IMPACT OF CLIMATE CHANGE ON CROP PRODUCTION IN CENTRAL DRY ZONE, MYANMAR: A CASE STUDY IN PHAUK-SEIK- PIN VILLAGE, NYAUNG-U TOWNSHIP, MANDALAY REGION

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Abstract

In these days, precipitation under monsoonal influence is more and more erratic and annual precipitation in central zone is very often fluctuating. Under many uncertainties of climate change scenarios, farmers' traditional farming practices must have some adaptation technologies to combat the harsh climate for several decades. Field surveys were conducted at Phauk-Seik- Pin village, Nyaung-U Township during the crop seasons from 2008 to 2010. To reduce the risk of crop failure, most farmers in the study village followed mix cropping patterns rather than mono-crop under the single or double cropping. Sesame, groundnut and pulses are the most common crops and farmers grow them in all three seasons of a year, namely, pre-monsoon, monsoon and post-monsoon. Among the last three years, the year 2009 designated as El Nino year, received the least annual rainfall while heavy rainfall occurred in 2010 because of the Cyclone Giri. The survey results clearly showed that insufficient rains reduced the sown acreage in all seasons while the heavy and untimely rains damaged the cultivated crops in the study village.

Key Words : Impact, dought, treaditional practice, decline

Introduction

Despite the many great technological advances in agriculture, weather and climate are still key factors in determining agricultural productivity in most areas of the world. Agriculture is one of the most vulnerable sectors affected by climate change. Climate change related phenomena include unusual fluctuations in rainfall patterns and temperatures, as well as their associated impacts on water availability, pests, disease, and extreme weather events, all of which can substantially affect the potential of agricultural prouction. The Myanmar Dry Zone has the characteristics of very low (annual rainfall of 500-700 mm) and erratic rainfall over time and space, shallow soils with low fertility and low moisture holding capacity. Generally, soils in the dry zone areas are being degraded mainly due to its topography and severe weather condition. The local farmers have long experiences of crop production under the unfavorable conditions. Their traditional farming activities must have in someway the adaptation technologies to their specific environment. Over several decades, with trials and errors, they have selected crops, crop varieties and cropping patterns which give a better yield. Location specific research is lacking in the dry zone areas and research on area study of farmers' existing crop production under the climate change scenario needs to be carried out before venturing into a new or additional crop sequences or a farming technology for the improvement of their farming systems. Therefore, a field station area study was carried out with the objectives of study on the existing cropping patterns and impact of climate change on crop production in dry zone area.

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Methodology

Phauk-Seik- Pin village, Nyaung-U Township, Mandalay Region was selected as a field station under the research project of the "Integrated Study on Sustainable Agriculture and Rural Development towards Research and Education". As a part of this research study, farmers' surveys and field observations on their cropping patterns and livelihood were conducted during the cropping seasons from 2008 to 2010. The primary data were collected from all farmers household in the study village (109 in total) and secondary data were gathered from the Myanmar Agriculture Service and Settlement and Land Records Department (Ministry of Agriculture and Irrigation) in Nyaung-u Township.

Survey Research Finding

The study village, Phyauk-Seik-Pin, is located in Kone-Tan-Gyi village tract which constitutes 7 villages. The demographic data, land type and land holding size, and type of houses were shown in Table 1, Table 2 and Table 3, respectively. Most of the lands are Yar type (upland) and upland crops such as sesame, groundnut, mungbean and pigeon pea are mostly cultivated. Farmers' interviews and farm equipments and livestock holdings showed that traditional ploughs and harrows were the main farm implements together with the cattle draught power used for their farming operations. For the extra income, goats and pigs were reared as a livestock breeding (Table 4). Some farmers use only organic manure of cow dung and of excreta of goats and pigs while some applied them with a few amount of chemical fertilizers. Fuel wood and water were scarce items and household and drinking water relies on the river pumping project started in 2002 (Photo 1 and 2).

The largest areas of oil seed crops (sesame, groundnut and sunflower), pulses and cotton concentrate in the central dry zone. Since the scarce and erratic rainfalls with low soil fertility enhance the risk of crop failure, farmers generally adopt different cropping patterns on a plot by plot basis to secure a reliable income. Crop yields vary year from year and plot from plot mainly depending on the rainfall and soil condition. Farmers grow mono-crop in pre-monsoon (April / May), monsoon (July / August) and / or late monsoon (September / October) seasons. Besides, multiple copping patterns (mix cropping, double cropping, relay cropping and crop rotation) are traditionally practiced with the objectives of reducing the crop losses and retaining soil fertility. Many farmers broadcast the seeds of two or more crops together at a same plot and harvest them according to their duration. The risk-averse farmers concept is that they invest the least and they will collect whatever left after the stresses. The low yields of crops generally reflect low levels of inputs and management.

