



Universiti Malaysia
KELANTAN

**EVALUATION OF THE IMPACT OF
CLIMATE CHANGE (RAINFALL) TOWARDS
NET REVENUE FARMERS IN KELANTAN
USING RICARDIAN APPROACH**

by

AMEER SABRIN BIN MUHAMMAD SHUKRI

Thesis submitted in fulfillment of the requirements for the degree of
Bachelor of Applied Science (Sustainable Science) with Honors

**FACULTY OF EARTH SCIENCE
UNIVERSITI MALAYSIA KELANTAN**

2020

DECLARATION

I declare that this thesis entitled “**Evaluation Of The Impact Of Climate Change (Rainfall) Towards Net Revenue Farmers In Kelantan Using Ricardian Approach**” has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by references or acknowledgment, the work presented is entirely my own.

Signature : _____

Name : Ameer Sabrin Bin Muhammad Shukri

Date : 5 January 2020

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ACKNOWLEDGEMENT

Bismillahirrahmanirrahim.....Assalamualaikum W.B.T, Alhamdulillah praise to Allah with His blessed and help, I'm finally completing this dissertation. First and foremost, I would like to give a thank to my supervisor, Mr. Hizami Bin Hassin, my co – supervisor Dr Azahar Bin Abas and to my partner of this research, Asya Sabreena Binti Mohd Fuad and Nur Azleena Binti Azmi for their guidance and endless support from the planning stage until the final stage of this research project. This research project was formulated with their advice, inspiration, motivation and encouragement in order to gain new knowledge about problem nowadays.

My sincere thanks to Miss Syarifah, research assistance from UMK, Madam Tanty Mazni, Mr Mustafa Kamal and their team (PKJ Pasir Mas), Mr Mohd Hisyam Bin Daud and his team (PKJ Pasir Puteh), Madam Wan Hasyila Binti Wan Suleman and her team (PKJ Tumpat). Thanks for their assistance and commitment in surveying and helping in communication with the farmers for this research. Great appreciation goes to University Malaysia Kelantan Short Term Research Grant for providing me financial assistance for this research project.

My superb appreciation goes to my parents, siblings and family for their love, patience, understanding and support for me in order to finish my research. I would like to thanks to all my friends and especially my housemate for lend me their times, ideas and help solve the problem regarding my research. Lastly, special appreciation goes to everyone involved directly or indirectly towards the compilation of this project.

**Evaluation of The Impact of Climate Change (Rainfall) Towards Net
Revenue Farmers in Kelantan using Ricardian Approach**

ABSTRACT

Climate change plays an important role in ensuring that agricultural activities and the availability of financial resources in Kelantan state. Climate change such as rain has had a huge impact on the farmers because of this, the majority of farmers make agriculture a major source of income. This problem often occurs and causes huge losses to the farmers in Kelantan. The study was conducted to identify problems faced by the farmers and to identify the variables and effects of rainfall that have an impact on the financial resources of the farmers. The method used in this study is the Ricardian approach in which this equation is used to identify the problem encountered. The results obtained from this study indicate the significance of the variables of the variables taken in this study. Overall, the impact of climate change and other factors such as storage, paddy size, first and second season harvest affect the financial resources of farmers.

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**Penilaian Impak Perubahan Iklim (Hujan) bagi Pelan Pendapatan Bersih Pesawah
di Kelantan Menggunakan Pendekatan Ricardian**

ABSTRAK

Perubahan iklim sangat memainkan peranan yang penting dalam memastikan kegiatan pertanian pesawah dan sumber kewangan pesawah di negeri Kelantan. Perubahan iklim seperti hujan telah memberi impak besar terhadap pesawah hal ini demikian kerana, majoriti pesawah menjadikan pertanian sebagai sumber utama kewangan. Masalah ini kerap kali berlaku dan menyebabkan kerugian yang besar kepada pesawah di negeri Kelantan. Kajian ini dijalankan untuk mengetahui masalah yang dihadapi oleh pesawah dan mengenal pasti pemboleh ubah dan kesan hujan yang memberi impak terhadap sumber kewangan pesawah. Method yang digunakan dalam kajian ini adalah Ricardian approach di mana persamaan ini digunakan untuk mengenal pasti masalah yang dihadapi. Keputusan yang terhasil dari kajian ini menyatakan nilai signifikasi dari beberapa pemboleh ubah yang diambil dalam kajian ini. Secara keseluruhannya, impak perubahan iklim dan beberapa faktor seperti simpanan, saiz keluasan padi, hasil tuaian musim pertama dan kedua mempengaruhi sumber kewangan pesawah

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

The climate change refers to measurably huge change of the average climate conditions or diversity, for a long period of time (commonly decades or more). The climate change might be due to inner processes of the earth, external driving, or consistent anthropogenic changes in atmospheric compositions and land use. The climate change is defined as: " Environmental change caused straightforwardly or indirectly by human activity that alters the composition of global atmosphere and is an addition to the diversity of natural climates for a comparable period of time". The climate change additionally give a major effect towards the decrease of downpour in Malaysia. It is critical to see how climate brief action that produces downpour in the upstream territory adds to the arrangement of downstream downpour focuses. It offers an alternate way to deal with finding the reason for climate change (Sciences, 2012).

Climate factors as expressed by the measure of precipitation, daylight hours, temperatures, relative humidity and length of the dry season time frame brought about the variety of yearly generation to zone and territory to region. These climate factors change over time mixing with agriculture. In addition, changes in climate factors are also associated with other environmental changes as well as economic and social changes that affect the agricultural sector of a country. As a result, climate change changes cause the agricultural weakness (McCranie et al., 2011)

The rate of natural disasters particularly floods that causes by overwhelming downpour brought about a huge cost misfortunes. Rice-producing regions of flood-inclined have been developing yearly, particularly marsh zones and territories with poor water system frameworks. Furthermore, there are different variables that add to the event of floods in both the district and the rustic regions. Among the primary elements are logging exercises that brought about an absence of downpour support. Rainfall cannot be having stream straightforwardly to the settlements and homesteads (Barrett & Dorosh, 1996). Defilement of waterway or lake and clashing maintenance causes water drainage to end up shallow and stopped up. The impact of exceed precipitation and obstructed issues cause floods. The floods that occurred in rice improvement zones give such a great impact on farmers that working in the rice fields. This impact the net income of the farmers who are depend on the rice yields as their essential money every day.

