



# Socioeconomic Conditions and Perception of Climate Change in Rice Varietal Selection by Smallholder Farmers in Myanmar

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**Abstract** Rice is an economically, socially, politically, and culturally important crop grown in diverse agro-ecological conditions all over Myanmar. Climate change impacts affect rice production directly and link in farming decisions for cropping systems. As the population keeps growing and climatic variabilities and extreme weather events keep increasing the marginal productivity of land would not be negligible for the food security and sustainable agriculture. This study was conducted to meet the objectives of to overview the socioeconomic characteristics of farmers, find out the serious problems faced by the farmers in rice production, know the most practicing coping strategy to adopt the weather variability and determine farmers' preferred characteristics of rice and perception on climate change in rice variety selection. A sample of 203 rice farmers from Thazi Township were randomly selected and conducted interview. Descriptive analysis and weighted average method were employed. Rice varieties were very diverse and Manawthukha was the most favorite variety. The newly released salt tolerant variety, Pyi Myanmar Sein was adopted by only one percent of respondents. The farmers are quite aware of climate change and they claimed the extreme weather conditions are the most stressful to rice production and they want shorter duration variety in order to make sure the enough soil moisture because majority of them do not have access to irrigation water. Changing rice variety was the most cited coping strategy to climate change adaptation followed by changing crop, changing sowing time, practicing crop rotation, changing cultivation methods and managing fertilizer application. The most preferred trait was high yielding variety followed by high quality, resistance to disease, pests and drought.

**Keywords** climate change, strategy, adaptation, stress, traits, coping strategy

## INTRODUCTION

Myanmar has been experiencing various features of climate change conditions such as frequent and strong storms, floods, late onset of monsoon, early departure of monsoon, lower minimum temperature and higher maximum temperature, erratic rainfall patterns, frequent falls of hales and thunder storms, and sea level rise, etc. According to the long-term climate risk index (CRI) published by Germanwatch, Myanmar stood as the third most affected country in the world on annual average from 1998-2017. Increased intensity of storms has taken a toll on small island states and poor countries since 1997, and over 520,000 people have been killed by more than 11,000 extreme weather events (Burck et al., 2017). Myanmar is the second most vulnerable country revealed by global climate risk index. Extreme weather events have a strong negative impact on economic development of a developing country. Besides, their main economic sector is still agriculture and it is extremely vulnerable to weather variabilities. Furthermore, more than two third of farming society are smallholders and they grow rice in rain fed and/or irrigated lowland area in Myanmar. Therefore,

this study was conducted to learn more about how socioeconomic background of farmers and their perceptions on climate change affect their choice of rice varieties.

## **OBJECTIVE**

The study was conducted to meet the objectives for to overview the socioeconomic characteristics of farmers, find out the serious problems faced by the farmers in rice production, know the most practicing coping strategy to adopt the weather variability and determine farmers' preferred characteristics of rice and perception on climate change in rice variety selection.

## **METHODOLOGY**

### **Description of Study Area**

This study was conducted in Thazi Township located in Meiktila District of Mandalay Division, Myanmar. Thazi Township is situated in North Latitudes 20° 50' and East Longitude 95° 59', and its area is 2,039 km<sup>2</sup>. It is located in Central Dry Zone of Myanmar and has a tropical climate. According to the Department of Population (2014 Census, 2015), its total population was 202,680 - males were 95,463 and females were 107,217. In Thazi Township, about 182,119 (89.9%) of its population live in rural area and about 20,561 (10.1%) live in urban area.

### **Data Collection**

For this study, both quantitative and qualitative data were used. Pilot survey was done in November and main survey was conducted in December 2016. Simple random sampling method was used to collect primary data and 203 sample farmers from 19 villages in Thazi Township were interviewed by using structured interview schedule. Secondary data were collected from the Township Department of Agriculture Office.

### **Methods of Analysis: Descriptive Analysis**

Descriptive analysis was used to describe demographic characteristics of the household such as age, education, family size, farming experience, farm size and agricultural land utilization and to observe the problems faced by the rice farmers.

