AN ASSESSMENT OF RICE FARMERS PERCEPTION OF CLIMATE CHANGE AND ADAPTIVE CAPACITY: A STUDY OF THE STATE OF KEDAH

BY

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ABSTRACT

Agriculture is one of the most vulnerable sectors to be affected by the adverse effects of climate change. Among the countries that are affected, it was observed that Malaysia's agricultural productivity has been on a decreasing trend. This is because parts of the country have come under the unscrupulous ravages of climate vulnerability and other natural disasters caused by climate change. Farmers are the most affected because not only are they less knowledgeable about the effects of climate change, they are also less capable of protecting themselves and this is due to the many constraints they face. In order to help farmers to be better at adapting to the vulnerability of climate change, it is important to analyse their understanding of the consequences of climate change, their selection of appropriate adaptation methods as well as their capacity to identify the barriers that could affect their adaptation behaviours. In line with this, this study aims to examine the perception of Malaysian farmers, their adaption capacity and their attitudes towards climate change. It also examines their views about the barriers affecting their adaptation behaviour. To achieve this aim, a questionnaire survey was conducted on a sample of 400 rice farmers from the Kedah region of Malaysia. Data was analysed using the structural equation modelling (SEM) approach. The findings of this study show that 84% of the respondents had perceived a decrease in rainfall due to climate change while 75% had perceived an increase in temperature over the last 10 to 15 years as a result of climate change. It is also found that the farmers who participated in this study possess a moderate adaptive capacity to adapt to climate change and some of their common adaptation practices include improving their irrigation system, using organic fertilizers and changing their activities from farming to non-farming activities. The analysis also indicates that the farmers were facing several kinds of adaptation barriers such as high cost of input, unpredictable weather, lack of water resources, lack of timely weather information, lack of access to credit facilities and a few more constraints. Based on the statistics, the study also finds a significant positive relationship between the farmers' perception of climate change and awareness (AWN) with their attitudes (ATT) towards their adaptation behaviour (ADB), a finding which is consistent with theoretical assumptions. Furthermore, the results also reveal that awareness and attitudes play a mediating role between perception and adaptation behaviour. It is hoped that the outcome of this study can be used by the relevant parties to help the public and private organisations to learn more about the farmers' perceptions about climate change and the barriers they face in trying to adapt to the effects of climate change. Therefore, an appropriate policy framework needs to be developed so as to enable farmers to overcome their adaptation obstacles.

خلاصة البحث

تُعَدُّ الزراعة من أبرز القطاعات المتوقع أن تتعرض للأضرار الناتجة عن التغير المناخي. مما يلاحظ بين الدول المتضررة أن الإنتاجية الزراعية لماليزيا بدأت تنخفض لأسباب تتعلق بكونها من الدول التي تتعرّض للتأثير مناخية العالية وغيرها من الكوارث الطبيعية. فالمزارعون ليسوا متضررين من قلة الدراية للأضرار الناجمة عن التغير المناخي فحسب، بل لا يملكون أيضا من القدرة ما يحميهم منها لأسباب عديدة من المعوقات التي يواجهونها. لذا، من أجل معاونتهم على تكييفهم بأساليب القيمة لمواجهة هذه الأضرار المناخية، من المهم القيام بتحليل مدى إلمامهم بعواقب التغيير المناخي، ومعرفة اختيارهم لأساليب التكييف المناسبة وكذلك قدرتهم على تحديد الحواجز التي تستطيع أن تؤثّر في سلوكياتهم. يتطرق هذا البحث لدراسة آراء المزارعين الماليزيين، والمعوقات ومدى إمكانيتهم على التعامل مع التغيير المناخي. من أجل إيجاد هذا، يقوم البحث بتوفير استبيانات لأربعمائة (400) مزارع من منطقة قدح، ماليزيا وللاستطلاع آراء المزارعين عن طريق استخدام الأنموذج التركيبي المعادل. وتظهر نتيجة الدراسة أن % 84 من المستطلعيين يرون تراجعا نسبيا في حجم الأمطار نتيجة التغير المناخي. بينما يرى 75% ازديادا في درجة الحرارة طوال عشر سنوات حتى خمس عشرة سنة الأخيرة. ويتضح أيضا أن المزارعين الذين شاركوا في هذا الاستطلاع يمتلكون قدرة تكيفية معتدلة لمواجهة آثار التغيير المناخي. مما يشمل تحسين نظام الري، واستخدام الأسمدة العضوية وتغيير بعض أنشطتهم الزراعية إلى غير الزراعية. والجدير بالذكر أن التحليل البحثي يشير إلى أنّ المزارعين يواجهون عديدا من الحواجز التكيفية مثل: ارتفاع تكلفة الدخل، والطقس غير المتوقع، ونقص الموارد المائية، وعدم توفير المعلومات المتعلقة بالطقس، وصعوبة إيجاد القروض الائتمانية وغيرها من الصعوبات التي تواجههم. وبناء على الإحصاءات، تشير الدَراسة إلى وجود علاقة إيجابية كبيرة بين إدارك المزارعين ووعيهم التغيير المناخي وسلوكياتهم اتجاه انسجامهم للتناسب مع هذا التغيير مما يجعل هذه النَتيجة تتّفق مع النظرية المقترحة. وتشير النتيجة نفسها أيضا إلى أن الوعي والسلوك يؤديان دور الوساطة بين الإدراك والتكييف. لذا، يتوقع أن تستخدم نتيجة هذه الدَراسة لمساعدة المنظمات العامة والخاصة لمعرفة مدى تفكير المزارعين اتجاه إزاء التغيير المناخي والحواجز التكييفية. وبناء عليه، فإن وضع الإطار السياسي المناسب مطلوب لتهيئة المزارعين على للتغلب الصعوبات التي تواجههم.

