THE CHALLENGES IN THE ADOPTION OF FERTIGATION SYSTEM IN JOHOR

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DECLARATION FORM

The project entitled " The Challenges in the Adoption of Fertigation System in Johor Area", prepared by Siti Fatimah binti Johan and submitted to the Faculty of Agriculture in fulfilment of the requirement of PPT 4999 (Project Paper) for the award of the degree in Bachelor Science (Agribusiness) is based on my original works

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ABSTRACT

Population of Malaysia is increasing drastically over the years. This cause the demand on food also increases. However, the self-sufficient level still does not achieve to 100%. Therefore, the agriculture sector had changed its trend because of the development of agriculture sector and because of the consumption patterns. It resulted to majority of the farmers seek to maximum yield and produce high quality food-based products. Therefore, the adoption of fertigation system had become main choice for agriculture producers especially vegetables producers. The purpose of this study is to determine challenges in the adoption of fertigation system in Johor. This include to find out the association between socio-demographic and the rate of adoption and also to find out the challenges that influence the rate of adoption. A sample of 60 respondents was selected from 10 districts in Johor. 6 respondents were chosen to represents each districts. The data collected were analyzed by using descriptive analysis, chi-square analysis and factor analysis. The findings is majority of the farmers still adopted this system in small scale farming and only chili crops had become a main crops among the farmers. From chi-square analysis, only gender and education level had an association with the rate of adoption. The factor analysis had concluded that there are three main challenges factor that could affect the rate of adoption. A first challenge is innovation where it could become a barrier depending on the attributes of the technology. Second, communication challenges had become problems when the spreading of the information is not widely. Lastly, the social system could become challenges when there is no motivation and influence from the society.

ABSTRAK

Bilangan penduduk Malaysia semakin meningkat secara drastik sepanjang tahun ini. Ini menyebabkan permintaan terhadap makanan juga meningkat. Walau bagaimanapun, tahap sara diri masih tidak mencapai 100%. Oleh itu, sektor pertanian telah mengubah trendnya kerana pembangunan sektor pertanian dan corak pemakanan. Hal ini menyebabkan kebanyakan petani berusaha untuk maksimum pengeluaran hasil dan menghasilkan produk berasaskan makanan yang bermutu tinggi. Oleh itu, sistem fertigasi telah menjadi pilihan utama bagi pengeluar hasil pertanian terutama pengeluar sayur-sayuran. Tujuan kajian ini adalah untuk menentukan cabaran dalam penggunaan sistem fertigasi di Johor. Ini termasuk untuk mengetahui perkaitan antara sosio-demografi dan kadar penggunaan dan juga untuk mengetahui cabaran yang mempengaruhi kadar penggunaan. Sampel sebanyak 60 responden dipilih daripada 10 daerah di Johor. 6 responden dipilih mewakili setiap daerah. Data yang dikumpul dianalisis dengan menggunakan analisis deskriptif, analisis ki-square dan analisis faktor. Penemuan melalui kajian ini adalah majoriti petani yang masih menggunakan sistem ini dalam skala pertanian kecil dan hanya tanaman cili yang menjadi tanaman utama di kalangan petani. Dari analisis ki-square, hanya jantina dan tahap pendidikan yang berkaitan dengan kadar penggunaan. Analisis faktor telah menyimpulkan bahawa terdapat tiga cabaran utama yang boleh menjejaskan kadar penggunaan. Cabaran pertama adalah cabaran inovasi di mana ia boleh menjadi halangan bergantung kepada sifat-sifat teknologi. Kedua, cabaran komunikasi menjadi masalah apabila penyebaran maklumat tidak meluas. Akhir sekali, sistem sosial dapat menjadi cabaran apabila tidak ada motivasi dan pengaruh dari masyarakat.

CHAPTER 1

INTRODUCTION

1.1 DEMAND ON FOOD

Currently, in April 2018 the world population has already reached more than 7.6 billion people. That is huge amount of population. This situation leads to the world demand on food product to increase drastically. As the population increase, the food consumption will also increase. Average per capita food consumption in growing countries is expected to expand by 2030, with only one in seven people consuming less than 2500 calories per day. It is expected that only one from seven people will eat less. That is why the demand on food had been increase. It is also predicted that by 2030, global food demand is expected to grow by 35% in future. This is drastic growth for global food demand.

In order to fulfil the needs and wants of the people in the world on food product is by increasing the agriculture yield. However, global water demand is expected to increase more than 50% in 2030, with agriculture sector itself requiring more water than domestic and industrial use. This water usage will make the water supply reduce day by day. Many alternatives had been done to ensure the water consumption by the agriculture sector reduces. Therefore, most of the farmers tend to adopt new technology such as fertigation technology in agriculture practices that could maximize the yield and at the same time reduce the water consumption.

1.2 AGRICULTURE TREND

Nowadays, agriculture sector producers seek to produce maximum yield and in the same time producing high quality food base products. This condition happens because the demand from consumer of the agricultural product is higher than the production itself. Increasing the population in the world becomes a main factor of increasing in the demand of high quality food based product. Therefore, producer want to produce have to make the self-sufficient level achieve 100 percent or more in future. In order to obtain maximum yield with a high quality agricultural food base product, it is crucial to supply the crops with enough water and nutrients needed by plant (Hagin, J. , M. Sneh, 2003). The balance of water supply and nutrient taken by crops will make the crops live healthily and producing more high quality products.

At World Food Summit 1996, Food and Agriculture Organization (FAO) estimated that in future 60 percent of the extra food demanded by consumer in the world is come from irrigated agriculture. This is because the irrigated agriculture keeps supplying enough water and nutrients to the plant growth. In the same time, The International Commission on Irrigation and Drainage (ICID) predicted that food production in the next 25 years must double from the current productivity to meet the world demand. Unfortunately, in order to produce sufficient food 70 percent of fresh water in the world is used for agricultural sector. Therefore, ICID came out with a slogan “More crop per drop” to solve the water crisis among farmers (FAO, 2003). This slogan will help to the efficiency of using water for food production and at the same time the yield increase.