Next, rainfall variability can increases the level of environmental stress that affects the capability of the system to maintain productivity. Most extreme rains in the former region happen in November-December, while in the second district happen amid December-February. Most extreme rainfall time district indicates that the mechanism of arrangement is different for precipitation centres in two parts of Malaysia (Sciences, 2012). Precipitation in Malaysia was expanding yet its month to month variety was excessively lofty. Along these lines, the effect of lower precipitation is essentially possible to check through real water framework system, anyway the opposite phenomenon of over precipitation for a particular time, especially at the completion of the yield cycle or at the improvement time period, causes genuine and wild collect harms. As precipitation caused yield hurts, low productivity, high creation cost, it prompts to salary misfortunes to increase and addition in their poverty level.

Additionally, there are other physical components, for instance, soil geography, socioeconomic dimension of education and age estimates of families and the amount of the family unit, which are known as independent factors that give some impact on the net incomes of farmers. Thusly, to counter the issues looked by farmers in the Kelantan districts, this examination is fundamental through driving some survey in order to procure neither or nor the repeat of downpour, socioeconomic and physical conditions of the rice field give an impacts on the reduction and increase in the net income of the farmers.

1.2 Problem Statement

Understanding impact of the climate change on paddy crop will assist to illuminate the point view of view in an issue adding to the plan of supportable sustainable livelihood. Natural disaster events, particularly floods result in a great many ringgit lost, destruction of common assets and environmental. The domains risk for the paddy creation have been building up every year, especially in lowland ares and water framework structures. The absence of an early advised framework system makes farmers increasingly vulnerable against disasters. There are two sorts of deluge structures that can possibly become the factors of flooding. First, medium-sized of the downpour and long duration. Generally downpour overspreads on a wide area. Second, high power and short duration term, this downpour just covers the regions. Also, flood records resulted that there are regular examples of flood occasions. The east and southern shoreline of the peninsular Malaysia, Sabah and Sarawak are commonly affected by floods from December to January when the north eastern storm occurs.

In addition, the time span and intensity force of the downpour/rain. There are different components adding to the deluge and net income of farmers. Among of the fundamental components, one of it is the logging actions, this may cause in an absence of downpour buffer. Besides, total compensation of farmers is similarly a huge issue looked by farmers working in rice fields. Money related imbalance may similarly be one of the segments that causes the absence of net incomes of the farmers. The problem faced by the farmhand are not a direct result of the storm, it may moreover be a socioeconomic components which is immovably associated with the money related issues by farmers as the highest level education in the family members, the size of the family unit and normal average age of the family members.

In view of the past record of the flood in Malaysia, the real floods have occurred since the close – term . In mid1886, a colossal flood with tempest give a serious destruction and economic misfortunes in Kelantan. By then, in 1926 the heavy flood occur and it was said to be the worst flood and had the most seriously impact that have been recorded in Malaysia, makes the decimation to property, Structure of the road, agricultural sectors and yields. One of the most fundamental wellsprings area of the rice production in Malaysia, Kelantan are said to have a worst impact amid the rainy season and this will definitely give an impact to the net incomes of the farmers. Subsequently, the objective of this research was directed to find the impact or factors of growing and decreasing the total compensation of the farmer's impact by precipitation or another of socioeconomic components.(Khairul Hafifi, Nor Amna A'liah, Mohd Syauqi, & Maidin, 2015) .

1.3 Objectives

The study focus on the following objectives:

- To determine the highest net income of the farmer.
- To identify the socioeconomic factors that can be related with the expansion and diminishing of the net income of the farmer.
- To measure the particular effect of downpour on mass production of paddy and the net income of the farmers.

1.4 Scope of Study

The main scope of this study is to determine the impacts of downpour that hit the region all over the states of Kelantan toward the net income of farmers. This research study was held for three month. The survey will be conduct within period to obtain the data from the farmers and villagers. The reason for the investigation was to recognize the issues faced by the farmers. In addition, this survey is conducted to collect the data on each house to obtain the second data to be used in this final year project.

1.5 Significances of Study

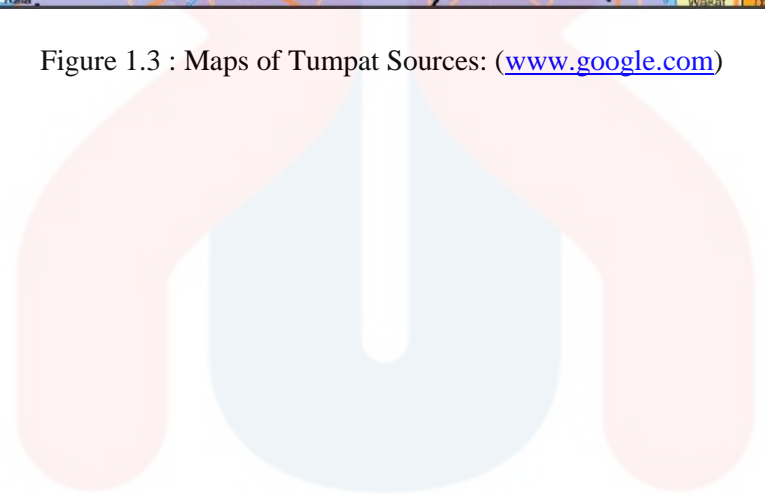
By monitoring and making some research on the impacts of downpour that strike the area around the state of Kelantan, it understands the issues faced by farmers around there. Furthermore, this investigation and studies also distinguishes the issue of the farmers whether it is firmly connected with the impacts of downpour or other independent components that impact the general net income of the farmers. The study will help to find the problem faced by the farmers and come out with ideas and method to diminish the problem occurs.

