Assessment on farmers' agricultural practices, uses of organic manure, variety and availability of water in Madaya township, Myanmar

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Abstract

To investigate the farmers' currently used varieties, water management and uses of organic manures, and to evaluate the farmers' perception on climate change, the study was conducted in three village tracts in Madaya township, Mandalay region in January 2017. Purposive random sampling method was used to select 63 respondents from the study area and both qualitative and quantitative data were collected using a structured questionnaire. Most of the farmers (49.2%) in this study are middle aged. The majorities of the farmers are middle-scale farmers (96.8%). The respondents (50.8%) are well-experienced in farming and the most farming experiences are 25-40 years. Almost all of the farmers (92.1%) are male household head. Most farmers in the study area finished their educations in the primary (36.5%) and middle (33.3%) schools. With being of the irrigated village tract, there were found most easy for irrigation (87.3%). Therefore, most farmers practices continuous flooding (44.4%). But some farmers (12.7%) have the difficulties about irrigation because their fields were in tail end of canal (25.4%). The constraints are that the water is not available when necessary (39.7%) and sometimes they experienced the flooding (6.3%). In the study area, there were found scarcity of organic manure for soil amendment in their fields (87.3%). For the farmers' perception on climate change awareness upon the agricultural practices, the farmers noticed the climate change not only on their environment but also on their agricultural practices. However, according to statistical results, they can be supposed that they have no experience about the causes of climate change and agricultural practices are one of the anthropogenic activities for climate change.

Key words: rice variety, irrigation water, organic manure, perception on climate change

Introduction

In 2011-2012, Myanmar's rice area was 7.59 million hectares and total production was 29.01 million metric tons (MOAI 2015). Although one fourth of total area of the country is cultivable land, presently there are only about 20 million acres of net sown area in Myanmar. Most of Agricultural lands are currently cultivated by small scale farmers. The average size of holdings is 5.6 acres and most of the farmers in Myanmar owns lands from 5 acres to 10 acres (MOAI 2004).

In South Asia, 75% of farmers are smallholders (*APAARI and IFPRI 2013)*. It is important to acknowledge that increasing smallholder productivity not only improves smallholders' food security but also global food security because they produce such a large share of developing countries' food supplies. Its importance for global food security is expected to rise because of a growing world population (*HLPE 2013).* The massive agricultural research and technology transfer effort of the 1960s and 1970s, often referred to as the 'green revolution', led to dramatic increases in agricultural productivity. Smallholders in developing countries, especially in Asia and Latin America, benefited substantially from these advances in agricultural research as well as from strong extension services (*Ellis 2005).* However, many of these production gains resulted in environmental degradation (*IFAD 2013).* Not only does food production need to increase substantially in order to meet future demand, but with climate change, there is considerable concern that we may even struggle to sustain current food production levels. Therefore, agricultural productivity needs to rise both to meet new demand and to offset expected climate-related yield losses in some regions (*GAFSP 2009).*

As global warming is being felt all over the world, Myanmar also suffers from the adverse effects of climate change such as scarcity of rainfall, irregular rainfall, heat stress, drought, flooding, sea water intrusion, land degradation, desertification, deforestation and other natural disasters (MOAI 2015). By 2030, Myanmar aims, achieve food security and nutrition and climate resiliency, with a globally competitive agriculture sector attaining high productivity through climate-smart good agricultural practices (GAP) resulting in higher standard of living especially in the rural areas. Feeding the country's population in the context of climate change will require gradual and significant expansion of agricultural products. Adopting agricultural practices that are able to withstand changes in climate and contribute to the reduction of GHG emissions require the application of new technologies, modification of existing ones, and revision of relevant laws and policies. Therefore, the development of a Climate smart agriculture (CSA) strategy is indispensable in boosting agriculture and food security in Myanmar (MOAI 2015).

The objective of this study is to investigate the farmers' currently used varieties, water management and uses of organic manures, and to evaluate the farmers' perception on climate change.