APPROVAL PAGE

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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DEDICATION

In the name of Allah (SWT), the Most Gracious, the Most Merciful All the praises and thanks to Allah, the lord of the mankind, and all that exists. May peace and blessing of Allah Almighty be upon His Messenger Prophet Muhammad (SAAWS), his family and all his companions.

I dedicate this research to my father Asad Uddin Ahmed and mother Noor Jahan Begumn. And also my beloved husband Dr. Muhammad Mehedi Masud and my only son Suhail Nabhan Saad. Without their love and sacrifice, I would not have been able to complete this piece of work. I will forever be grateful for their sacrifices and tolerance. To my brothers and sisters who helped me to accomplish my academic achievements with their continuous prayers and inspirations. From Allah (SWT) standpoint, I pray that may Allah (SWT) grant us success here on the earth and again in the hereafter, Ameen.

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LIST OF ABBREVIATIONS AND SYMBOLS

AC	:	Adaptive Capacity
ADB	:	Asian Development Bank
ADB	:	Adaptation behaviour
AMOS	:	Analysis of Moment Structure
ATT	:	Attitudes
AVE	:	Average Variance Extraction
AWN	:	Awareness
BI	:	Behavioural Intention
C.R	:	Critical Ratio
CC	:	Climate change
CCPI	:	Climate Change Performance Index
CEP	:	Consciousness of the extensiveness of the problem
CFA	:	Confirmatory Factor Analysis
CFI	:	Comparative Fit Index
CH_4	:	Methane
CIA	:	Central Intelligence Agency
CO_2	:	Carbon dioxide
df	:	Degrees of freedom
DFID	:	Department for International Development
EFA	:	Exploratory Factor Analysis
ESCAP	:	Economic and Social Commission for Asia and the Pacific
FAC	:	Farmer's Adaptive Capacity
FAO	:	Food and Agriculture Organization
FAOSTAT	:	FAO Statistics Division
GDP	:	Gross domestic product
GFI	:	Goodness of Fit Index
GISS	:	Goddard Institute for Space Studies
HBM	:	Health Belief Model
IADA	:	Integrated Agricultural Development Area
IPCC	:	Inter-Governmental Panel on Climate Change
KADA	:	Kemubu Agricultural Development Authority
KMO	:	Kaiser-Meyer-Olkin
MADA	:	Muda Agricultural Development Authority
MDG	:	Millennium Development Goals
MLE	:	Multi-Level Equation
MMD	:	Malaysian Metrological Department
N_20	:	Nitrous Oxide
NAHRIM	:	National Hydraulic Research Institute of Malaysia
NAP	:	National Agricultural Policy
NASA	:	National Aeronautics and Space Administration
NC	:	National Communication
NFl	:	Normed Fit Index
NGO	:	Non-governmental organization