Table 1. Demographic data on Phyauk -Seik-Pin village

Item	Male	Female	Total	Percentage of total population
Population	727	784	1511	
Family labor	199	196	395	26.14
Over 15 age	506	574	1080	71.48
Under 15 age	209	206	415	27.47
Schooling	119	116	235	15.55

	Farmers	Landless	Total
Number of households	109	176	285
Average landholding size (acre)	21.73		

Table 2. Type of land and landholding size

Land type	Acres	Hectare	%
Low land (le)	4	1.62	0.33
Upland (ya)	1191	481.99	99.67
Landholding	**Frequency**		**%**
Less than 5 ac.	26	10.52	23.85
5 to 10 ac.	42	17	38.53
Above 10 ac.	41	16.59	37.61

The dry zone region has a bimodal pattern of monsoon season with an interruption during July, which is locally known as July drought. Average annual rainfall from 2000 to 2010 was presented in Figure 1. It was noticed that July drought became more and more intense with longer durations since the last decade. About 10 -15 years ago, sesame were grown in April / May as a pre-monsoon crop, which is called "Moe-kyo-hnan" in Myanmar language. However, the farmers faced the increased frequency of crop failures due to the scarce rainfall. For the fear of the July drought, farmers changed the growing time of sesame to the late July / August. At present, most farmers grow their crops when the rain comes after the July drought as a monsoon crop (which is called "Moe-hnan") and in September/ October as a post-monsoon season crop (which is called "Saung-hnan"). As a traditional practice, land preparations are started after the previous crop's harvest and continued for a long period while waiting for the sufficient amount of rain. It creates to expose the bare soils susceptible to wind and water erosion at the time of high wind and rain velocity (July and August). The most widely grown crops and the crop calendar were shown in Table 5.

Table 3. Type of houses

	Roof	Wall	Floor
Zinc sheet	102		
Thetkal	4		
Wood		15	
Bamboo	70	225	
Brick		37	
Toddy palm leaf	108	7	
Total	284	284	279

Table 4. Farm equipments and livestock holdings

Farm machineries			Livestock holdings		
No.	Items	Frequency	No.	Items	Frequency
1	Bullock cart	120	1	Bullock	81
2	Plough	31	2	Buffalo	1
3	Harrow	239	3	Goat	20
4	Pump	7	4	Fowl	10
5	Sprayer	7	5	Pig	15

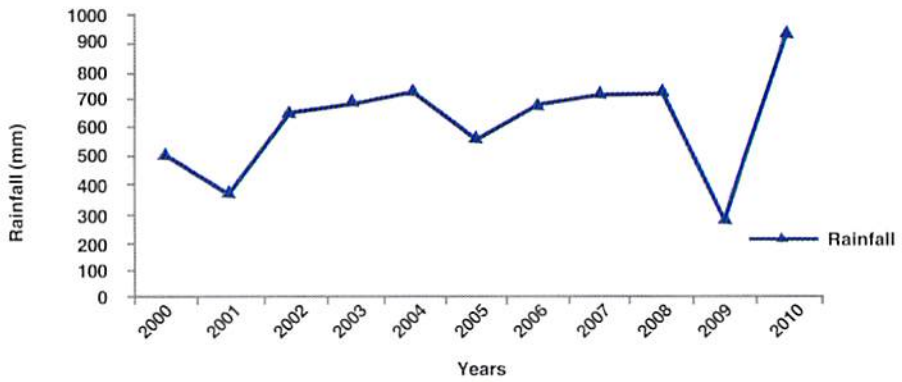

Figure 1. Average annual rainfall in Nyaung-U Township

Source : Weather Station at Nyaung-U Agricultural Research Farm

Table 5. Crop calendar in Phyauk-Seik-Pin Village

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Groundnut												
Mungbean												
Sesame												
Sorghum												
Watermelon												
Pigeon pea												