Research Methodology

Description of study area

Madaya is situated at 22° 13' 0" N and 96° 7' 0" E. The total area is 1098 km^2. The rural area is 233767 km^2 (90.6 %) and the urban is 24237 km^2 (9.4 %). The population is 258001 and the population density is 235.0 per km^2. Over hundreds and twenty two thousand (122879=47.6 %) out of total population is male population and 135122 (52.4 %) is female population (Online Wikipedia). There are eighty eight village tracts with total of 285 villages. The allocated land area of Madaya township is shown in Table 1. There are 98669 acres of dry and wet land areas occupying 43502 acres of summer rice areas and 55167 acres of monsoon rice areas. Irrigated areas are 42225 acres and favorable area 1277 acres in summer season. Irrigated areas are 42917 acres, favorable area 10708 acres and rainfed areas are 1542 acres in rainy season. Seven rice varieties (IR 50, 90-day, 110-day, Pyi Taw Yin, Manawthukha, Ayeyarmin and Thuhtaygyi) are cultivated. Out of them IR 50 is cultivated for 3500 acres (6.3 %) of rainy season and 35902 acres (82.5 %) of summer season (DOA Madaya 2016). Irrigation water was mainly from Si Taw Kyi Dam, Madaya. The total serviceable area of Si Taw Kyi Dam is shown in Table 2.

Data collection

This study was conducted in January 2017. Purposive random sampling technique was used. The highest rice producers according to data from Department of Agriculture (DOA), Madaya were selected for the questionnaire survey. Three village tracts (Tha Min Twin, Si Taing Kan and Kan Lal Khon) were chosen according to their irrigation water availabilities and large rice production of DOA, Madaya also. The sample size from each village tract was 21 respondents and therefore a total of 63 summer and rainy seasons rice producers. Demographic data, socio-economic data, availability of irrigation water, uses of organic manures, rice varieties, constrains of farmers related to them and farmers' awareness to climate change were prepared in the structured questionnaire. Secondary data were recorded from Department of Agriculture, Head office, Madaya township. Data analyses were done by using SPSS (Version 22.0).

Results and Discussion

Socio-demographic factors of the respondents in the study area

In this study, the minimum age of respondents is 27 and maximum age is 78. The mean age of the respondents was 51.5 years. The majority (49.2%) of the respondents were between the ages of 45 to 61 years. This was followed by 31.8 % of them whose ages ranged from 27 to 44 years, 19.0% were between the ages of 62-78 years. This implies that majority of the respondents were within the middle ages and hence they could engage actively in rice production and innovative in perception of new technology and methods (Table 3).

The total farm size varied from 4 to 200 ac, with a mean value of 15.4 ac. 61 (96.8%) of the farmers was within 4-69 ac group. But these respondents owned only less than 31 ac, herein 27 respondents owned between 4-10 ac and 32 respondents between 11-19 ac and only two respondents owned 21 ac and 30 ac respectively. Whereas only one respondent (1.6%) owned 200 ac and another one (1.6%) owned 85 ac. According to result, most of the farmers could be characterized as medium scale farmers in the study area (Table 3).

The minimum farming experiences was 9 years and the maximum was 56 years. The average farming experience was 30.6 years. The majorities (50.8%) of respondents were in the range of 25-40 farming experiences. 31.8 % of respondents have the farming experiences from 9-24 years. The rest 11 (17.4 %) of respondents have the farming experience of 41-56 years (Table 3).

Among the respondents, male respondents were 92.1 % and females were 7.9 %. It was observed that large proportions were male household heads and they managed the farming operation (Table 3).

Education level

Education is important to accept the new technology and practices and to percept the innovative and the good agricultural practices. Education level can improve the social and living status of population. Educated person can get many experiences and knowledge through books and papers. Therefore literacy is important for national development and well beings. Education can be fulfilled through monastery, primary school (1-5 years), middle school (6-9 years), high school (10-11 years) and university (graduate) (14 years).

