Paddy Farmers' Adaptation Practices to Climatic Vulnerabilities in Malaysia

Md. Mahmudul Alam*

Postgraduate Student

Institute for Environment and Development (LESTARI)

National University of Malaysia (UKM), Malaysia;

Email: rony000@gmail.com

Chamhuri Siwar

Emeritus Professor

Institute for Environment and Development (LESTARI)

National University of Malaysia (UKM), Malaysia

Email: csiwar@ukm.my

Rafiqul Islam Molla

Professor and Specialist in Economics

Faculty of Business and Law

Multimedia University, Malaysia

Email: rimolla@gmail.com

Basri Talib

Associate Professor

Faculty of Economics and Business

National University of Malaysia (UKM), Malaysia

Email: basri@ukm.my

Mohd Ekhwan bin Toriman

Associate Professor

School of Social, Development & Environmental Studies (FSSK)

National University of Malaysia (UKM), Malaysia

Email: ikhwan@ukm.my

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* Corresponding Author

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Abstract

The climatic factors in Malaysia have been changing very rapidly affecting agricultural productivity and farmers' sustainable livelihood. Agriculture which depends heavily on climate is becoming increasingly vulnerable to risk and uncertainty. In order to face and manage the situation farmers are trying in various ways to adapt to these climatic vulnerabilities. This study analyses paddy farmers' perception of climatic variations and vulnerabilities and focuses on the techniques they use to adapt to the situation. It uses primary data collected through a questionnaire survey on the paddy farmers in the Integrated Agricultural Development Area (IADA), North-West Selangor in Malaysia. Through a descriptive analysis of the data, the study finds that most farmers do not have a clear perception of the climatic changes and vulnerabilities. Farmers' adaptation practices to the climatic vulnerability are mostly based on their common sense responses. It suggests that farmers need necessary training and support from the government and international agencies to make them able to effectively adapt to the climatic vulnerability and avert any adverse effect on their socioeconomic sustainability and national food security.

Key words: *Agricultural Sustainability; Climate Change; Climatic Vulnerability; Adaptation Technique; Farmer; Paddy; Malaysia*

Introduction

Malaysia, with a population of about 27 million, is currently the 26th largest greenhouse gas emitter in the world. It may quickly move up on the list due to high growth rate of emissions as a result of agricultural and industrial expansion in the country. Due to high greenhouse gas emissions the temperature is projected to rise by 0.3-4.5°C. Warmer temperature will cause sea level to rise by about 95 cm over a hundred-year period. The changes in rainfall may fluctuate from about -30 to +30%. This change will reduce crop yield. It may cause drought in many areas so that cultivation of some crops such as rubber, oil palm, and cocoa will not be possible (NRS 2001). The projection shows maximum monthly precipitation will increase up to 51% in Pahang, Kelantan and Terengganu, and the minimum precipitation will decrease by 32-61% for the entire Peninsular Malaysia. Consequently, annual rainfall will increase by 10% in Kelantan, Terengganu, Pahang and North-West Coast and decrease by 5% in Selangor and Johor (NAHRIM 2006). This variation in climatic factors will cause the agricultural system to become vulnerable to risk and uncertainty.

The average temperature in the rice growing areas in Malaysia is about 26°C. Under current climatic change scenario, temperature above 25°C may cause decline in grain mass by 4.4% per 1°C rise in temperature (Tashiro and Wardlaw 1989) and grain yield may decline as much as 9.6 - 10.0% per 1°C rise (Baker and Allen 1993). Singh et al. (1996) shows that in Malaysia the actual yield of paddy rice per hectare vary from 3-5 tons, when the potential yield is 7.2 tons. There is a decline of paddy rice yield between 4.6 - 6.1% per 1°C temperature increase under the present CO₂ level. But a doubling of CO₂ concentration (from present level of 340-680ppm) may offset the detrimental effect up to 4°C temperature increase. In a recent study it is found that a 1% increase in temperature leads to a 3.44% decrease in current paddy yield and 0.03% decrease in paddy yield in next season; and a 1%

increase in rainfall leads to 0.12% decrease in current paddy yield and 0.21% decrease of paddy yield in next season (Alam et al. 2010c).