### **Weighted Average**

Weighted average method was used to investigate farmers' preferences on rice varietal characteristics. Farmers' preferences were categorized into three groups: production characteristics, stress tolerant characteristics and grain quality characteristics. Farmers were requested to score on the given rice varietal traits. If they assumed that the given trait was extremely important or important, the trait was scored as 3 or 2, respectively. If the trait was assumed as not important, it was scored as 1.

$$\text{Weighted Average} = \frac{\text{Sum of Weighted Terms}}{\text{Total Number of Terms}}$$

The score values were calculated by using weighted average method to rank farmers' preferences on rice varietal trait.

## **RESULTS AND DISCUSSION**

### **Socioeconomic Conditions of Farmers**

The demographic characteristics such as age, farming experience, family size, education and farm size the sample farmers are presented in Table 1. In Thazi Township, the average farmer age was 55.6 years, and ranging from 28 to 86 and most farmers are quite old. Agriculture is mainly threatened by climate change and becoming less profitability. Therefore, young people from rural area are not interested in agriculture and moving out of rural areas. That is becoming an important issue for Myanmar Agriculture. The average farming experience was 29.6 years with the range of 2-70 years. Although farmers have many years of farming experience with a lot of knowledge and experience in agriculture, they may rarely adopt new agricultural technologies. The average family size was 5.5, ranging from 1 to 14 family members. In case of education, the average schooling years was 7.3, and ranging from 3 to 16 years. Some farmers were graduated, and thus they can adopt new technologies and can manage their farm very well. The average farm size was 4.1 hectares with a range between 0.4 and 14.9 hectares, respectively.

**Table 1 Demographic characteristic of the respondents in Thazi Township**

Items	Unit	Average	Minimum	Maximum
Age of household's head	Year	55.6	28	86
Farming experience of household's head	Year	29.6	2	70
Family size	No.	5.5	1	14
Education of household's head	Year	7.3	3	16
Farm size	ha	4.1	0.4	14.9
Low land (70.2 %)	ha	3.0	0.4	13.0
Upland (29.2 %)	ha	1.7	0.2	8.1
Orchard (0.6 %)	ha	2.8	2.4	3.1

In Thazi Township, the average farm size of lowland, upland and orchard were 3.0, 1.7 and 2.8 hectares, respectively. Lowland area ranged from 0.4 to 13.0 hectares while upland area ranged from 0.2 to 8.1 hectares. Orchard was the smallest agricultural land area, ranging from 2.4 to 3.1 hectares. Among the agricultural land areas, lowland occupied 70.2%, and rice was the major crop in Thazi Township. Upland growing area was the second largest, and it occupied 29.2%. Orchard was the smallest area and it was only 0.6% of total agricultural land of the respondents.

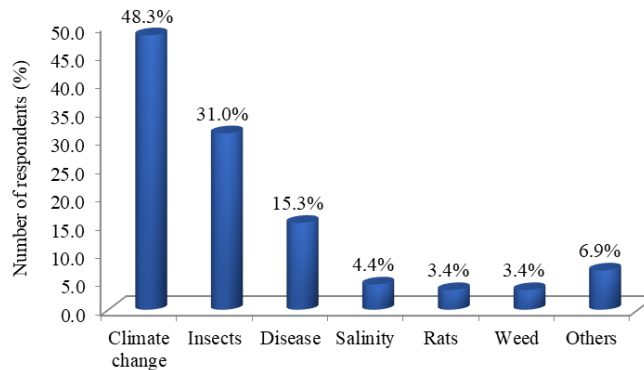
**Table 2 Annual household incomes in Thazi Township (MMK in million)**

Types of Income	N	Average	Minimum	Maximum
Crop Income	203	3.51	0.08	33.70
Livestock income	61	1.68	0.18	6.40
Off-farm income	16	0.84	0.03	4.73
Non-farm income	106	2.36	0.02	8.64
Total annual household income	203	5.32	0.38	38.70

Annual household incomes earned by respondents in Thazi Township are shown in Table 2. Crop income was the main income source for sample farmers. Average crop income was 3.51 million MMK per year for farmers, ranging from 80,000 MMK to 33.7 million MMK per year. Livestock income was earned by 61 respondents, and it amounted to 1.68 million MMK in average per year while maximum and minimum livestock incomes were 0.18 million MMK to 6.4 million MMK per year, respectively. Only 16 respondents had off-farm income, and the average off-farm income was 0.84 million MMK per year. The maximum off-farm income was 4.73 million MMK per year, but the minimum income was only 30,000 MMK per year. Non-farm income was earned by 106 sample households, and the average non-farm income was 2.36 million MMK per year ranging from 20,000 MMK to 8.64 million MMK per year. As a total annual household income, the average annual household income was 5.32 million MMK per year. The minimum and maximum total annual household incomes were 0.38 million MMK and 38.7 million MMK per year.