Most of respondents who completed primary education were 36.5 % and followed by middle education level group (33.3 %) of the respondents. 8 (12.7 %) out of total respondents finished the high school. In the study area, some (11.1 %) of respondents finished their education in Monastery. Only 6.4 % of the respondents are graduated (Table 4).

Availability of Irrigation Water

The study area was in Madaya township and most of farms were irrigated because there was Si Taw Kyi Dam and it can deliver the irrigated water for farming. In the availability of water for irrigation, 55 respondents (87.3 %) out of total 63 gave the answer for easy irrigation whereas only 8 (12.7 %) of respondents said that difficult condition for irrigation. Because farms of some (25.4 %) of respondents was in the tail end of canal. But farms of most (50.8 %) of the respondents are close to canal, in the other hand, in the upstream of canal. Farms of 23.8 % of respondents were in the downstream to canal. Most of the water for farming in the study area came from dam (98.4 %) and only 1.6 % got the water for farming by pumping from stream (Table 5).

For times of irrigation, most (38.1 %) of farmers irrigated 14-25 times per crop season. Similarly 36.5 % respondents preferred to keep the standing water in their fields so they irrigated more than 25 times per crop season. In decision for irrigation, the majorities (49.2 %) of farmers irrigated their crops when the soil dried or run out of water and 44.4 % farmers always keep their fields with standing water whereas only 6.4 % farmers irrigated depending on the plant growth (Table 5).

About the irrigation water for farming in the study area, there were no constraints for 54.0 % respondents. But some farmers (39.7 %) gave the constraint about irrigation water that is they can't get the water when necessary. However, 6.3 % farmers replied that sometimes their fields experience flooding (Table 5).

Uses of Organic Manures and Rice Varieties

In the study area, there are three crops seasons in one year (summer rice, rainy rice and winter food legumes). So the soil didn't get the rest besides most of farmers didn't incorporate the stubble in the fields because of time limited condition for stubble decomposition. In recent time, the agriculture led to sustainable. In this aspect, organic manure plays the vital role not only for food safety but also for sustainable management. On the other hand, the manure gives rise to global greenhouse gases emission from agricultural soil. Therefore the farmers were asked for their organic manure uses in their fields for soil amendment. There were 57.1 % of respondents who used manure in their fields. About half of respondents (42.9%) didn't use manure in their fields. For respondents who use manure in their fields, they were asked for types of organic manures. In this study, stubble was one type of organic manure because farmers in this area burned the stubble for limited time of decomposition. Some respondents gave more than one answer. Most (80.6%) of the respondents used cowdung manure for their field amendment. 25% respondents used back the stubble in their fields. Other residues (dried leaves, rubbish, rice hull ash, goat manure) were used only for 19.4% respondents. Again farmers who used cowdung manure were asked the amount of cowdung manure. In this case, this character was categoried two type; one is equal and below of recommended cowdung manure (5t ha^{-1} or 4 carts ac^{-1}) and the another is greater than the recommended amount (>5t ha^{-1} or 4 carts ac^{-1}). In total cowdung manure used farmers, 79.3% farmers applied less than 4 carts ac^{-1} and only 20.7% farmers used more than 4 carts ac^{-1}) (Table 6).

There were so many constraints for organic manure amendment in the study area. The main constraint was that organic manures were not available enough because this area was reformed to mechanized farming and they didn't give time for the soil amendment. Some farmers (28.6%) didn't apply any manure because of difficult land preparation. Some (15.9%) farmers said that because of high cost of organic manure in their area. 7.9% farmers replied they didn't use manure because they kept the farmyarn manure for feed of cattle. Only 3.2% farmers stated soil problem (weeds and disease incidence of organic manure adding) (Table 6).

Rice varieties (Ayeyarmin, IR 50, Manawthukha, Basmati, 90 day variety) were grown in the study area. In summer season, only IR 50 (89.2%) and 90 day variety (10.8%) were grown. In rainy season, Ayeyarmin (51.7%), IR 50 (33.9%), Manawthukha (7.4%), Basmati (1.7%) and 90 day variety (5.3%) were grown in this study area (Table 7).