Tisdell (1996) finds that rainfall variability increases the level of environmental stress which adversely affects the ability of the system to maintain productivity. It is projected that in Malaysia any change in rainfall, both positive and negative, by more than only 0.4% by 2020 will cause decline in paddy yield (NRS 2001). Alam et al. (2011a) indicate that the yearly total rainfall is increasing and its monthly variation is too high. The adverse effects of lower rainfall can be reduced or averted by introducing proper irrigation system. But the effect of the opposite phenomenon of over rainfall especially at the end of the crop cycle or at the maturity period is absolutely uncontrollable.

As climatic change is a continuous process, its effects and solutions are also similarly time and efforts consuming processes. Most of the global warming during the next 30 years will be due to emissions that have already occurred. Over the longer term, the degree and pace of warming mainly depend on current and near future emissions (Stern 2007). In recent years, adaptation has gained prominence as an important response measure especially in vulnerable countries. Even though it has become clear that some impacts are now unavoidable in the short to medium term.

According to IPCC (2001), adaptation refers to adjustments in ecological, social or economic systems in response to actual or expected stimuli. This term refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climatic change. It outlines few basic principles like a) adaptation to short-term climatic variability and extreme events for reducing vulnerability to long-term climate change; b) adaptation policy and measures in a developmental context; c) adaptation at different levels in society; d) and the adaptation strategy and the process. According to UNDP (2005), a climate change adaptation strategy for a country refers to a general plan of action for addressing the impacts of climate change. It may include a mix of policies and measures, selected to meet the overarching objective of reducing the country's vulnerability. Under current climatic change scenario, adaptation strategies are crucial for vulnerable groups because failure to adapt could lead to deprivation, social disruption and population displacement, and even morbidity and mortality (Downing et al. 1997). As a result, different countries have applied different approaches and techniques to adapt with climatic vulnerabilities. Malaysia is in the process of developing its adaptation policy for averting the adverse climatic impacts.

Data and Methodology

To determine the nature and extent of farmers' adaptation to climatic vulnerability in Malaysia, this study relies on the primary data collected under a research project on economics of climatic change at the Institute for Environment and Development (LESTEAR), National University of Malaysia (UKM). It was funded by the Ministry of Science, Technology and Environment, Government of Malaysia (Alam et al. 2010a). It is a case study of Malaysia's paddy sector. Data were collected through a random sample survey of paddy producing farmers in the eight sections of the Integrated Agricultural Development Area (IADA) of North-West Selangor, Malaysia during 2009-2010 (Fig 1). The IADA covers an area of 100,000 hectare (ha). 55,000 ha are marked for cultivation of palm oil, 20,000 ha for coconut, 5,000 ha for fruits and vegetables, and 20,000 ha for paddy. This 20,000 ha for paddy cultivation include major rivers, (i.e Sungai Sireh and Sungai Karang), a 75 km

irrigation system, and other infrastructures. Currently paddy is cultivated on 18,355 ha leaving 625 ha for drainage. There are a total of 10,300 paddy farmers and 30,000 other crops producers in the IADA. A population of about 50,000 forms the total size of the agricultural community in the area.

< Figure 1>

The survey was conducted by regular enumerators of the IADA authority using a structured questionnaire under the direct supervision of IADA officials. Data were collected from a sample of 198 paddy farmers proportionately distributed among the eight areas. Details of socioeconomic profiles of the respondents are available at Alam and others (2010b, 2010d, 2011c). This study uses a 5-point scale with 1 as very low and 5 as very high for measuring farmers' perceptions of change in climatic factors and the extent of their adaptations. The data have been analysed under a descriptive framework using descriptive statistics, percentile and ordinal scale.