1.6 Study area

Kelantan is one of the countries that has high yields of rice for the local community. Among the areas that produce high yields are in Pasir Puteh, Pasir Mas and Tumpat areas. This area became the highest area in producing rice crops in Kelantan because the soil structure suitable for paddy and complete and clean water drainage system distributed to paddy crops resulted in high yields. however, there are some



Figure 1.3 : Maps of Tumpat Sources: (www.google.com)



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CHAPTER 2

LITERATURE REVIEW

2.1 Agriculture Sector

The contribution of the Agriculture sector is crucial to the development of a country. Nearly 70% of the total population in rural areas depends largely or partly on the agricultural sector. Small-scale, non-commercial farming practices and traditional traditions produce low productivity, which affects the level of income and saves especially small farmers, and rejects them into a vicious circle of poverty (Lebbe, 2017). The efficiency of agricultural production has increased continuously the application of scientific knowledge. Agricultural development programs are often aimed at increasing generation, transfer and use of knowledge. The increase in total production and average yields are often seen as variables used to measure the return on investment in such development efforts. The main objective of the research is to look at the issue that causes the rate of increment and lessening in net income of farmers where it is a major issue for farmers around Kelantan and Kedah. The issues routinely faced by the farmers are the rate of precipitation and the impact on paddy and rice creation. This issue causes the rate of decrease of paddy net income because of downpour factor, causing the farmers unable to perform agriculture work, such as rice reaping and processing to create rice that are available to be purchased. Furthermore, the condition of paddy fields that were

flooded because of downpour cause the paddy to die due to an excessive water and this impact the creation and qualities of the paddy.

2.2 Climate Change

Climate and agriculture are highly interconnected. Agriculture is highly dependent on climate factors. Climate factors as well as other factors determined by the weakness of agricultural climate and agricultural production (McCranie et al., 2011). The climatic factors as communicated by the measure of precipitation, daylight hours, temperature, relative humidity and length of the dry season time frame result in year-to-year and zone to-zone variability of harvest creation. Weakness to the climatic change and others hazards is a critical set of associations among individuals and the natural environment (Lioubimtseva & Henebry, 2009). These climatic factors are changing over the time having mixed effects on agriculture. Moreover, the changes in climatic factors are also linked with other environmental changes as well as economic and social changes that affect the agricultural sector of a country. As a result, the change of climatic factors leads to the vulnerability of agriculture.

Various impacts of climate change affect various sectors, regions and actors in different ways (Klein, Schipper, & Dessai, 2005). Agricultural sector dominates the economies of 25% of the world's countries, where half of the world's workforce is currently employed. It also accounts for 24% of world agricultural outputs, and uses 40% of land area (Coulter, 2015). Because of the environmental change the farming part is helpless in term of profitability. Climate change affect many agriculture relevant factors and climatic factors like rainfall, temperature, weeds, injurious insects, soil fertility, drainage water supply, cost of inputs, labour scarcity and paddy prices, etc.

These factors vary place to place mostly based on environmental condition. This paper provides a brief outline about the scenario of climate change in Malaysian, and the vulnerability of Malaysian agriculture due to climatic change. It also discusses about the policy options for effectively coping with the vulnerability of climate change. According to the high emissions of greenhouse gases, the temperature is expected to rise by 0.3°C to 4.5°C. The warmer temperatures will cause the sea level to rise by about 95cm within a hundred years. Changes in rainfall can fluctuate from about -30% to +30%. Will this change reduce crop yields in many areas (McCranie et al., 2011).

2.3 Geographical Condition

Land and geographical condition are essential to make sure that the area used as a spot to create rice is powerful and prepared for delivering enormous amount of paddy and quality rice. Flat and contiguous soils from water sources are significant for paddy yields to make sure that paddy yields is sufficiently watered and it similarly urges the farmhand to get water for use during planting. In addition, the slight topographical condition of the stream is a great idea to make sure that the water system framework in the rice fields is not obstructed, runs easily and can convey water to the waterway to avoid the effect of deluge on rice crops. The geographical region of the slopes will give a tremendous impact on paddy crops as water from the slants may flood the rice fields and cause paddy demolition. Accordingly, it is important to give a consideration on the geographical zone of paddy improvement. This is because the topographical conditions likewise give an impact to the net gain of the farmhand. monetary geology may clarify minimal about the global structure of generation (Davis & Weinstein, 1999).

2.4 Ricardian Approach

The Ricardian technique is a model that utilized a cross-sectional way to deal with the agricultural production. The model was created from the investigations land value would reflect its net profitability by David Ricardo (1772-1823). And then in 1994, (Mendelsohn et al., 1994;) the method was introduced in order to assess the impact of deluge, financial and land towards the overall gain of the farmers. The technique rely upon the land the assumption that land lease would reflect the long haul net profitability of farmland. Previous study have coordinated appraisal models of environmental change. They have started to think about the expenses and advantages of controlling

atmosphere. In spite of the fact that there remains a lot of vulnerability about a significant number of the segments of these models, a standout amongst the most questionable marvels is the effect of a particular environmental change on human welfare. One of the most significant effects that originally frightened individuals was the likelihood of widespread harm to agriculture. Subsequently, it not astonishing that agriculture impact studies are among the most sophisticated of the impact studies finished to date (Mendelsohn, Nordhaus, & Shaw, 1995).



CHAPTER 3

MATERIALS AND METHODS

3.1 Study Sites

The study sites of the research on the net income of the farmers is in Kelantan state. This because we find out that Kelantan is a rice cultivation area. In Kelantan the selected area are around Pasir Puteh, Pasir Mas and Tumpat. This territory is a flood-inclined zone and give an affects toward net income of farmhand and paddy processing area. The area selected is specific and is closely related to the climate change problem facing the area. Specific population and area populations are important in the pursuit of data on affected areas. The census was conducted by distributing the questionnaire to the respondents and conducting an interview with 252 people to obtain data in selected areas in the state of Kelantan. The number of the sample sizes was determine by the population of the farmers at the study sites that was choose for the research project. The questionnaire that we provide are easy to understand, most of the farmers have a low level of education. Difficult questions can makes respondents less interested in answering because they do not understand the content in the questionnaire.

3.2 Methods

For this study 2 methods have been used to determine the impact of climate change on farmers in Kelantan. The first method is descriptive statistics where demographic data in section A were used to find out the highest percentages and meanings of the variables in this study. Data from the questionnaire taken from the sample were key in into the SPSS software before analysis. In order to determine the impact of climate change on farmers' net income, the demographic data were used to know the significant number from the descriptive data that was run from the SPSS. The data analysed by SPSS is used to identify variables that influence the income of the farmer in Kelantan.