About the constraint for availabilities of seed, there were no constraints for 47.6% farmers. But some farmers (30.2%) had the constraint for not purities of seed. Other (22.2%) farmers said that they couldn't get the enough seed for their cultivation (Table 7).

Farmers' awareness on climate change

The level of awareness was stated as the degree to which the farmers had information on climate change and agricultural practices related to climate change. There was different awareness of people to the adverse impact of climate change among the respondents in the study area. The strongly agree on too high temperature and decrease raining day was described by 52.3% and 41.3%. The highest percentage on dry period is longer, suffered from drought, induced little cool, induced too cool, too little rainfall and too much rainfall was described in the decreasing order (50.8%, 47.6, 47.6, 44.4, 46.0, and 38.1, respectively). The awareness on flood incidence was described as highest percentage of disagree (31.8%) among the respondents in this study area (Table 8).

Agriculture is one of the most vulnerable sectors to the climate change as this primary production activity is highly linked with the natural resources and the environment. The effect of climate change on agriculture is due to three major impacts, namely temperature rise, rainfall variation and carbon fertilization effects (Herath and Dharmakeerthi 2010). The effects of climate change on local environment, socio-economic condition and agricultural production was surveyed in this study. The information of farmers' awareness on effect of climate change on local environment, socio-economic condition and agricultural production was described in Table 4.9. Most of the respondents described the agreement on effect of local environment, socio-economic condition, decrease agricultural production, increase incidence of pest, disease and weeds by 46.0%, 42.9%, 49.2%, 44.4%, 41.3% and 38.1, respectively. Agricultural production disturbed due to climate change was supported by strongly agreement (50.8%) among the respondents (Table 9).

Climate change was caused by natural and anthropogenic activities. Agriculture is one of the anthropogenic activities for releasing greenhouse gases to atmosphere. Therefore, the awareness of respondents on agricultural practices induced climate change was studied. Unfortunately, most of the respondents didn't notice the information about agricultural practices induced climate change although they aware the effect of agricultural practices to climate change by 41.3% in this study area. So undecided answers were recorded on two or three days puddling duration induced methane, continuous flooding induced methane, un-decomposed cowdung induced methane, using urea induced nitrous oxide and

methane, and rice-rice cultivation induced climate change by 85.7%, 84.1%, 76.2%, 65.1% and 47.6%, respectively. But they agreed that burning of rice straw produced carbon dioxide and nitrous oxide by 52.4% and mismanagement of cultural practices induced climate change by 66.7% (Table 10).

Mean awareness score were classified as above 2 and below 2. Mean score above 2 revealed the awareness of respondents on the climate change induce agricultural practices. Most of the scores were observed above 2 in this study (Table 8, 9, 10). These results implied that the respondents aware of the climate change induced agricultural practices.

Conclusion

The survey was conducted in the four villages within three village tracts. The average population is about 800 in each village. The main economy in these villages is farming. Most of the farmers (49.2%) in this study are middle aged. So they are active to learn and to observe the new methods and technology. This study was conducted depending on the irrigation capacity and large farming area. However, according to the farm size in the survey, the majorities of the farmers are middle-scale farmers and they can't afford the inputs shown on organic manure uses. The respondents (50.8%) are well-experienced in farming and the most farming experiences are 25-40 years because the farming is their professional heritage. It was observed that almost all of the farmers are male household head. However, most farmers in the study area finished their educations in the primary and middle school. With being of the irrigated village tract, there were found most easy for irrigation. Therefore, most farmers practices continuous flooding and they believe the rice plant can give good yield with standing water. But some farmers (12.7%) have the difficulties about irrigation because their fields were in tail end of canal. Their constraints are that the water is not available when necessary and sometimes they experienced the flooding. According to results, it can be suggested to construct the new canal and control the water hole, and to repair and clean the old canal for good water flowing. In the study area, there were found scarcity of organic manure for soil amendment in their fields. Besides, this area was mechanized for farming. As a result, in some farmers there are no cattle and no manure. Furthermost, as mentioned above, these farmers can't afford to put the manure in their fields. Therefore, it can be needed that extension workers should train the farmers in compost making of available materials for their sustainable soil amendment.

