Administration (MPA) at Yangon University of Economics now. I would like to know farmer's perception and adaptation to climate change thus I requested the teachers and presented about the aims of studying to get permissions. Please answer the questionnaire and provide data required to accomplish my thesis.

Thanks you for your kind help and sorry for taking your precious time.

**Household Questionnaires**

Household no …  Interview date…

1. Village name…  2. District…  3. Region…

1. Respondent Profile

| Question | Answer |
|---|---|
| 1.1 Name | |
| 1.2 Sex of respondents | 1.Male<br>2.Female |
| 1.3 How old are you? | 1.≤ 35years old<br>2.between 35-60years old<br>3.>60years old |
| 1.4 Are you married? | 1.Single<br>2. Married<br>3. Divorced<br>4. Others |
| 1.5 What is your education level? | 1.Monastery education<br>2. Primary education<br>3.Secondary education<br>4.High school<br>5.College/ university or above<br>6.Others, specify |
| 1.6 Number of household members | |
| 1.7 What is your family' primary source of income? | 1.Crop production (eg, paddy, pea and bean)<br>2.Weaver<br>3.Regular employment (including government)<br>4.Others |

| | |
|---|---|
| 1.8 Land ownership | 1.less than 5acres<br>2.5-10acres<br>3.10-15acres<br>4.16-20acres<br>5.above 20acres |
| 1.9 Credit from where | 1.Government<br>2.Non-government organization<br>3.Others |
| 1.10 Credit assessment | 1.Don't get<br>2.Insufficient<br>3.Sufficient<br>4.More than sufficient |
| 1.11 Information assessment for technology | 1.No assessment<br>2.Insufficient<br>3.Sufficient<br>4.More than sufficient |
| 1.12 Information assessment between farmers | 1.No assessment<br>2.Insufficient<br>3.Sufficient<br>4.More than sufficient |
| 1.13 Water resources | 1.Dam<br>2.Rainfed<br>3.Electricity pump (by government)<br>4.Tube well (owned by farmers)<br>5.Others |

2. Current Threats in Farming in Study area

| Question | Answer |
|---|---|
| Current threats/ barriers<br>/ | Intensity of current threats/ barriers<br>1.very less<br>2.a little<br>3.unchanged<br>4.serious<br>5.extremely |
| 2.1 Soil degradation | |
| 2.2 Pest infestation | |
| 2.3 Disease infestation | |
| 2.4 Weed infestation | |
| 2.5 Labor shortage | |
| 2.6 Water assessment | |
| 2.7 Market fluctuation | |
| 2.8 Financial resources | |

3. Knowledge on climate-change and causes within the past 10years

| | |
|---|---|
| 3.1 Have you noticed any major changes in the weather in your life time? | 1. Yes<br>2. No |
| 3.2 How much do you understand it? | 1. don't understand<br>2. somewhat understand<br>3. understand |
| 3.3How long have you notice? | 1.less than 5years<br>2.5-10years<br>3.11-15years<br>4.16-20years<br>5.more than 20years |
| 3.4Causes to climate changes | Perception on causes<br>1.I don't know<br>2.agree<br>3.disagree |

| | |
|---|---|
| 3.4.1 Deforestation | |
| 3.4.2 Natural Causes | |
| 3.4.3 Industrial and related causes | |
| 3.4.4 Human behaviors | |

4.1. Overall Climate Change within 10years ago

| Agricultural production | 4.1.1 How are these risks occurring in the past 10years?<br>1.increase<br>2.usual<br>3.decrease |
|---|---|
| 1. Annual rainfall | |
| 2.prolonged dry spell in an rainy season | |
| 3. pre-monsoon rainfall and duration | |
| 4.post-monsoon rainfall and duration | |
| 5.unpredictable weather changes | |
| 6.summer temperature | |
| 7.temperature in winter | |