The annual rainfall patterns in three successive years (from 2008 to 2010) in Nyaung-U Township were described in Figure 2. The annual total rainfall was 723.39 mm, 272.29 mm and 926.34 mm in 2008, 2009 and 2010, respectively. Crop failures of sesame, groundnut, mungbean and sorghum in Phyauk-seik-pin village were recorded in November, 2009 and in July, 2010 (Photo 3 and 4). The impact of drought on sesame cultivation was most severe in 2009 since it received the least rainfall among three successive years. The sesame sown areas in monsoon season were 3.64 ha in 2008 and 1.62 ha in 2009 but there was no monsoon cultivation of sesame in 2010 because of the very few rainfalls in July and August, 2010. Moreover, some villages of the Kone -tan-gyi village tract could not grow sesame in monsoon and post-monsoon in 2009 and monsoon in 2010. The post-monsoon sesame areas were also declining with 111.29 ha, 22.26 ha and 27.11ha in 2008, 2009 and 2010, respectively (Table 6).

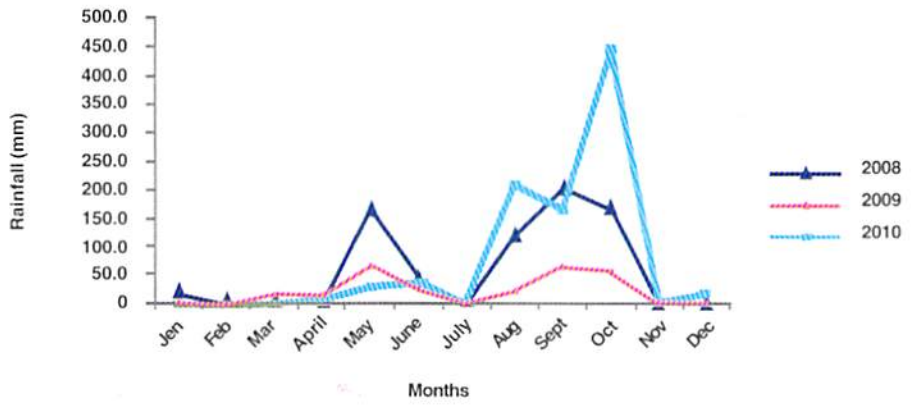

Figure 2. The annual rainfall patterns in three successive years in Nyaung-U Township

Source : Weather Station at Nyaung-U Agricultural Research Farm

Table 6. Sesame cultivation from 2008 to 2010 at Kon-Tan-Gyi Village tract, Nyaung-U Township

Village	Sesame Sown Area (ha)					
	2008		2009		2010	
	Monsoon	Post-M	Monsoon	Post-M	Monsoon	Post-M
Kone-Pha-Yar	0.81	55.04	0.00	0.00	0.00	29.95
Phyauk-Seik-Pin	3.64	111.29	1.62	22.26	0.00	27.11
Kone-Sin-Kye	0.00	2.02	0.00	0.00	0.81	3.64
Taung-Shay	7.69	141.24	0.00	10.12	0.00	44.92
Mya-Kan-Gyi (North)	10.52	22.26	12.95	0.00	4.05	11.33
Mya-Kan-Gyi (South)	18.21	27.11	4.86	0.00	1.62	11.74
Kone-Tan-Gyi	24.28	144.88	6.88	0.00	3.24	14.97
Total	**65.16**	**503.84**	**26.31**	**32.38**	**9.71**	**143.67**

In the pre-monsoon season 2010, there were only few rains in April/ May so that groundnut and mungbean were sown in all villages but only some villages grew a few sesame areas. The cultivated areas and damaged areas of sesame by drought in pre-monson, 2010 were shown in Table 7. In the Kon-tan-gyi village tract, groundnut, mungbean and sorghum were grown in monsoon, and sesame and sorghum were in post-monsoon in 2010 (Table 8).

Table 7. Area of cultivation and damage by drought in Kon-Tan-Gyi Village tract in pre-monsoon season, 2010

Village	Groundnut (ha)		Sesame (ha)		Mungbean (ha)	
	Cultivation	Damage	Cultivation	Damage	Cultivation	Damage
Kone-Pha-Yar	17.81	10.12			12.95	4.05
Pyyauk-Seik-Pin	44.92	20.23			41.28	18.21
Kone-Sin-Kye	14.16	6.07	0.81	0.81	10.52	5.26
Taung-Shay	102.79	50.59			79.32	39.66
Mya-Kan-Gyi (North)	20.23	8.09	4.05	4.05	14.16	4.86
Mya-Kan-Gyi (South)	22.66	12.14	1.62	1.62	14.97	5.67
Kone-Tan-Gyi	51.40	28.33	3.24	3.24	54.63	26.31
Total	**273.98**	**135.57**	**9.71**	**9.71**	**227.84**	**104.01**