Next is, using the Ricardian approach to determine the inferential statistics result. The data obtain from the questionnaire and annual rain data were used to determine the result of this project. The result consist of standard deviation, mean, minimum and maximum number of the statistical variable used in Ricardian method. From the result obtain we can interpret the variable that influence in net revenue of the farmers. Besides, we also can determine whether the impact of climate change on the net income of the farmers is influence by the descriptive or non-descriptive data.

3.2.1 Questionnaire

This questionnaire consist of 3 part to be answer by the respondent. This question is particularly important in the effort to collect primary data from farmers to ensure that the data provided is complete and correct for use in the Ricardian method in order to obtain results of the impact of climate change (rainfall) towards net revenue farmers in Kelantan. Section A is the demographic of respondents, where data is taken from this section are PKJ area, PPK area, Gender respondent, Age of respondent, ethnicity, religion of respondent, marital status, number of households, number of working households, area of paddy cultivation area , experience in the agricultural sector, government subsidies, education level, highest household level of education, monthly household income, savings, working hours, first and second season of harvesting income, irrigation systems and planting systems . The use of demographic data is intended to facilitate the process of obtaining information from farmers. Sample studies have become the basic building blocks of demographic research (Axinn, Link, & Groves, 2011). Many of the major advances in both empirical evidence and theoretical reasoning are based on the findings from the survey. But despite the sophistication of surveying and analytical progress, the general population's reluctance to participate in surveys poses a major threat to the field.

Next is section B, which is knowledge and awareness. This section covers questions related to the farmer's knowledge and awareness of climate change that are likely impact the farmer. Part B covers knowledge-related questions on climate change, harvesting season, change in rainy season, up/down temperature, frequency of rainfall, rainfall period, crop damage problem, crop disease, pest control and crop management cost improvement issues. This data was taken in an effort to gain a deeper

understanding of the knowledge and level of preparation of climate change farmers that play an important role in the rice cultivation process.

Lastly, section C includes questions based on the level of preparedness for climate change. The questionnaire was a likert scale in which respondents should mark questions on the scale provided 1 = disagree, 2 = disagree, 3 = moderate agree, 4 = agree and 5 = strongly agree. This question covers the level of preparation of the farmers, in terms of knowledge, the steps to prepare in the event of flood or drought, Technical (appropriate use of paddy, use of technology and durable crops) and Finance (savings, insurance protection, side work and government assistance for climate change)

3.2.2 Data Collection

The primary data will be collected from the survey among the farmers and villagers. With the farmers as research subject from three area that consist of 2 to 3 PPK in each area. From this database were selected: demographic, knowledge & awareness, and preparation level of the farmers. While for the secondary data or identification of climate information for the study sites was made by taking the annual rainfall data from 2004 to 2018 taken from Lembaga Kemajuan Pertanian Kemubu (KADA) that will be utilized to accomplish the targets of the investigation. The discoveries will be obtain through two research strategies which is descriptive and regression model. Survey was conduct in each selected district which is Pasir Puteh, Pasir Mas and Tumpat. The purpose of the survey was to obtain data from farmers and villagers about the impact of rain, the frequency of rainfall in the area

In addition, this survey also gather the information about the number of households in the village, the average age of the house members, the income of the household and the level of education of the village community. The surveys provided

questionnaire and conduct an interviews session to the villagers in order to identify the problems faced by farmers. A total of 252 surveys was conduct in each selected area for data collection. The area coverage were about 2km from the paddy field to make sure that the data collected were from the farmers and the villagers from the study area. The data collected was used to performing the results. The information in this scenario is the basis for Lembaga Kemajuan Pertanian Kemubu (KADA) to assess the impact of climate change and develop solutions to respond to climate change today.



3.3 Data Analysis

For the descriptive data, demographic data were collected from questionnaire in section A and was analysed using SPSS software to find out the percentage and mean of each data taken from the farmers in Kelantan. The data's taken from this section are PKJ area, PPK area, Gender respondent, Age of respondent, ethnicity, religion of respondent, marital status, number of households, number of working households, area of paddy cultivation area , experience in the agricultural sector, government subsidies, education level, highest household level of education, monthly household income, average savings, average working hours, average seasonal revenues 1 & 2, irrigation systems and planting systems . The use of demographic data is intended to facilitate the process of obtaining information from farmers. The aim of obtaining the highest percentages and meanings is to obtain results that indicate the highest number of variables that contribute to the problem faced by the farmers in Kelantan.

Next is for inferential data, the data was analysis by applying the Ricardian approach to investigating the relationship between climate and agriculture productivity using household-level (Kurukulasuriya, Nations, Programme, Ajwad, & Bank, 2007). The Ricardian method is a model that used a cross-sectional approach to studying agricultural production. This study applies two main set of the modified Ricardian model. The first model is defined without adaptation, which relies only on integrated physical factors as climatic variables which was the annual rainfall data that was collected from KADA. It was used to determine rather the rainfall give an impact towards the net revenue of the farmers or not. Next, for the second model, with adaptation which is the net revenue is the function of two sets of regresses are climate variables (rainfall data) and socioeconomic variables such as characteristics of the

households (age of household, education level, sex of household head, cropland area, household size).

These have empowered us to think about farmers adjustments and to survey their impacts on the agriculture income. This second stage will prompt the model that are with and without adaptation were separately assessed. With cross sectional information, interpretation data from SPSS software may experience issues, for example, change the perception of the rainfall towards net revenue of the farmers, the relationship between socioeconomic and income of the farmers, which predispositions the estimation results for the this research.

3.3.1 SPSS Software

SPSS is short for the Statistical Package for Social Science, and is used by various researchers for complex statistical analysis of data. SPSS software packages have been created for statistical management and analysis of social science data. It was originally launched in 1968 by SPSS Inc., and subsequently acquired by IBM in 2009. Quantitative data involves techniques of converting data to numerical forms and subject them to statistical analysis. The demographic data that was collected from the questionnaire was inserted into the SPSS software in order to get the result. The SPSS software is set to produce the highest percentages and number of mean in each variable that has been set. The SPSS will analysis the data with the reliable statistical test and the output data will produce and use to interpret the net revenue of the farmers. From the result obtain it can clearly show the highest percentage of the each variable, the mean number. Besides, it also can be used to decide and know the problem occurs between the farmers in Kelantan.

