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Farmers Sensitivity Towards the Changing Climate in the Cameron Highlands

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Abstract: The main purpose of this study is to discuss the sensitivity of farmers living in the Cameron Highlands towards the changing climate. This is a qualitative study in which a focus group discussion was conducted by 4 researchers from Universiti Putra Malaysia with 4 farmers from the Cameron Highlands, Pahang. The Cameron Highlands is one of the main agricultural areas and tourist attractions in Malaysia. However in recent years, the changing climate has brought threats to the environment, ecology and agricultural products, thereby negatively affecting socio-economic aspects relating to farmersin the area. From the analysis performed, it can be confirmed that Cameron Highlands farmers have realized that environmental changes are occurring in the region and also recognize the disastrous impacts that the changing climate is having on their agricultural activities. Based on the findings, it is recommended that the appropriate parties strictly monitor and observe any illegal environment-related activities.

Key words: Climate change, farmers, agriculture, environment change, socio-economic

INTRODUCTION

Agriculture is asector that is vulnerable to climate change, as its primary production activity is highly linked to natural resources and the environment. Farmers in the Cameron Highlands are some of the primary producers of Malaysian agricultural products, particularly fresh vegetables. The Cameron Highlandsare located in Pahang and are one of Malaysia's most popular agricultural production areas. Situated on the main mountain range in Malaysia (Banjaran Titiwangsa) and nestled over 1,000 m (3,300 ft) above sea level. The Cameron Highlands is one of the few places in Malaysia that has tropical climates and is suitable to plant highland crops. The mean annual temperature in the area is about 18°C (64°F), the yearly precipitation is >2,800 mm (110 inch). Similar to other places in the world, the Cameron Highlands are threatened by the negative impacts of climate change. There are 3 major impacts of climate change on agriculture: Temperature rises, rainfall variation and carbon fertilization effects (Herath and Dharmakeerthi, 2010). Climate change is a global phenomenon that adversely affects different social groups. Agricultural communities (farmers) are one of the most affected and at-risk groups due to their high dependency on agriculture (Alam *et al*., 2012).

Climate change is also occurring in Malaysia and is expected to worsen in the future. A number of local and international studies have monitored the climate in Malaysia and drawn several conclusions. For instance, Wai *et al*. (2005) identified that the mean annual temperature has been subject toan obvious increment, with temperature rises ranging from 0.99-3.44°C per 100 years. The Intergovernmental Panel on Climate Change (IPCC, 2007) conducted an investigation into the impact of global warming in Malaysia and forecasted that temperatures willrise by between 0.6 and 4.5°C by 2060. A study conducted by Kwan *et al*. (2011) on the changing climate in selected areas in Malaysia (such as Bayan Lepas, Ipoh, Malacca and Miri) found that most of the areas studied were experiencing changes in terms of cold days, warm days, cold nights and warm nights.

In addition to a temperature rise, Malaysia is also expected to experience unstable rain patterns. The National Hydraulic Research Institute of Malaysia (NAHRIM, 2006) collaborated with the California Hydrologic Research Laboratory (CHRL) to conduct a study on the impact of climate change on the hydrologic regime and water resources of Peninsular Malaysia. The results show that the maximum monthly precipitation of Pahang, Kelantan and Terengganu will increase by up to 51% while Peninsular Malaysia sminimum precipitation

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will decrease by between 32 and 61%. Therefore, the annual rainfall will also be affected by these changes. To illustrate this, the annual rainfall of Kelantan, Terengganu, Pahang and the North West coast will increase by up to 10% while that of Selangor and Johor will decrease by up to 5%.

Similar to the climate scenario in other places in Malaysia, the Cameron Highlands are experiencing the effects of the rising temperature. Despite the fact that the Cameron Highlands are situated in a mountain range, a time series of the mean, maximum and minimum annual temperatures plotted for the period 1965-2007 indicates that temperatures have been steadily increasing (Ismail *et al*., 2011). This situation is a threat to the Cameron Highlands, since the area is known as a place that produces highland crops. Generally, due to the adverse effects of climatic factors on agriculture in Malaysia, both income stabilization and poverty reduction programs among farming communitiesare under threat. Thus, in order to ensure the sustainability of agriculture and farming livelihoods, it is very important to assess farmers' sensitivity towards the changing climate. This will enable the identification of suitable approaches and techniques to adapt to climatic vulnerabilities, since Malaysia is continuously planningto avoid adverse climatic impacts. Therefore, this study attempts to measure farmers sensitivity towards the changing climate and also identify the related factors and impacts of the changing climate in the Cameron Highlands.