Source : Settlement and Land Records Department, MOAI (21-7-2010)

Table 8. Sown area of crop in Kon-Tan-Gyi Village tract in monsoon and post-monsoon seasons, 2010

Village	Monsoon			Post-monsoon	
	Groundnut	Mungbean	Sorghum	Sesame	Sorghum
Kone-Pha-Yar	9.31	73.25	9.71	29.95	
Pyauk-Seik-Pin	16.59	53.01	9.31	27.11	1.62
Kone-Sin-Kye	0.81	8.90	3.24	3.64	0.00
Taung-Shay	44.52	66.77	13.76	44.92	4.86
Mya-Kan-Gyi (North)	24.69	24.28	14.16	11.33	0.00
Mya-Kan-Gyi (South)	16.59	19.02	7.69	11.74	2.02
Kone-Tan-Gyi	28.33	41.68	14.57	14.97	2.02
Total	**140.83**	**286.93**	**72.44**	**143.67**	**10.52**

Source : Settlement and Land Records Department, MOAI

In October 2010, the Giri Cyclone hit Myanmar in Yakhaine State, Magway, Mandalay and Sagaing Regions. The continuous and heavy rain occurred for about 2 weeks and amounted to 448.6 mm in this month in Nyaung-U Township (Source: weather station at Nyaung-u Agricultural Research Farm). According to the farmers' survey on 18th January 2011, it was noted that the sesame crops were severely damaged but the groundnut and sorghum gave a very good yield. It was because the cyclone-rains favored the pod formation of groundnut and growth of sorghum (Data unpublished). Sown area of groundnut and sesame in pre-monsoon, monsoon and post-monsoon in five successive years (2006 to 2010) were described in Figure 3. The sharp area decline post-monsoon sesame areas occurred up to 2010 while the other three crops are stable with the low sown crop area in general.

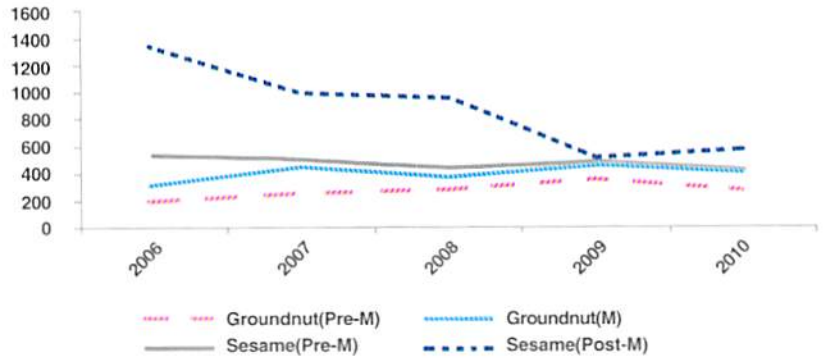

Figure 3. Sown area of groundnut and sesame in Kone-Tan-Gyi Village tract

Source : Settlement and Land Records Department, MOAI

Plate 1.To fetch water is a daily routine for drinking and household use

Plate 2. Fuel wood relies on the Toddy *and Acassia* trees

Plate 3. Groundnut plants under drought in 2009

Plate 4. Mungbean and watermelon damaged by drought in 2010

Conclusion

Agricultural practices, such as sowing dates, cropping patterns, crop varieties and their relationships with the environment are the key factors for the successful production of a particular crop. According to the surveys, it was clear that farmers are striving to harvest a good yield under their existing fragile condition. With the scarce resource of soil moisture and fertility, they prefer double cropping system to a single crop to ensure a good yield of a crop. As an adaptation measure, most farmers follow the mix-cropping rather than mono-crop, under the single or double cropping pattern, to avoid the entire crop loss by drought or untimely rain. However, due to the severe drought in 2009, farmers harvested only half of the normal production. The continuous and heavy rain in November, 2010 caused the farmers lose the entire sesame crop but gave a bumper harvest of groundnut and sorghum.

Traditionally, crop residues are mostly used as animal feed (e.g. groundnut and pulses) and fuel (e.g. sesame and groundnut), and farmers do not apply them into their fields and it leads to decrease in organic matter and fertility replenishment to the soil. Therefore, insufficient application of organic matter is a major cause of low soil fertility in the farming systems. The availability of drought tolerant varieties and irrigation facilities, access of micro credits, crop insurance system and off-farm income opportunities should be introduced for the livelihood and to overcome the impact of current and future climate change.

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