3.3.2 Ricardian Method

$$v = \sum PiQi(X, C, S, G, H) - \sum PiX \quad (4.1)$$

The equation above (4.1) was the model of the Ricardian method, in this equation, Pi is the market price of crop Income, Qi is the output of crop Income, X is a vector of purchased inputs (other than land), C is a vector of rainfall variable, S is a vector of soil variable, G is the vector of economic variables, H is the water flow, and PiX is a vector of input prices. The theoretical profit function, this study assumes that farm households are always looking to optimize their profits basing on the terms available of the inputs change, and they will select crops, production type or input to maximize net income, which will be a function of just the exogenous variables. The standard Ricardian model relies on a quadratic formulation of climate.

For the modified Ricardian Method, it was created in order to rely on a quadratic formulation of climate. This modified Ricardian only for model to describe the net revenue. All calculations use SPSS software to find significant values to determine the relationship between the net revenue of the farmer and the variables used. The net revenue of the farmers can be expressed as follows:

$$v = \beta_0 + \beta_1 C^1 + \beta_2 C^2 + \beta_3 S + \beta_4 G + \beta_5 H + \mu i \quad (4.2)$$

Coefficient of β (constant) = 1.529

From the equation (4.2), v is the net revenue of the farmers, C is a variable of the average annual rainfall, S is the profit of first season of harvesting, G is the profit of second season of harvesting, H is the set of household's socioeconomic variables, β coefficient of the variables and μ is an error term. The modified equation can be used to determine the income of the farmers by using different variables to obtain different

values as needed . The modified of Ricardian model which was separated into two main set of model in order to calculate the data that will collect from the questionnaire and secondary data from KADA. The first model is known as without adaptation which only depends on the physical factors that are integrated as climate variables such as rainfall. In the second model, with the adjustment, the function of two sets which are climate variable (rainfall data) and socioeconomic variable were use in order to find the net result of the farmers. The socioeconomic variable include of characteristics of the households (age of household, education level, sex of household head, cropland area, household size, income of first and second season of harvesting) (Huong, Bo, & Fahad, 2018).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter discusses the result of the study. The purpose of this study is to determine the effect of the climate change towards net revenue of the farmers. The chapter begins with the discussion of the descriptive data interpret by the SPSS software that included the variables that need to be consider in the research project which were PKJ area, PPK area, Gender respondent, Age of respondent, ethnicity, religion of respondent, marital status, number of households, number of working households, area of paddy cultivation area , experience in the agricultural sector, government subsidies, education level, highest household level of education, monthly household income, savings, working hours, income of first and second season of harvesting , irrigation systems and planting systems. The percentage and mean of each variable that were require in this project had been discuss to clear the objective of the project.

Next, the discussion on result after using the Ricardian method that can be separated into two parts which is with adaptation and without adaptation. Next, the discussion after the result present on Ricardian approach that has been figure out to give a clear explanation for the effect of the climate change towards net revenue of the farmers. Finally, The correlation between the with adaptation and without adaptation result.

4.2 Socio – demographic of the respondent

This section describes the socio demographic data of respondents including household income, respondent's age, number of households employed, household education, savings, area of paddy field, income of first and second of harvesting season in the study area which are likely became the factors that can impact the net revenue of the farmers.

Variables	Frequency	Percentage (%)
Income	RM601-RM1000	40.1
	>Rm4001	2.8
Gender	Woman	4.8
	Man	94.4
Age	50-59 Years old	30.6
	<20 Year old	1.6
Ethnic	Melayu	97.2
	Siamese	2.8
Number of household	3-4 Orang	34.1
	<2 Orang	9.9
Education (leader)	Secondary school	41.7
	Others	3.2
Saving	<RM50	36.5
	RM301-RM400	7.9
Sizes of paddy field (acre)	<10	76.3
	>31	4

Table 4.1 : Socio – demographic of the respondent

Farmer's income is important to support the family (Barrett & Dorosh, 1996), farmer's income depends on the size of the paddy fields and the changing seasons. Seasonal changes such as floods and droughts have a major impact on the income of these farmers as rice is likely to be damaged due to flooding because of excessive flooding and lack of water in the paddy field during the dry season. From the table above it can be said that, The highest percentage of farmer's salaries was 40.1% which is on average between RM 601 to RM1000. This is because the value of the farmers' salaries depends on the yield of each season and the area of rice cultivation. Next is the gender of the farmers which plays an important role in knowing the manpower to manage the rice crop in Kelantan. The highest percentage was 94.4%, which was the highest number of farmers is male while the low value was female as the job requires a strong workforce to make sure the quality of the paddy.

The highest percentage age of the farmers was 30.6% . The average age of the farmers were within 50 -59 years old, because most of the farmers start to farm the paddy after retire and certain of them were already work as farmers since they were teenagers. Farmers in Kelantan have 2 ethnicity which were Malay and Siamese, the highest was Malay (97.2%). Minority the farmers were Buddhist as the state of Kelantan near to Thailand, besides, there were also Siamese village in Kelantan (Village, 1982). For household , the highest percentage of householders was 34.1% which were 3 - 4 were members. this can be stated that most farmers still have dependencies for non-working households. Next is the education level, which was very important in ensuring that people have the knowledge of climate change and how to avoid the harmful effects of climate change (Maccarthy, 2012). According to census data taken from farmers, it was found that farmers in Kelantan have low education level where the highest percentage of the education level was 41.7%.

Size of paddy fields play an important role in producing high quality and quantity of the rice. The size of the paddy field depends on the landowner(Hussin, 2013). Most of the farmers here cultivate rice on their own land and are assisted by the government by subsidizing oil and fertilizers to facilitate farming and ensure the quality of rice produced. The highest percentage area of paddy field was 14.3% which was about 10 acre of land. Saving is important for future use, according to table 4.1 the highest percentage of saving was 36% which was below than RM 50, This because the net revenue of the farmers are low as it was depending on the income of these farmers. Most farmers said that they do not have enough financial resources to make their savings as rice production was decline due to climate change.