MATERIALS AND METHODS

This study is qualitative in nature whereby the data collection process was conducted via a Focus Group Discussion (FGD). The FGD was conducted by 4 researchers from Universiti Putra Malaysia in April, 2013 with 4 farmers from the Cameron Highlands, Pahang. The study relied on a generic approach to conduct the qualitative research (Lichtman, 2010). The number of respondents was determined by the need for saturation. The saturation point can be understood as the moment that the researcher arrives at an understanding of the experience, after which point the understanding cannot be enhanced any further by additional discussions with respondents (Laverty, 2003). The respondents differed from one other with regard to age, type of crops, income generation, experience and educational achievement. These differences were vital, as they added some data variation with reference to the respondents. To ensure that the respondents meet the criteria specified, the help from Federal Agrigulture Marketing Authority (FAMA) agriculture officer in Cameron Highland is obtained.

Table 1: Focus Group Discussion (FGD) respondent details, duration 1 h and 28 min

Name	Occupation	Location
R1	Tea plantation farmer	Refrigerator room, Federal Agrigulture
R2	Tomato farmer	Marketing Authority (FAMA), Cameron
R3	Strawberry farmer	Highland, Pahang
R4	Strawberry farmer	

In order to guarantee that the FGD process would be fully understood by the respondents, it was conducted in dual languages Malay and English though with a huge portion of it in Malay. To ensure that the FGD metthe study's objectives, an interview protocol was pre-prepared. This was developed based on 3 main aspects: The agricultural activities in the Cameron Highlands, the current climate of the Cameron Highlands and the sensitivity of the farmers towards the changes, factors and impacts of the changing climate. The questions served as a guide but the respondents were allowed freedom and flexibility in their answers. The FGD lasted 1 h, 28 min and began with a short introductory conversation to allow the researchers to understand the respondents backgrounds. The FGD was later transcribed and then analyzed using the matic analysis. The transcription data was reviewed and examine the main points and themes within the recording data. Themes are patterns across data sets that are important to the description of a phenomenon and are associated with a specific research question (Daly *et al*., 1997). In this research, the selected themes included the changes, factors and impacts of the changing climate in the Cameron Highlands that affect the farmers sensitivity (Table 1).

RESULTS

Changes: The installation of rain shelters for some crops in the Cameron Highlands has resulted in greenhouse gas emissions. Greenhouse gases are thought to affect the climate both directly and indirectly, as they trap electromagnetic radiation from the sun that would otherwise have been reflected back out into space. This causes an overall warming of the earth and erratic weather. One of the respondents discussed this, stating: The installation of rain sheltershas had an impact on climatic change in the Cameron Highlands. The heat from the sunlight should be fully absorbed into the earth, however with the use of rain shelters, the heat may be reflected and form clouds. From there, it causes fast kinds of rain and may be heavy rain (R2).

The respondents view can be supported by facts produced by the IPCC (2007) which reported that global agriculture contributes about 13.5% of the world's total greenhouse gas emissions. In 2010, Malaysia with its population of about 28.3 million, ranked as the 29th largest

greenhouse-gas emitter in the world. As one of the main areas producing agricultural products, there is a high probability that the Cameron Highlands are contributing to this high rank.

Since, the Cameron Highlands are situated a long way above sea level, their mean annual temperature is about 18°C (64°F) and the yearly precipitation is >2,800 mm (110 inch). However, due to the changing climate temperatures have been steadily increasing in the area. According to R1, this situation affects farmers and other people's daily lives in the Cameron Highlands: Now-a-days, the temperature in the Cameron Highlands can reach 34°C. I was born in the Cameron Highlands and this is my home town. I am the 2nd generation of my family. The 1st generation did not use air conditioners in the Cameron Highlands. But now-a-days at 12 o'clock, we have to use an air conditioner because it is very hot (R1).

This scenario is not surprising, given the supporting findings of a number of studies. First, the Ministry of Science, Technology and the Environment (MOSTE, 2001) claimed that the temperature in Malaysia is projected to rise by 0.3-4.5°C while the amount of rainfall may fluctuate by between -30 and +30%, due to the impact of high greenhouse-gas emissions. Consequently, crop yield will be reduced in many areas. In another study by the National Hydraulic Research Institute of Malaysia (NAHRIM, 2006) on the projection of rainfall changes by 2050 Pahang (the state in which the Cameron Highlands are located) will experience an increase in monthly precipitation of up to 51%. This variation in climatic factors will affect the agricultural system in Malaysia.