For the farmers' perception on climate change awareness upon the agricultural practices, some questionnaires were prepared and asked. The farmers noticed the climate change not only on their environment but also on their agricultural practices. However, according to statistical results, they can be supposed that they have no experience about the causes of climate change and agricultural practices are one of the anthropogenic activities for climate change. Therefore, it can be concluded that there need the agricultural extension services and works in the study area.

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Table 1: Agricultural land allocation in Madaya township

No.	**Item**	**Land area (acre)**
1	Agricultural Land	134823
	Lowland	53421
	Upland	32916
	Kai/Kyung	45283
	Horticultural Land	3203
2	Unable to cultivate	102519
3	Fallow land	12
4	Wild land	15021
5	Wood land	38812
	Total	291187

Source: DOA, Madaya, 2016

Table 2: Total serviceable area of Si Taw Kyi dam in Mandalay Region

No.	Township	Acre
1	Madaya	57364
2	Mandalay	165
3	Patheingyi	27097
4	Amarapura	12263
	Total	96889

Sources: 'Irrigation Department, Madaya Township (2009)

Table 3: Socio-demographic factors of the respondents in the study area

	Items	Frequency	Percentage
Age (yrs)	27-44	20	31.8
	45-61	31	49.2
	62-78	12	19.0
	Mean	51.5	
Farm size (ac)	4-69	61	96.8
	70-134	1	1.6
	135-200	1	1.6
	Mean	15.4	
Farming experiences (yrs.)	9-24	20	31.8
	25-40	32	50.8
	41-56	11	17.4
	Mean	30.6	
Gender (%)	Male	58	92.1
	Female	5	7.9

n=63

Table 4: Education status of respondents in the study area

No.	Education Status	Frequency	Percentage
1	Monastery	7	11.1
2	Primary school	23	36.5
3	Middle school	21	33.3
4	High school	8	12.7
5	Graduate	4	6.4

n=63

Table 5: Availability of Irrigation water of Respondents in the study area

	Items	Frequency	Percentage
Availability of water	Easy	55	87.3
	Difficult	8	12.7
Nearness to water source	Upstream	32	50.8
	Downstream	15	23.8
	Tail end	16	25.4
Water supply	Dam	62	98.4
	Pump	1	1.6
Times of irrigation	2-13	16	25.4
	14-25	24	38.1
	>25 (Continuous)	23	36.5
Decision for irrigation	Soil dry	31	49.2
	Depend on growth	4	6.4
	Continuous	28	44.4
Constraints	Nil	34	54.0
	Not available when necessary	25	39.7
	Flooding	4	6.3

n=63

Table 6: Uses of Organic Manures of Respondents in the study area

	Items	Frequency	Percentage
Use of organic manure	Yes	36	57.1
	No	27	42.9
Types of organic manure	Stubble	9	25
	Cowdung	29	80.6
	Other residue	7	19.4
Amount of cowdung manure	≤ 4 carts/ac	23	79.3
	> 4 carts/ac	6	20.7
Constraints	Not available	55	87.3
	Difficult land preparation	18	28.6
	Feed for cattle	5	7.9
	High cost	10	15.9
	Soil problem	2	3.2

n=63
Note: Total numbers of farmers are more than 63 because one farmer gives more than one answer.