Variable	Frequency	Percentage (%)
First season of harvesting (Acre)	< RM 6000	39.5
	RM 6001 – RM 15000	37
	RM 15001 – RM 35000	15.5
	>RM 35001	8
Second season of harvesting (Acre)	< RM 6000	45.3
	RM 6001 – RM 15000	37.5
	RM 15001 – RM 35000	11.2
	>RM 35001	6

Table 4.2 : Gross profit of harvesting season 1 and 2

Based on the table 2.0, the data of first and second harvesting seasons was very important in order to justify the gross profit and income of the farmers in Kelantan. The harvest usually depends on the area of rice fields and climate change. the larger the rice cultivation area, the bigger the income of the farmers. The gross income of the farmers from the harvest each season will be deducted to buy new seeds and the use of bulldozers. Furthermore, the net income value for the season will be divided into 6 months to get a monthly income of the farmers. The result of the first season is usually greater than the second. The first season, (March till August) were protected from monsoon season and the second season (Sept till February) were decreasing as monsoon season hits the state of Kelantan. According to table 2.0, the highest percentage of the gross profit in season 1 and season 2 was 13.9% and 10.3% which was RM 10000 respectively.

4.3 Summary statistics of variables used in the Ricardian Method

With farmers household as research subjects, a total of 252 farmers from 3 PKJ were selected specifically due to the frequently flood problem in Kelantan. From this database were selected is socioeconomic characteristics of the farmers in order to identify the relationship between the socioeconomic of the farmers and the net revenue of the farmers. The socioeconomic of the farmers such as gender, age, ethnic, household, area of rice field, education (KIR), income, savings, first and second season of harvesting paddy. and also an annual rainfall for 5 years from 2014 to 2018 will be used as variables to investigate the impact of the climate change towards net revenue of the farmers.

Variable	Mean	Std. Deviation	Minimum	Maximum
Gender		0.031437	Woman (12)	Man (238)
Age		1.36964	20	56
Ethnic		0.49399	Siamese	Malay
Household		1.01119	2	>6
Area of rice field (Acre)	9.3142	12.08454	3	150
Education(KIR)		1.02341	Others (8)	Secondary school (145)
Income (RM)	2460.03	1.22166	400	4000
Savings (RM)	2100.11	1.71377	50	3500
First season of harvesting (RM)	14937.02	28573.489	30	400000
Second season of harvesting (RM)	12514.37	26136.803	0	370000
Average rainfall low season for 5 year (mm)	818.28	2163.06	704.22	1057.05
Average rainfall low season for 5year (mm)²	669582.16	4678828.56	495925.81	1117354.70
Average rainfall peak season for 5 year (mm)	2312.08	4993.36	1299.82	3152.77
Average rainfall peak season for 5year (mm)²	5345713.93	24933644.09	1689532.03	9939958.67

Table 4.3 : Summary statistic of variables used in the Ricardian Method

The identification of climate information which is rainfall data for the study sites was made by taking the annual rainfall from Lembaga Kemajuan Pertanian Kemubu Kelantan (KADA). Rainfall data were collected by KADA from the meteorological station which includes the amount of monthly precipitation and annual precipitation in the 2014 – 2018 periods. Average rainfall data were calculated according to season based on the classification, the low season from March to August and the peak season from September to February of next year. The key summary statistics of all the variables used in the estimation were given in Table 4.3.

4.4 Regression Models

Variable	Model without adaptation	Model with adaptation
Average rainfall low season for 5 year (mm)	0.078	0.056
Average rainfall low season for 5 year (mm) ²	0.115	0.108
Average rainfall peak season for 5year (mm)	0.041	0.032
Average rainfall peak season for 5year (mm) ²	0.033	0.027
Area of rice field (Acre)		0.001
Savings (RM)		0.000
First season of harvesting (RM)		0.000
Second season of harvesting (RM)		0.000
N	252	252
Pseudo R ²	0.016	0.223

Significant at 5% level

Table 4.4 : Result of significant value for variable

The study applies two main set of the modified Ricardian model. The first model is defined without adaptation, which relies only on integrated physical factors as climatic variables which is rainfall data(Shakoor, Saboor, Ali, & Mohsin, 2011). In the second model, in order to observe the net revenue of the farmers, two sets of regressors are used which is climate variables (rainfall data) and socioeconomic variables such as characteristic of the households (gender of household, age of household head, ethnic, household, education of household head, area of rice field, savings, first and second season of harvesting). The significant level used is 0.05 as it can give an efficient result in order to determine the problem occurs.

The result on table 4.4 obtain from SPSS helps us to take farmers adaptations into consideration and to assess their effects on the farmer's income. This second stage will lead to the model with adaptation options. The coefficients of Ricardian model in two models that are with and without adaptation were respectively estimated. With SPSS software, using the multiple regression to interpret the data to produce the significant value for variable that was used in non – adaptation and adaptation model. Table 4.4 depicts the regression estimates of two models. The level of interpretation of the model reflected through Pseudo R² was 1.6% in the non – adaptation model and 22.3% in the adaptation model. The coefficient explained a defined relationship between socio – economic of the farmers and impact of rainfalls towards net revenue of the farmers.

In table 4.4, the result shows the response of net revenue to average rainfall and socioeconomic of the household. The linear terms of average rainfall on low and peak season both showed significant value of the variables used which were under 0.05 except for the average rainfall on low season squared. The linear term for average rainfall on low season, peak season normal and squared is positive and significant and linear term of rainfall on low season squared is not significant. This result implies that increase in rainfall tend to impact the net revenue of the farmers(Shakoor et al., 2011) therefore it can be said that further increase of the rainfall start to have negative effect on farmer's net revenue as the downpour will damage the cropland due to excessive of water and poor irrigation system.

Next is, the result on the table 4.4 also shows the regression result with adaptation which is depends on climatic change(rainfall) and socio – economic variables entertained in the model. The linear term of most average rainfall was significant as it was under 0.05 and gave the expected signs except the average rainfall on lower season squared. The significant value of average rainfall (except average rainfall on low season squared) and socioeconomic variables such as area of paddy field, saving, first and second of harvesting give an effect towards net revenue of the farmers, therefore it give an evidence that the net revenue of the farmers depends on the downpour and certain socioeconomic variables. Area of paddy crop is an important factor in knowing the income of farmers as it affects the amount of rice production per farmer. The bigger the rice crop area, the bigger the income of the farmers. In addition, the harvest of the first and second seasons is also important because by knowing the amount of rice production in the first and second seasons, we can indirectly identify the gross income of the farmers and identify the net revenue of the farmers as it is closely related to the income of the farmers.