Deforestation is an important factor in global climate change, climate change can be caused by the build-up of carbon dioxide in the atmosphere and deforestration is one of the human activities that contribute to the accumulation of carbon dioxide. The Cameron Highlands are still experiencing deforestation and land-clearing activities for infrastructure development and commercialized farming. Most of the farmers in the Cameron Highlands use natural water resources for crop irrigation purposes. Through deforestation and land-clearing, these water resources are affected. Deforestation and illegal land-clearing activities are the biggest factors of the changing climate in the Cameron Highlands. A few years ago, there were a lot of trees in the Cameron Highlands and trees contribute to their environment by providing oxygen, improving air quality, providing climate amelioration, conserving water, preserving soil, supporting wild life and filtering the ultraviolet rays. Thus, deforestation will cut a lot of trees, affect the water resources and contribute to global warming (R1).

The conversion of Malaysias forests into agricultural areas was identified many years ago (Butler, 2012). Based on a case study by Abdullah and Hezri (2008), the landscape pattern in Peninsular Malaysia is changing and 2 major crops (rubber and oil palm) have been identified as driving several environmental changes, including a loss of biodiversity, geo hazard incidents and the spread of vector-borne diseases.

Factors: The increasing cost of capital has put pressure on farmers in the Cameron Highland, it has negatively affected their incomes, so that clearing new areas of land to double their productivity is seen as an effective solution. Additionally, food demand has increased due to the increased population size. These factorsare driving the farmers to increase their productivity. The income is less than the input. The overhead and operational costs are very high (R2).

The Tenth Malaysian Plan (EPU, 2010) highlighted that the country intends to increase the production of its agricultural commodities (such as rice, beef, lamb/mutton, milk, fruit and vegetables) in order to raise its level of self-sufficiency. However due to the limited resources in the agricultural sector, as well as the negative impacts of climate change on the production of agricultural commodities, it could be difficult to achieve the targeted level of self-sufficiency in the short to medium term. In addition, the increasing population size of the country in the next few decades will require a significant increase in food supplies (Siwar *et al*., 2013).

The high cost of living means that Cameron Highlands farmers need more money. As their main income is generated from agricultural activities, the only way to generate more income is by increasing productivity. In turn in order to double their agricultural productivity, the farmers need more space for their farming activities. As such, clearing new land for agriculture is one of the options available to them: So that's one of the factors (leading) people (to) deforestation: To plant more, they want to gain more income to overcome their high cost of living. Years ago with only RM100 we could live and buy anything. But now-a-days, just RM100 is not enough. So that's the problem (R1).

Although, commercial farming has positive socio-economic impacts for a community, particularly in terms of employment opportunities and continuous protein supplies, its impacts on the environment are more disastrous compared to small-scale farming. Within the context of the Cameron Highlands, commercial farming is conducted on a large scale which requires substantial amounts of space. This can create problems relating to

deforestation and illegal land clearing. First respondent (R1) highlighted this issue and supported by others: Its happened within these 7 years because of the big-scale and commercial farmers in Lojing. We asked farmers near there about how many acres of field they own. They have about 20-30 acres of planted area. There is no such thing as 2 or 3 acres for each farmer in Lojing. In terms of income, the commercial farmers are the ones that affect the small farmer. And they also affect the environment and changing climate in the Cameron Highlands (R1).

The fourth respondent (R4) support the statement above: I agree with him, commercial farmer is a threat to the small scale farmers because it leads to deforestation (R4).

Infrastructure development has also taken place and several high-impact inventions produced that have uplifted community standards of living and provided better ways for the community to undertake their daily routines. The farmers, as one of the most important groups in the community are provided with access to such standards of living and inventions, however this access alone is inadequate and money as a necessity of lifeis one of the main factors. For the farmers having more money means that more land needs to be sacrificed. Years ago, if we only had two acres and bought a Proton Saga (a Malaysian car) then it would be enough. But now-a-days, people are really unsatisfied with only a Proton Saga. Instead, I want to drive a BMW car. But, I have to put in more effort and get a big farming area. Before my father could eat chicken and rice but I now want to eat atthe high-standard hotel. So, life is changing. Our desires in life are changing (R1).

Impact: The issue of climate change is vital in determining crop performance. Physical damage, loss of crops and decreases in productivity are some examples of the direct and indirect effects of extreme climate change. The sustainability of food supplies can also be affected by climate change. Most of the farmers in the Cameron Highlands use natural water resources for crop irrigation purposes. Too much deforestation will affect the water resources. Hence, the water quality is poor and produces low-quality leafy vegetables and fruits. Besides within 10 years from now, Cameron Highlands forests will be destroyed, as will the vegetables (such as cabbage) that require low temperatures between 17 and 18°C to plant. Thus, when the temperature increases, it will not be possible to plant most of the highland vegetable varieties (R1).