### Problems Faced by Rice Farmers

As lowland was the largest area, rice was the major crop in Thazi Township. Therefore, stress or problems in rice production faced by the respondents were collected. It was found that six main stresses for rice farmers were climate change, insects, disease, salinity, rats and weeds. According to the opinions of farmers, the largest group of respondents (48.3%) assumed that climate change is one of the biggest stresses for rice production. The second (31%) and third (15.3%) biggest group of farmers said that insects and diseases were major serious problems for rice production. In addition, 4.4% of respondents thought that soil salinity was one of the problems for rice production. Incidence of rats and weed problems were faced by 3.4% of respondents. Moreover, 6.9% of respondents faced other stresses such as scarcity of labor and high price of inputs, especially fertilizer in their rice production (Fig. 1).



**Fig. 1 The stresses in rice crop production in Thazi Township**

### Climate Change Coping Strategies

**Table 3 Adaptation strategies to climate change in Thazi Township**

Response to climate change	Frequency	Percent (%)	Rank
Change varieties	88	41.7	1 <sup>st</sup>
Change crop	57	27.0	2 <sup>nd</sup>
Change sowing time	18	8.5	3 <sup>rd</sup>
Crop rotation	15	7.1	4 <sup>th</sup>
Change cultivation methods	10	4.7	5 <sup>th</sup>
Use fertilizer	10	4.7	5 <sup>th</sup>
Use underground water	4	1.9	6 <sup>th</sup>
Put F.Y.M	4	1.9	6 <sup>th</sup>
Use traditional varieties	3	1.4	7 <sup>th</sup>
Use quality seeds	2	0.9	8 <sup>th</sup>

Since climate change was the major stress according to farmers’ opinion, adaptation strategies of local farmers to climate change were observed. According to the results, changing crop varieties was the strategy used by most of the respondents (41.7%) to combat climate change. It was followed by changing crop as the second rank and used by 27% of respondents. Changing sowing time, practicing crop rotation, changing cultivation methods and using fertilizer were the strategies used by 8.5%, 7.1%, 4.7% and 4.7% of respondents, respectively. Using underground water, putting F.Y.M and using traditional varieties were used by 1.9%, 1.9% and 1.4% of respondents. Using quality seeds was the least strategy used by respondents (0.9%) to adapt to climate change (Table 3).

Farmers’ preferences on production characteristics of rice are shown in Table 4. Majority of farmers preferred the trait of high yielding most. It is clear that a variety to be yielding high is the most important factor for rice growing farmers. Moreover, farmers preferred rice variety trait of high yield with less inputs, and it was ranked as the second. However, few of them think rice variety with that trait is not that important. Rice variety producing high number of tiller ranked as third factor according to farmers’ preferences. Most of farmers assumed that the more the tiller numbers, the higher the rice yields. Resistance to lodging and shorter growing duration were ranked as fourth and

fifth factors, respectively. Heavy rains and floods caused lodging of rice plants causing the yield loss. If the farmers were able to grow lodging resistant variety, they could reduce yield loss. Short duration variety can avoid extreme climatic conditions relative to traditional long duration variety. In addition, farmers preferred shattering resistant variety as the sixth rank. It is clear that shattering leads to both pre-harvest and post-harvest yield losses. Therefore, shattering resistant variety is also important for farmers. High rice straw production was ranked as the last according to farmers' preferences. Farmers mostly used rice straw for cattle feeding. During recent years, cattle have been scarce in the study area, and some of farmers did not prefer to get high rice straw.