Table 7: Uses of Rice varieties of Respondents in the study area

	Items	Frequency	Percentage	
			Summer season	Rainy season
Rice varieties	Ayeyarmin		-	51.7 %
	IR 50		89.2 %	33.9 %
	Manawthukha		-	7.4 %
	Basmati		-	1.7 %
	90 day variety		10.8 %	5.3 %
Constraints	Nil	30	47.6 %	
	Not pure	19	30.2 %	
	Not enough	14	22.2%	

n=63

Table 8: Farmers' awareness of climate change in the study area

No.	Statement	SD		D		U		A		SA		Mean Score
		No.	%	No.	%	No.	%	No.	%	No.	%	
1	Some places had too high temperature	0	0	3	4.8	0	0	27	42.9	33	52.3	4.43
2	Some places had decrease raining day	1	1.6	13	20.6	3	4.8	20	31.7	26	41.3	3.90
3	In some places, dry period is longer	1	1.6	6	9.5	1	1.6	32	50.8	23	36.5	4.11
4	Some places are suffered from drought	0	0	8	12.7	2	3.2	30	47.6	23	36.5	4.08
5	Some places of winter season induced little cool	1	1.6	16	25.4	0	0	30	47.6	16	25.4	3.70
6	Some places of winter season induced too cool	1	1.6	14	22.2	1	1.6	28	44.4	19	30.2	3.79
7	Some places had too little rainfall	1	1.6	13	20.6	2	3.2	29	46.0	18	28.6	3.79
8	Some places had too much rainfall	1	1.6	15	23.8	1	1.6	24	38.1	22	34.9	3.81
9	In some places , flood is in incidence	14	22.2	20	31.8	12	19.0	13	20.6	4	6.4	2.57

SD= Strongly Disagree, D= Disagree, U= Undecided, A= Agree, SA= Strongly Agree

Table 9: Farmers' awareness of climate change on local environment, socio-economic condition and agricultural production

No.	Statement	SD		D		U		A		SA		Mean Score
		No.	%	No.	%	No.	%	No.	%	No.	%	
1	Climate change affects on local environment	2	3.2	8	12.7	2	3.2	29	46.0	22	34.9	3.97
2	Climate change affects on socio-economic condition	1	1.6	8	12.7	2	3.2	27	42.9	25	39.7	4.06
3	Agricultural production was disturbed	0	0	10	15.9	2	3.2	19	30.2	32	50.8	4.16
4	Decrease agricultural production	1	1.6	9	14.3	0	0	31	49.2	22	34.9	4.02
5	Increase incidence of pest	2	3.2	11	17.5	0	0	28	44.4	22	34.9	3.90
6	Increase incidence of disease	1	1.6	14	22.2	1	1.6	26	41.3	21	33.3	3.83
7	Weed infestation	1	1.6	23	36.5	1	1.6	24	38.1	14	22.2	3.43

SD= Strongly Disagree, D= Disagree, U= Undecided, A= Agree, SA= Strongly Agree

Table 10: Farmers' awareness on climate change related to agricultural practices

No.	Statement	SD		D		U		A		SA		Mean Score
		No.	%	No.	%	No.	%	No.	%	No.	%	
1	Climate change is related to agriculture	3	4.8	6	9.5	8	12.7	26	41.3	20	31.7	3.86
2	Two or three days puddling duration induced methane	1	1.6	3	4.8	54	85.7	5	7.9	0	0	3.00
3	Continuous flooding of paddy field induced methane	1	1.6	2	1.6	53	84.1	7	11.1	0	0	3.05
4	Un-decomposed cowdung induced methane	0	0	0	0	48	76.2	13	20.6	2	3.2	3.27
5	Using urea induced nitrous oxide and methane	0	0	1	1.6	41	65.1	18	28.6	3	4.8	3.37
6	Burning of rice straw produced carbon dioxide and nitrous oxide	0	0	1	1.6	26	41.3	33	52.4	3	4.8	3.60
7	Rice-rice cultivation induced climate change	6	9.5	11	17.4	30	47.6	14	22.2	2	3.2	2.92
8	Mismanagement of cultural practices induced climate change	2	3.2	7	11.1	9	14.3	42	66.7	3	4.8	3.58

SD= Strongly Disagree, D= Disagree, U= Undecided, A= Agree, SA= Strongly Agree