A number of studies agree that climate change poses a major threat to food security. A study conducted by the Food and Agriculture Organization (FAO, 2009) reported that until at least 2050, the impact of climate change on food production may be small but the distribution of production will have severe consequences on food security. As a result of global warming, it is also estimated that developing countries may experience a decline of between 9 and 21% in overall potential agricultural productivity. Alam *et al*. (2011) identified the negative impact of climate variability on agriculture and food security. Their research attempted to examine the impact of climate change on agriculture and food security at the farm level in Malaysia and the researcher reported that the farmers experienced a decline in terms of crop production. The study anticipated that in the long term, continuous decreases in crop yield at the farm level will have a negative impact on both self-sufficiency in food production and food security. In the Cameron Highlands we plant mostly temperate crops, such as strawberries and tomatoes. But, the crops also need enough sunlight to carry out the photosynthesis process. But once the erratic weather changes occur, it will affect the crop production. The most suitable temperature for planting strawberries is between 17 and 20°C for the whole day. So, if the temperature is too high, the crops may be fresh but there will probably be other side effects, such as fertilizer shortages, a lack of nutrients, leaf spot diseases and other symptoms (R2).

Precipitation amounts change and severe weather events happen more frequently due to temperature increases. These changes can cause negative outcomes in agricultural systems that are difficult to predict. For example, Battisti and Naylor (2009) found that due to temperature increases, some crops may experience extended growing seasons. The same scenario can be seen in the Cameron Highlands, according to the views of one respondent: Strawberries need a lot of sunlight. So when the rainy season comes, the strawberry production will slow and decrease. The 2 or 3 days of exposure to sunlight are needed to get fully ripe fruits. If there is no sunlight during the day, the strawberries will take a week to ripen. So in terms of production without a doubt, it will go slowly (R3).

Climate change also poses a threat to the control of pest and disease invasions whereby factors such as increasing average temperatures, changes in precipitation patterns and water shortages are among the main contributors. Such, impacts have already been experienced by the Cameron Highland farmers and one of the options used to face such consequences is applying more chemicals to the soil. However, this scenario can be dangerous as it can result in contaminated soil which in turn can give rise to pollutants that can affect the water quality and indirectly affect human health via the

consumption of food. During a very hot day, in order to control diseases and pests we have to use more chemicals (R2).

This situation can be explained with reference to a study conducted by Ziska (2003) which found that weeds generally respond more positively to increasing carbon dioxide or high temperatures. Thus, farmers need to increase the frequency of insecticide treatment under these conditions, resulting in increased costs and negative environmental impacts.

There is no doubt that climate change can have serious effects on agriculture. Highland vegetable and fruit production, as well as floriculture are prominent activities in the Cameron Highlands. Increases in the mean annual temperature and precipitation due to the changing climate may result in the farmers being unable to plant these types of crops. We fear that the Cameron Highlands 10 years from now will become an area for lower-land crops, so we will not have the highland crops (R2).

At present, farming activities are degrading which is soon likely to damage tourism, biodiversity, hydropower generation and the quality of life of many people in the Highlands. The changing climate has affected social, economic and environmental aspects in the Cameron Highlands and has resulted in the younger generation becoming less involved in agriculture. Within the scope of Malaysia, particularly in rural areas such as the Cameron Highlands, young people are migrating in significant numbers to urban areasdue to the many job opportunities offered there and the fact that they view farming as a second-class job that does not offer good future prospects. One of the respondents clarified this stating: Most of the young generation in the Cameron Highlands do not become farmers and they travel to get jobs. The local people who are living here think that there are no job opportunities here. Most of them go to Kuala Lumpur or Singapore to work. Working there and getting a salary every month is much easier than becoming a farmer. My business involvement in agricultural industries by now is only about 60-70%. I have already started to establish a different business for my future. I am worried (about) the government management and also (about) the current climate in the Cameron Highlands. So, this situation is not going to support my future (R1).

R2 expressed a similar view to R1, stating: We are becoming more independent and the dependence on the government is lower than before. Now-a-days, the climate is showing significant changes and this is affecting the agricultural industries in the Cameron Highlands, so this is one of the reasons, we the young generation have started to go to other areas (R2).

The findings of Siwar *et al*. (2013) are in line with this scenario, as they claimed that a warmer world will have both direct and indirect impacts on the economic dynamics of farmers. Crop damage, reduced productivity and increased costs will minimize farmers incomes, increase poverty levels and cause seasonal unemployment rates to increase. These are some of the negative impacts of global warming.