NOAA	:	National Oceanic and Atmospheric Administration
NRS	:	National Rseponse Strategies
PBC	:	Perceived Behavioural Control
PCI	:	Problem Confrontation Index
PERBAR	:	Perceived barrier
PERBEN	:	Perceived benefit
PERSEV	:	Perceived severity
PERSUS	:	Perceived susceptibility
PM	:	Peninsular Malaysia
PPK	:	Pertubuhan Peladang Kawasan
PS	:	Perception of Severity
RCT	:	Rational Choice Theory
RECOFTC	:	Regional Community Forestry Training Center
RMR	:	Root-Mean-Square Residual Index
RMSEA	:	Root-Mean Square Error Approximation
SDGs	:	Sustainable Development Goals
SEM	:	Structural Equation Modelling
SN	:	Subjective norm
SPSS	:	Statistical Package for the Social Sciences
TPB	:	Theory of Planned Behavior
TRA	:	Theory of Reasoned Action
UNDP	:	United Nations Development Programme
UNEP	:	The United Nations Environment Programme
UNFCCC	:	UN Framework Convention on Climate Change
UNISDR	:	The United Nations International Strategy for Disaster Reduction
VIF	:	Variance Inflation Factor
WAI	:	Weighted Average Index
χ^2	:	Chi-square

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Agriculture plays a significant role in the economy of a country and as the backbone of a nation's economy, it has also enabled human civilizations to develop further particularly in terms of the various productions and inventions of agricultural products. Agriculture is the deliberate effort made by mankind to change a part of the land's surface by producing crops and animals for subsistence or economic gains (Rubenstein, 2003). Most poor countries such as Burma, Nepal, Somalia, Niger, Congo, Ethiopia, Liberia and others, depend on agriculture to sustain their economy because of the countries' poor infrastructure and lack of development. However, among developing countries such as India, China, Thailand, Vietnam, the Philippines and Malaysia, agriculture is equally important because it helps to sustain the food production of the respective countries. Among these countries, the poor tend to live in the less developed parts of the country, called the rural areas and among those who live in the rural areas, agriculture is their main livelihood. These people depend on their crops and the related rural economic activities for survival. It has been noted that more than half of the world's usable land is used for agricultural activities (Allajabou & Bello, 2014) and this means that agriculture is an important part of the world as it produces the amount of food to feed the entire global population.

However, the agricultural sector has been severely affected by the adverse effects of climate change (CC) such as rising temperatures, rising sea levels, droughts, floods, hurricanes, and landslides. The fourth Intergovernmental Panel on Climate

Change (IPCC) indicates that CC will continue to affect the world for decades to come (IPCC, 2014). Like the rest of the natural catastrophes that cannot be predicted or adequately assessed by mankind, CC also creates many serious implications on the well-being of mankind. Climate change, it appears, will continue to cause damage to earth unless mankind works in a concerted effort to minimize environment change so as to mitigate some of the consequences that are brought about by technology and man's defiance. The adverse effects of CC on agricultural productivity has been noticed by farmers in developed as well as developing countries (Morton, 2007). CC has adversely affected the livelihoods of many rural farmers (Esham & Garforth, 2013) where crops die and animals succumb to diseases, causing a great loss of investment. CC is expected to increase the global average temperature from 1.8 ° C to 4.0 ° C, by the end of the 21st century (Esham & Garforth 2013) although the recent Paris Agreement made by the UN Framework Convention on CC (UNFCCC) has emphasized on taking the necessary steps to keep the increment of the global temperature well below 2 ° C.

Of the adverse effects caused by CC , the one involving rising temperatures is the most commonly felt effect and if let unaddressed by the relevant parties, rising temperatures can seriously hamper agricultural yields (Ziervogel, Bharwani & Downing, 2006). If still unnoticed, rising temperatures can ultimately lead to a huge food insecurity within the world. The recent Sustainable Development Goals (SDGs) (2016-2030) focused on environmental sustainability as a means to ensure a sustained economic growth, to prevent hunger and to address global food security (SDGs, 2016). Other strong adverse effects caused by climate change can impact on the national economy and this can destabilize the nation's economic power. Therefore, it is important for policymakers to be more concerned about future food security and the vulnerability of the agricultural sector due to CC. Both food insecurity and agricultural

vulnerability can lead to uncertainty in the food chain and this can ultimately, threaten the world's food security, especially in the tropical and subtropical regions (Al-Amin, Leal, De la Trinxeria, Jaafar, & Ghani, 2011).

The IPCC recognizes that developing countries are more vulnerable than developed countries to CC. This is because developing countries have an extreme shortage of capital for the development and dissemination of adaptation measures (Hertel, T. W. & Lobell, D. 2010; Tubiello, F.N. & Rosenzweig, C. 2008). The IPCC also notes that the effects of CC, by the year 2050, will reduce the global production of crops such as corn, rice and wheat by as much as 25 per cent (Rosegrant et al., 2014). The IPCC (2007) also predicts the same result for cereal productions.