Farmers' Perception of Climatic Vulnerability

Farmers are the directly affected group and close observers of climatic change and vulnerability (Siwar et al. 2009, Alam et al. 2011b). Their understanding about climatic vulnerability differs largely. Overall, 40.9% of farmers have no idea about climatic change and vulnerability.

<table 1>

53.3% farmers understand climatic vulnerability as increase in temperature or change in temperature and for 55.6% farmers climatic vulnerability is unpredictable rainfall or changes in rainfall. For 43.2% farmers it means drought; for 46.5% farmers it is increase in flood. To 53.3% farmers, rise in sea level is an indicator of climatic vulnerability.

<table 2>

Farmers' Approaches towards Adaptation

Various farmers take various types of measures to adapt with the climatic vulnerability. Their approaches vary based on their perceptions, knowledge, locations, availability of resources, cropping patterns, nature and degree of vulnerability, etc.

83.8% farmers mostly rely on using chemical fungicide and pesticide to cope with the insect and paste attacks. Some try to seek solution to the problem through natural process such as by changing the crop planning schedules. They try to produce chemical free crops, especially vegetables. In Malaysia, chemical free crops (or organic crops) have good market and their prices very high. For example, the prices of organic vegetables could be more than three times the prices of non-organic vegetables.

<table 3>

IADA provides the irrigation facilities. Farmers are fully dependent on it for irrigation. When there is shortage of water supply for irrigation, farmers try to collect water from the drains and drainage area with the help of small water pumps.

<table 4>

In case of low rainfall, farmers do not have proper idea how to cope with the situation. They rely on IADA for the solution.

<table 5>

In case of excessive rainfall, farmers pump out water from the paddy fields. Other than this, they have no idea about how to protect the crop from the adverse effects of heavy rainfall.

<table 6>

Nearly 44% of farmers add more water in the field for maintaining required moisture level during the time of high temperature or sunshine.

<table 7>

40.4% farmers use organic fertilizer, 24.7% use lime, and 15.2% use chemical fertilizer to cope with soil fertility losses.

<table 8>

When weeds grow on the crop field, farmers cut the weeds or use weedicide.

<table 9>

Farmers' adaptation practices to cope with the agricultural vulnerability due to climatic change are not found adequate and satisfactory (Alam et al. 2011d, 2011e). Their adaptation methods are based only on their ideas or reactions. As a result, only 30.3% farmers believe that they have been able to properly cope with climatic vulnerabilities.

<table 10>

Conclusion and Recommendations

The study finds that most paddy farmers do not have clear perception of climatic change and vulnerability. Most farmers understand that increases in drought, flood, and sea level are the results of climatic changes. 53.3% of farmers feel that the temperature, one most important climatic factor, is changing, and 55.6% believe that the rainfall, the other most important climatic factor, is changing. To cope with the situation and avert any adverse effect, farmers are trying various methods to adapt to the changes in various climatic factors. However these methods are not found so effective. As a result the agricultural sector of the country is becoming increasingly vulnerable threatening farmers' livelihood sustainability and national food security. Paddy farmers in the study area, therefore, need necessary training and support from the government and the international agencies for better adaptation to climatic vulnerabilities. It is essential for agricultural sustainability and human livelihood sustainability. The options for agricultural adaptation can be grouped as technological developments, government programs, farm production practices, and farm financial management (Smit and Skinner 2002, Alam et al. 2010e). Accordingly, all necessary training and support should be given to the farmers by the government and international agencies to make them able to effectively adapt to the climatic vulnerabilities to avert any adverse effect

on their livelihood sustainability and national food security (Alam et al. 2011f). Crop insurance may be considered as a more effective adaptation instrument and a viable option in this respect.