In order to increase awareness among the younger generation on the importance of agriculture for national food security, educational programs can be used to teach them about sustainability, local agriculture and land use. Such, programs need to be developed from the existing perceptions that the young people have about farming and sustainable agriculture and the contributions of these industries to their country: For me I have a different thought. At college, I studied agriculture, so my interest is 100% in agriculture. I know that climate change is one of the challenging aspects in the agricultural industries. Thus, by hook or by crook, I have to overcome the problems that are occurring and keep surviving in this industry (R3).

DISCUSSION

The Malaysian government has established a National Adaptation Plan to counter climate change. However, there is a gap between the climate change adaptation programs and the ongoing development program business as usual. Agriculture is a strategic sector that needs to support food security, livelihoods and rural development. Despite the sensitivity of agricultural crop production to climate change, agriculture is also a major contributor to greenhouse-gas emissions. Special attention to the agricultural sector's development is required in the adaptation plan, amid the challenges of growing food supply demands.

The adaptation plan should consider 3 key aspects, namely: It should address the vulnerability factors, these include natural disasters and trends such as a decline in soil fertility or an increase in pests/diseases. Each type of vulnerability requires a different strategy, it should strengthen the farmers capacities to respond to the changing climate in the short and long term. Adaptation strategies may include the development of crop varieties, soil fertility improvement, the development of technological innovations and the establishment of a farmers institution to address the challenges of the changing climate and it should consider risk management in climate change. This could involve the dissemination of climate information at the local level, creating solutions for potential natural disasters and developing best practices. Providing a source of information for farmers on these aspects is an important way of reducing risk.

Adaptation to climate change should be an integral part of the farmers agricultural development program and must not be implemented separately. Agricultural development programs in various sub-sectors should contain principles and strategies for the farmers' adaptation to climate change. Adaptation is a process, so the involvement of farmers in designing the adaptation plan at the local level is very important. The conditions faced by the farmers in general, compounded by the threat of climate change have already become very difficult. For example, insome areas, the negative impacts of extreme climate change on agriculture have included a longer rainy season and a shift of the dry season from its usual time. The farmers can no longer use their local knowledge to accurately predict the growing season, nor to predict seasonal fluctuations as a result of the changing climate.

From the interview discussion, it seems that the major problem that Cameron Highlands farmers have to deal with is deforestation. Deforestation for urbanization, tourism, agriculture and infrastructure development is a significant cause of the changing climate in the Cameron Highlands, according to the discussion. There is no doubt that the changing climate will affect the socio-economic welfare of the farmers, along with water resources, crop performance, the environment and young peoples interest in the agricultural sector. The Malaysian Government needs to have a development policy in placethat emphasizes environmental protection. Over-development of the Cameron Highlands will destroy the agricultural sector and climate andcause temperature increases which in turn will affect the tourism industry.

CONCLUSION

Overall, the changing climate is threatening the socio-economic welfare of farmers, the environment, ecology and sustainable agriculture in the Cameron Highlands and the farmers in the area seem to be struggling to cope with such changes. Among the main environmental changes detected by the farmers are temperature increases, deforestration and significant increases in the number of rain shelters which lead to uncontrolled greenhouse-gas emission. All of these changes have negatively affected the 2 main industries in the Cameron Highlands agriculture and tourism.

A number of factors have been identified as the main causes for such changes. The increasing cost of capital and the need to cope with higher costs of living have placed pressure on the Cameron Highland farmers. These increases and needs are driving farmers in the Cameron Highlands to think of ways to somehow increase their income where clearing new areas of land in order to double their productivity is seen as an effective solution. Additionally, food demand has risen due to the increased population size.

The changing climate has resulted in a number of impacts on the agriculture and tourism industry in particular. Deforestration, as mentioned earlier is one of the changes detected on the positive side, deforestation benefits the agriculture industry as it makes more land available which then results in greater agriculture productivity. Comparatively, however deforestration results in a warmer temperature and this will negatively affect the tourism industry in the area, since the areas cool weather is among the main attractions for tourists to visit the Cameron Highlands while deforestration also means that the Cameron Highlands is gradually loosing its green views. In addition, the changing climate has affected the social and economic aspects of farmers in the Cameron Highlands. Farmers are losing out on income as their agriculture products are suffering from reduced quality and quantity while climate change has degraded interest in agriculture among the younger generation who are opting to migrate to urban areas to seek better jobs.

An adaptation plan needs to be included as an integral part of farmers agricultural development programs. Such, adaptation is vital, as it can ensure the sustainability of the agriculture and tourism industries in the Cameron Highlands. The adaptation plan should consider 3 key aspects, namely: It should address the vulnerability factors, it should strengthen the farmers capacities to respond to the changing climate in the short and long term and it should consider risk management in relation to climate change.

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