Agriculture is an important source of livelihood in Southeast Asia where 115 million hectares of land are used to grow rice, oil palms, corn, rubber and coconut (ADB, 2009). The systematic production of rice in the Asian region have been increasingly threatened by the effects of CC (Masutomi, Takahashi, Harasawa & Matsuoka, 2009) in the last few decades where a large part of the Asian region which cultivate rice has become vulnerable in terms of being affected by floods and droughts, both of which affect the yields of the crop. The lesser the yield, the more the cost incurred in planting and producing and the higher the demand for the low supplies.

Agriculture plays an important role in Malaysia's economy. According to the Central Intelligence Agency (CIA) report, agriculture provides 8.2 per cent of the nation's GDP while the industrial sector provides 37.8 per cent and the services sector provides 54 per cent (CIA 2016). In Malaysia, rice is the most important food sub-sector for two reasons. Firstly, per capita consumption in Malaysia represents the food intake of 500-799 calories a day, making rice a staple food in the Malaysian diet (Firdaus, Latiff & Borkotoky, 2013). Secondly, among the small-scale farmers, agriculture is the

main source of their income and most of these farmers largely depend on rice cultivation. Currently, there are about 296,000 rice producers in Malaysia and nearly 40 per cent of them are full-time farmers (Firdaus et al., 2013). According to Man and Sadiya (2009), there are approximately 300,000 rice farmers who rely on rice farming for their survival. Malaysia has eight main granaries and some small sheds throughout the peninsular that involve rice farming too (Fahmi, Samah & Abdullah, 2013). To date, Malaysia's self-sufficiency level of rice production is 73 percent which means that it has to look outside, for the additional 27 per cent to fulfil its country's rice needs. As the years advance and as the rice production of the country becomes more affected by CC in the future, the yield in rice cultivation will decrease and Malaysia's dependence on the outside world to fulfil its rice needs will be higher. Thus, this will also become a major concern for Malaysia (Masud, Rahman, Al-Amin, Kari, & leal Filho, 2014).

In Malaysia, the actual rice yield is 3 to 5 metric tons per hectare although the possible yield is 7.2 tons (Alam et al., 2013). The production of rice in Malaysia has decreased over the years due to the decline in cultivated areas, negligible productivity gains, continued increase in production costs and a decrease in productivity (Alam et al., 2010). As a result, agricultural productivity is diminishing and farmers are getting poorer. It has been greatly acknowledged that poor communities or less developed nations are more susceptible to climate change, as reported by the National Response Strategies (NRS, 2001; IPCC, 2007). Therefore, to improve the policy in the fight against CC which pose as challenges to farmers, it is essential to have empirical evidence that can portray the farmer's understanding of climate change, their selection of appropriate adaptation methods as well as their identification of barriers that could affect climate change adaptations. Maddison (2007) stated in order to be able to develop the adaptation measures to climate change, farmers must first understand the issue of

CC. This understanding will increase their competence to take on the necessary adaptation strategies which can minimize the destructive effects of CC on their farming activities (Mabe, Sarpong, & Osei-Asare, 2012). CC adaptation is defined by the IPCC (2007, p 297) as:

"The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences".

Adaptability refers to the ability to accommodate changes accordingly and adaptability varies on the basis of assured aspects which are specific to agriculturalists. It is presumed that as human beings, farmers are reasonable and sensitive beings and as such, they should want to adapt to the climate change that is currently occurring because they want to protect their future. In some countries, ranchers have a greater capability to adjust to climate change than others. Nevertheless, environmental sustainability is required to sustain agricultural production hence, farmers have no choice but to embrace climate change by understanding how it affects them and what they can do to mitigate its impact.

An adverse effect of climate change, global warming is anticipated to pose many difficulties to the agricultural sector where crops will diminish due to the unpredictable droughts and floods occurring and the reduction of land for farming where land for cultivating agriculture may be slashed as more and more lands are being destroyed and consumed by natural disasters (Ali et al., 2017). In the context of Malaysia, local and global studies looking at climate change have confirmed that temperatures in the country have increased more than before (Al-Amin et al., 2011). The mounting pattern is predicted to be moving in an upward trend and due to this, making adaptation plans to induce more adaptation strategies that can protect their livelihood among the farmers,