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Table 1: Farmers' Understandings about Climate Change Vulnerability

Respondent View about Climate Change	No. of Respond	% of Total
Hot Temperature	74	37.40%
Unpredictable Rain	30	15.20%
Interferes with Cultivation Time	6	3.00%
Natural Disasters	1	0.50%
Drought	2	1.00%
Pest Attack	4	2.00%
Don't Aware	81	40.90%
Total	198	100%

Table 2: Farmers' Views about Vulnerability of Climate Relevant Factors

Climate Factors	Observation Scale*					Average Value of Scale	S.D.	Agreed (4 & 5) Respondent	Disagreed (1 & 2) Respondent
	1	2	3	4	5				
Temperature	9	10	73	50	56	3.68	1.08	106	19
	4.5%	5.1%	36.9%	25.3%	28.3%			53.5%	9.6%
Rainfall	6	7	75	67	43	3.68	0.95	110	13
	3.0%	3.5%	37.9%	33.8%	21.7%			55.6%	6.6%
Sea Level Increase	14	15	63	66	40	3.52	1.11	106	29
	7.1%	7.6%	31.8%	33.3%	20.2%			53.5%	14.6%
Flood	13	11	82	61	31	3.43	1.03	92	24
	6.6%	5.6%	41.4%	30.8%	15.7%			46.5%	12.1%
Drought	12	11	91	48	36	3.43	1.04	84	23
	6.1%	5.6%	46.0%	24.2%	18.2%			42.4%	11.6%

*Scale: 1 = Strongly Decreasing, 2 = Decreasing, 3 = Not sure, 4 = Increasing, 5 = Strongly Increasing

Table 3: Farmers' Adaptation Approaches for Injurious Insect

Approaches	No. of Respond	% of Total
Biologically Control	7	3.50%
Control at the beginning	12	6.10%
Proper Scheduling of Cultivation	7	3.50%
Spraying Fungicide and Pesticide	166	83.80%
No Idea	6	3.00%
Total	198	100%

Table 4: Farmers' Adaptation Approaches for Low Supply of Drainages Water

Approaches	No. of Respond	% of Total
Ensure Good Drainage	18	9.10%
Inform the Authority	2	1.00%
Pumps water from drainage	160	80.80%
No Idea	18	9.10%
Total	198	100.00%

Table 5: Farmers' Adaptation Approaches for Low Rainfall

Approaches	No. of Respond	% of Total
Change the Timing of Cultivation	3	1.50%
No Alternative Option	20	10.10%
Pumps in Drainage	114	57.60%
No Idea	61	30.80%
Total	198	100.00%

Table 6: Farmers' Adaptation Approaches for Excessive Rainfall

Approaches	No. of Respond	% of Total
Pumps water out of plot	121	61.10%
No Idea	77	38.90%
Total	198	100.00%

Table 7: Farmers' Adaptation Approaches for High Temperature

Approaches	No. of Respond	% of Total
Continuously Add Water	7	3.50%
Maintain water at paddy plot level	80	40.40%
No Alternative Option	9	4.50%
Plant protective Big trees	12	6.10%
No Idea	90	45.50%
Total	198	100.00%

Table 8: Farmers' Adaptation Approaches for Soil Fertility Loss

Approaches	No. of Respond	% of Total
Chemical Fertilizer Use	30	15.20%
Limefication	49	24.70%
Reduce chemical fertilizer usage	3	1.50%
Use organic fertilizer	80	40.40%
No Idea	36	18.20%
Total	198	100.00%

Table 9: Farmers' Adaptation Approaches for Weeds

Approaches	No. of Respond	% of Total
Cutting grass	19	9.60%
Weedicide	161	81.30%
No Idea	18	9.10%
Total	198	100.00%

Table 10: Farmers' Capabilities of Adaptation with Climatic Vulnerability

Types of Supports	Observation Scale*					Average Value of Scale	S.D	Agreed (4 & 5) Observation	Disagreed (1 & 2) Observation
	1	2	3	4	5				
Able to Cope Properly with Climate Change	21 10.6%	38 19.2%	79 39.9%	36 18.2%	24 12.1%	3.02	1.14	60 30.3%	59 29.8%

*Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, 5 = Strongly Agree

Figure 1: Location of study area, IADA in North-West Selangor, Malaysia