**Table 4 Farmers' preferences on production characteristics of rice**

Production characteristics	Extremely important	Important	Not important	Weighted average	Rank
	3	2	1		
High yield	198	4	1	2.97	1 <sup>st</sup>
high yield with less inputs costs	191	7	5	2.92	2 <sup>nd</sup>
High tillering	181	17	5	2.87	3 <sup>rd</sup>
Resistant to lodging	164	29	10	2.76	4 <sup>th</sup>
Shorter growing duration	130	48	25	2.52	5 <sup>th</sup>
Resistant to shattering	115	38	50	2.32	6 <sup>th</sup>
High straw production	82	47	74	2.04	7 <sup>th</sup>

Farmers' preferences on stress tolerant characteristics of rice are presented in Table 5. Majority of farmers preferred pests and diseases resistant varieties, and ranked them as first and second, respectively. Actually, pests and diseases are the main important stresses or problems for farmers, thus farmers preferred pest and disease resistant varieties most. Since the study area is in the dry zone, farmers preferred drought and salinity tolerant varieties as third and fourth ranks, respectively. In addition, some farmers preferred rice variety tolerant to cold injury, and it ranked fifth. Flood or submergence was also one of the stresses for some farmers, and it ranked sixth.

**Table 5 Farmers' Preferences on Stress Tolerant Characteristics of Rice**

Stress tolerant characteristics	Extremely important	Important	Not important	Weighted average	Rank
	3	2	1		
Resistant to pests	184	15	4	2.89	1 <sup>st</sup>
Resistant to diseases	183	14	6	2.87	2 <sup>nd</sup>
Tolerant to drought	173	15	15	2.78	3 <sup>rd</sup>
Tolerant to salinity	76	43	84	1.96	4 <sup>th</sup>
Tolerant to cold injury	81	30	92	1.95	5 <sup>th</sup>
Tolerant to flood/submergence	66	24	113	1.77	6 <sup>th</sup>

### Rice varieties Grown in the Study Area

There were about twenty varieties of rice grown in Thazi Township. The farmers are still growing the local varieties which still suit the weather and soil type. During the survey period, there was no summer paddy cultivation because of no supply of irrigation water from the dams. Therefore, the study included the only monsoon season rain-fed rice. Local cultivars are the primary source for farmers to cope with changing environments. Genetic diversity gives a species or a population that can have the ability to adapt to changing environments (Sthapit et al., 2007). Manaw Thukha was the most popular rice variety among others and mainly grown by nearly half of the respondents (49.8%) (Table 6).

**Table 6 Rice varieties grown in Thazi Township**

No.	Rice Varieties	F	%	No.	Rice Varieties	F	%
1.	Manaw Thukha	101	49.8	12.	Shwe Manaw	2	1.0
2.	90 Days	29	14.3	13.	Thee Htet Yin	2	1.0
3.	Sat Thukha	17	8.4	14.	Byawt Tun	2	1.0
4.	Thukha Tun	16	7.9	15.	Mann Nga Sein	1	0.5
5.	Khun War	6	3.0	16.	Shine Nat	1	0.5
6.	Yezin Thukha	4	2.0	17.	Tun Thiri	1	0.5
7.	Pale Thwe	4	2.0	18.	Taung Htate Pan	1	0.5
8.	Shwe Pyi Htae	4	2.0	19.	Shwe Manaw	1	0.5
9.	100 Days	3	1.5	20.	Yadana Thukha	1	0.5
10.	Shwe Poe	3	1.5	21.	Byawt Thukha	1	0.5
11.	Pyi Myanmar sein	2	1.0	22.	Shwe Thwe Yin	1	0.5

## CONCLUSION

Poverty prone rural dry zone still depends on rice cultivation and it is at the high risk under climate change. Farmers change the rice varieties with shorter days to secure the moisture to get filled grains in rain fed low land area. Nevertheless, they still prefer the high yielding variety most to reap high profit. On the contrary, they are facing problems with so much weather variability resulted in poor yield and profit. That is why more suitable variety for climate change resilient one, 90 Days variety was gradually accepted by many farmers. It is recommended that income diversification is one of the good strategies to combat the climate change impacts that more than half of farmers have non-farm incomes and many of them have income from livestock raising.

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