4.1 (b) Overview over risks on agricultural production in the past 10years

| Events | 4.1.2 How much these risks affected in your farming in the past 10years?<br>0.Nothing<br>1.Less<br>2.Adequate<br>3.More |
|---|---|
| 1.Total sowing area | |
| 2.Yield of crop | |
| 3.Pest and disease infestation | |
| 4.Crop losses due to unpredictable weather | |
| 5.Crop losses due to water scarcity or | |

| | |
|---|---|
| logging | |
| 6.Increasing unsown soil | |
| 7.Lowering crop quality | |
| 8.Infertility due to extreme temperature | |
| 9. Effect on farmer's income | |

4.1 (b) Overview of Climate-change and impacts on agricultural production in the past 10years

| Events | 4.1.2. How was the intensity of these risks in past 10years in your area?<br>1.increase<br>2.stable<br>3.decrease | 4.1.3. Frequency within 10years (years) | 4.1.4. How much did these risks effect on the agricultural production within past 10years?<br>1.stable<br>2.a little increase<br>3.constantly increase<br>4.extremely increase |
|---|---|---|---|
| 1.Drought | | | |
| 2.Floods | | | |
| 3.Temperature | | | |
| 4.Storm and other hazards | | | |

5. Agricultural production within past 10years

| Crops | Production within past 10years |
|---|---|
| | 1.don't grow anymore |
| | 2.decrease |
| | 3.unchanged |
| | 4.increase |
| Pigeon pea | |
| Sesame | |
| Peanut | |
| Cotton | |
| Green gram | |
| Cash crop | |
| Abandon crops | 1.Yes<br>2.No |
| Cropping pattern ( 10years ago) | 1. single<br>2. double<br>3. triple |
| Current cropping pattern | 1. single<br>2. double<br>3. triple |

5.1 Overview on adaptation measures in the past 10years

| Events | 5.1.1. Did you apply such changes or measures?<br>1. Yes<br>2. No (if no, skip) | 5.1.2. For how long have you applied these changes? | 5.1.3. The reason why farmers do changes in farming? |
|---|---|---|---|
| 1. Changes of crops (change the seasonal crops to cash crop) | | | |
| 2.Changes of varieties(use of drought-resistant varieties | | | |
| 3.Changes of agricultural practices (shift from transplanting to broadcasting, other fertilizers) | | | |
| 4. Land and water management | | | |
| 5. Others | | | |

Code for 5.1.3

1. Due to water scarcity
2. Resistant to drought or flood
3. Resistant to pests and diseases
4. Market/ better price
5. To increase yield
6. Due to labor scarcity
7. Local information radio/ television
8. Information from DOA, NGO and others
9. As the other farmers are carrying out
10. To decrease input demand (water, fertilizer, seeds)
11. To grow other crops if we have water
12. Others

5.2. Resources needed for adaptation

| Events | 5.2.1. finance needed;<br>1. none<br>2. some, but own resources were sufficient<br>3. a lot, we needed to get additional funds | 5.2.2. Labor support needed;<br>1. no additional<br>2. a little<br>3. a lot, needed additional extra labor | 5.2.3. Institutional support needed;<br>1. no needed<br>2. a little<br>3. a lot | 5.2.4. Why did you not start/ accomplish the change? |
|---|---|---|---|---|
| 1. Changes in agricultural production | | | | |

Code for 5.2.4

1. Lack of money, manpower or other resources (equipment, seeds, etc.)
2. Lack of knowledge about advanced technologies
3. Difficult to make new changes (conservative).
4. We don't have training/ demonstration for it
5. Not sure if there is a market demand (for new crop, livestock varieties, etc.).
6. Not sure if we will succeed.
7. National/local government doesn't allow us to do this.
8. Other_____

6.1. Outcome of adaptation strategies in agricultural production

| Events | 6.1.1 Yield of crops | 6.1.2 Disease/ insects | 6.1.3 Input requirement | 6.1.4 Labor requirement | 6.1.5 Profit of crops |
|---|---|---|---|---|---|
| 1. Changes of crops | | | | | |
| 2. Changes of varieties | | | | | |
| 3. Changes of agricultural practices | | | | | |
| 4. Land and water management | | | | | |

1. Increase
2. The same
3. Decrease