Increasing net revenue of the farmers as whole arid region was hugely dependent on rainfall as the paddy crop highly dependent on average of downpour as high downpour will affect the growth stage of paddy(Shakoor et al., 2011). Socioeconomic variables were used to define a linear relationship with net revenues. Gender, age, ethnic, household, education area of crop, saving, first and second season of harvesting were taken. The regression result indicate that the rainfall has significant impacts on incomes of the farmers. Besides rainfall factors, the result also shows the socioeconomic of household like savings, area of paddy crop, first and second season of harvesting that are positive and significantly affect the net revenue of the farmers(Huong, Bo, & Fahad, 2018).



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CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

In this study, it describe a Ricardian analysis of the net revenue of the farmers in Pasir Puteh, Pasir Mas and Tumpat. The above analysis more or less show the effect and problem occurs towards the farmers due to the impact of climate change in selected region in Kelantan. In general, based on significant values shows from the table 4.4, it shows that the rainfall is expected to be harmful to net revenue of the farmers. Kelantan government must consider designing and implementing adaptation system for the paddy to increase the production of the crop. Besides, adaptation option should focus on structural change of crops, development of new plant varieties that are suitable to the region climatic conditions, planting drought tolerant, educating farmers, strengthen the financial services, and implementing agricultural diversification.

5.2 Strength

These studies provide new knowledge on how the effect of climate change towards net revenue of the farmers. The farmers also have their own method to know the weather that is suitable to start the farming. Besides, the farmers share some knowledge to know the quality of the cultivated rice, how to cultivate the rice, the proper time used the pesticide and the type of rice used to ensure maximum yield and durability towards climate change.

5.3 Limitation

The problems encountered during this research were the time constraints and the knowledge level of the farmers in the study area. The time constraints that occur during the primary data collection process where to ensuring the farmers to spend time with us to answer the questionnaire are really hard because they started to work early in the morning. KADA had assist in the efforts to gather the farmers in one place to ensure that they answer the questions provided. Furthermore, due to the problem of farmers' understanding and level of knowledge , the average age of the farmers in Kelantan is between 50 - 60 years. According to result the level of understanding of farmers is low as the average highest education stage are on primary and secondary school only, which makes it difficult to understand the questionnaire that we provides. Besides, we need to give some explanation to ensure they understand the content of the question, what is climate change and the impact toward the net revenue of farmers.

5.4 Recommendation

There are several interesting investigation and research remaining to be carried out in this project. This research can be developed and solve by creating an idea or suggestion for the Kemajuan Pertanian Kemubu (KADA) in order to help the farmers in Kelantan. KADA has identified some issues related to agriculture and farmers, various ways and efforts have been made to improve manpower and produce. However, this effort took a long time because of the constraints faced by KADA itself in order to help farmers in Kelantan. The average farmer strongly agrees to adopt new technologies for the irrigation and cultivation system, besides, the farmers are also interested if KADA introduces new species for rice that are more susceptible to climate change and more durable. As recommendation, here are some suggestions in order to solve the problem faced by the farmers in Kelantan:

- Increase the use of technology
- Repair drainage system to avoid excess water in the paddy field
- Provide information and knowledge to the farmers in Kelantan

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APPENDIX A

Example of questionnaire:



MAKLUMAN

1. Universiti Malaysia Kelantan (UMK) sedang melaksanakan sebuah kajian mengenalpasti impak perubahan iklim kepada sosio-ekonomi pewasah di Kelantan.
2. Jesteru, pihak UMK memohon jasa baik Tuan/Puan agar dapat memberikan kerjasama kepada kami bagi menyempurnakan proses pengumpulan data ini.
3. Semua maklumat adalah SULIT dan RAHSIA.
4. Pihak Tuan/Puan boleh menolak dari menyertai kajian ini sekiranya boleh mengancam keselamatan Tuan/Puan.

BAHAGIAN A: DEMOGRAFI RESPONDEN

- 1) Kawasan PKJ:
 - Kota Bharu
 - Bachok
 - Pasir Putih
 - Pasir Mas
 - Tumpat
- 2) Kawasan PPK:
 - Niam Puri
 - Jaya Peringat
 - Sri Gunong
 - Bukit Jawa
 - Kubang Sepat
 - Alor Mas
 - Bakat Baru
 - Tanjung Puri
 - Sungai Ketereh
 - Puteri Saadong
 - Cherang Rotan
 - Kubang Bunut
 - Bunga Raya
- 3) Koordinat GPS: _____ (Hektar)
- 4) Jantina (KJR):
 - Lelaki
 - Perempuan
- 5) Umur (KJR):
 - < 20 Tahun
 - 20-29 Tahun
 - 30-39 Tahun
 - 40-49 Tahun
 - 50-59 Tahun
 - > 60 Tahun
- 6) Etnik (KJR):
 - Melayu
 - Cina
 - India
 - Lain-lain _____
- 7) Agama (KJR):
 - Islam
 - Buddha
 - Hindu
 - Lain-lain _____
- 8) Status Perkahwinan:
 - Berkahwin
 - Bujang
 - Janda/Duda
 - Lain-lain _____
- 9) Bilangan ahli isi rumah:
 - < 2 Orang
 - 3-4 Orang
 - 5-6 Orang
 - > 6 Orang
- 10) Bilangan ahli isi rumah yang telah bekerja:
 - 1 Orang
 - 2 Orang
 - 3 Orang
 - > 4 Orang
- 11) Luas kawasan tanaman padi
- 12) Pengalaman bekerja dalam sektor pertanian:
 - < 5 Tahun
 - 6-10 Tahun
 - 11-15 Tahun
 - > 16 Tahun

13) Menerima subsidi kerajaan:

Subsidi	Ya	Tidak
Racun	<input type="radio"/>	<input type="radio"/>
Baja	<input type="radio"/>	<input type="radio"/>
Minyak	<input type="radio"/>	<input type="radio"/>
Jentolak	<input type="radio"/>	<input type="radio"/>

14) Tahap pendidikan tertinggi (KIR)

- Sekolah Rendah
- Sekolah Menengah
- Sijil/STAM/STPM
- Dipoma
- Ijazah/Sarjana/PhD
- Lain-lain _____

15) Tahap pendidikan tertinggi ahli isi rumah:

- Sekolah Rendah
- Sekolah Menengah
- Sijil/STAM/STPM
- Dipoma
- Ijazah/Sarjana/PhD
- Lain-lain _____

16) Pendapatan isi rumah/bulan:

- < RM600
- RM601-RM1000
- RM1001-RM2000
- RM2001-RM3000
- RM3001-RM4000
- > RM4001

17) Purata simpanan isi rumah/bulan:

- < RM50
- RM51-RM100
- RM101-RM200
- RM201-RM300
- RM301-RM400
- > RM401

18) Purata jam untuk bekerja sehari:

- < 2 Jam
- 3-4 Jam
- 5-6 Jam
- > 7 Jam

19) Purata pendapatan kasar dari hasil tuai:

- a. Hasil tuai tahun pertama RM _____
- b. Hasil tuai tahun kedua RM _____

20) Sistem pengairan di bendang:

- Aktif (bantuan teknologi)
- Pasif (Manual)

21) Sistem Penanaman

- Poli (pelbagai tanaman)
- Mono (satu tanaman)

BAHAGIAN B: PENGETAHUAN & KESEDARAN

1) Adakah anda pernah dengar/tahu berkaitan isu perubahan iklim?

- Ya
- Tidak

2) Adakah anda mempercayai perubahan iklim itu benar-benar wujud?

- Ya
- Tidak

3) Adakah anda sadar perubahan iklim akan memberi kesan kepada tanaman padi?

- Ya
- Tidak

4) Adakah anda dapat merasai atau perhatikan perubahan iklim/cuaca dalam tempoh 30 tahun di kawasan anda?

- Ya (Sila ke soalan seterusnya)
- Tidak (Sila ke BAHAGIAN C)

5) Sila tanda (✓) perubahan yang anda dapat rasa/perhatikan:

Perubahan iklim/cuaca	Ya	Tidak
Suhu meningkat	<input type="radio"/>	<input type="radio"/>
Suhu menurun	<input type="radio"/>	<input type="radio"/>
Peningkatan tempoh hujan	<input type="radio"/>	<input type="radio"/>
Peningkatan jumlah hujan	<input type="radio"/>	<input type="radio"/>
Peningkatan kekerapan hujan	<input type="radio"/>	<input type="radio"/>
Penurunan tempoh hujan	<input type="radio"/>	<input type="radio"/>
Penurunan jumlah hujan	<input type="radio"/>	<input type="radio"/>
Penurunan kekerapan hujan	<input type="radio"/>	<input type="radio"/>

6) Apakah kesan-kesan perubahan iklim kepada pengurusan tanaman padi dalam tempoh 30 tahun yang anda perhatikan. Anda dibenarkan tanda (✓) lebih daripada satu jawapan.

- Mengubah masa dan taburan hujan
- Perubahan mendadak dalam musim menuai
- Pengurangan hasil tuai tanaman
- Peningkatan kekerapan kemarau
- Peningkatan kekerapan banjir di bendang/ladang
- Kerosakan hasil tuai
- Meningkatkan kadar gangguan serangga perosak
- Meningkatkan kelaziman penyakit tanaman
- Hakisan tanah di kawasan bendang/ladang
- Peningkatan kos pengurusan tanaman
- Kerosakan jalan penghubung di bendang/ladang
- Pencemaran air di bendang/ladang

7) Sejuah manakah perubahan seperti di atas (Soalan 5 & 6) yang anda rasa/perhatikan?

- Perubahan yang sangat ketara
- Perubahan yang ketara
- Beberapa perubahan
- Hanya sedikit perubahan
- Tidak pasti

8) Penilaian tahap keterancaman dan risiko perubahan iklim/luce kepada pesawah:

Penilaian tahap keterancaman kepada pesawah

1 = Tidak tahu, 2 = Tidak terancam, 3 = Sederhana terancam, 4 = Terancam, 5 = Sangat terancam

Penilaian tahap risiko kepada pesawah

1 = Tidak tahu, 2 = Rendah risiko, 3 = Sederhana Risiko, 4 = Berisiko, 5 = Sangat berisiko

Kejadian	Keterancaman (Skala 1-5)	Risiko (Skala 1-5)
Peningkatan suhu	()	()
Pengurangan hujan dan pengalihan yang lemah semasa musim tanaman	()	()
Bencana banjir	()	()
Kemarau (semasa musim menanam)	()	()
Perubahan masa hujan	()	()
Perubahan mendadak dalam musim menanam	()	()

BAHAGIAN C: TAHAP PERSEDIAAN

Sila tanda (!) pada skala yang disediakan

1 = Sangat tidak setuju, 2 = Tidak setuju, 3 = Sederhana setuju, 4 = Setuju, 5 = Sangat setuju

1) Pengetahuan

Kenyataan	1	2	3	4	5
Saya membust penambah baik dalam cara penanaman padi sebagai fidek beles kepada perubahan iklim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya pernah menghadiri sebarang kursus/program sebagai langkah menghadapi perubahan iklim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya mempunyai pengetahuan asas berkaitan langkah menghadapi perubahan iklim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya ada menerima sebarang informasi berkaitan perubahan daripada agensi kerajaan/bukan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Kenyataan	1	2	3	4	5
kerajaan					
Saya pernah menerima risalah maklumat berkaitan langkah menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2) Teknikal

Kenyataan	1	2	3	4	5
Saya menggunakan teknologi terkini bagi menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya bertukar kepada jenis padi yang sesuai bagi menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya bersedia bertukar ke tanaman lain yang lebih tahan/lasak bagi menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya bersedia menggunakan tekniksistem tanaman padi yang lebih rentan terhadap perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3) Kewangan

Kenyataan	1	2	3	4	5
Saya mempunyai simpanan kewangan sebagai langkah menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya ada mengambil perlindungan insuren jika berlaku kerosakan tanaman akibat perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya melakukan kerja sampingan sebagai langkah menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saya menerima sebarang bantuan kewangan/dana sebagai langkah menghadapi perubahan iklim	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

TERIMA KASIH
~SOALAN TAMAT~