1.3 ELEVENTH MALAYSIA PLAN (RMKE-11)

In 2016, the country's deficit in food trade balance is RM4.3 billion. Hence, the agricultural industry needs to be transformed to make this sector high value comparable to industry in the construction and manufacturing sectors as well as modern, dynamic and competitive services. The government sees that the country needs to increase the level and production process by changing from the dependency on labor to the use of up-to-date technology and knowledge-based. Therefore, technology transfer programs and new agricultural practice methods for increased productivity need to be implemented. These include incubator programs, closed house systems in poultry production and fertigation farming programs.

Project under Eleventh Malaysia Plan (RMKe-11) 2016-2020 was designed by government in order to guarantee the supply of the country's food sufficient and safe to eat, making the agro food industry as a competitive and sustainable industries and increasing levels income of farming entrepreneurs. Coincide with National Agrofood Policy (NAP) 2011-2010 government came out with RMKe-11 to make sure the self-sufficient level of food increase. NAP proposed that vegetable production increase 1.6% and for fruits the production grows 2.2% per year. During the same period, demand on vegetables is expected to increase by 2.1% per annum and 1.6% per year for fruits. Self-sufficient level for fruits is increased from 102.4% to 106.9% and self-sufficient level of vegetables increase from 90.46% to 93.63% in 2020.

Thus, Department of Agriculture had developed Food Crop Production Project Using Fertigation Technology System. The use of Fertigation Technology as a high-tech production method requires specialized equipment, materials and agricultural inputs as well as skills agriculture and management. Besides generating high yield and quality, this method allows Good Agricultural Practices (GAP) by all farmers that adopt this technology and agricultural products are safe for human use. Expansion fertigation technology use by agricultural entrepreneurs is expected to increase in their food production activities. At the end of this project, government target to increase food production to 1,900 tonnes in 2016 and also average income of producers at least RM4,000 / person / month (DOA, 2016).

1.4 FERTIGATION SYSTEM

Fertigation is come from the word “fertilization” and “irrigation”. “Fertigation is defined as the application of solid or liquid (fluid) mineral fertilizers via pressurized irrigation systems, thus forming nutrient - containing irrigation – water” (Kafkafi & Sciences, 1995). Fertigation is a modern agricultural technology that combines fertilizer (nutrients needed) with water and then supplies it to the crops through irrigation system (Hagin, J. , M. Sneh, 2003). In this fertigation system, water and nutrients needed by plant were supply to the crops simultaneously through a systematic irrigation.

There are two type of fertigation which are Open Fertigation and Structured Rain Protection House (SPH – Sistem Perlindungan Hujan). This fertigation technology is very important as it could help farmers to control and maintain the soil moisture at optimum levels throughout the growth of the crops. In this fertigation technology, the farmers that adopt this system can easily control not only the time supplying the nutrients but the amount of nutrients given, the concentrations and ratio of nutrients could also controlled by farmers easily (Hagin, J. , M. Sneh, 2003). Those fertilizer and water were supplied directly to the root of the plant according to time setting by farmers (Mohd, Manas, & Ahamad, 2016).

The equipment or components required in this fertigation system are tanks, nutrient stockpiles, pumps, poly or PVC pipes. Dripper, mini tubing, tubing, timer and water and nutrient control equipment. The irrigation system must be complete and perfect for the water and nutrient supply. Its then will supply directly to the root by using drip irrigation system. In the fertigation system, fertilizer is in a form of liquid is given depends on time setting between 3 - 6 times a day for 5 - 10 minutes each session. This depends on the weather and the crop area. Also, farmers could control the water and nutrients supply when the soil get enough water and extra nutrients. They could stop supplying the water and nutrients together depend on the crops needed.

This fertigation system is usually practice in soilless culture production system. Soilless culture had replaced the use of soil in planting crops with other medium that can support the root system of the plant. In soilless production system, many types of growing media or substrates such as rockwool, perlite, vermiculite and peat have been used to grow many kinds of crops (Raja Harun et al. 1991). Media such as rockwool, perlite and vermiculite are expensive because they have to be imported. Hence, alternative substrates that are cheaper and locally available such as coconut fibres and burnt paddy husks should be used as alternative media (Ortega et al. 1996).

1.5 ADVANTAGES OF FERTIGATION SYSTEM

This advanced technology had replaced the use of soil in planting crops with cheaper medium such as coconut fibres and burnt paddy. Fertigation technology is an alternative method to avoid soil-borne disease such as Phytium, Fusarium, Rhizoctonia and wilt disease (Mohd et al., 2016). By using this system, the soil-borne disease that could affect the crops growth and productivity could be avoided. Not only solve the soil-borne disease but it also could help to overcome unfertile soil problem. As this technology is fully control by irrigation system, it will make sure that the plants get enough water and nutrients through the drip irrigation system.

In addition to that, fertigation could also solve low productivity problem could be solve too. Yields of chilies, rock melons and tomatoes cultivated in soilless system increased 3 – 5 times compared to those using conventional method (Verdonck et al. 1983; De Rijck and Schrevens 1998). Technology of fertigation also could help in increasing eggplant production. Not only that, most of the vegetable could be planted by using this system. High value crops such as cucumber, cabbage, water spinach, spinach, bitter gourd, long beans, ginger, turmeric, onion strawberry and ornamental plant could be planted by using this system (Mohd et al., 2016).

One of the advantages that benefit to farmers most is this technology could help farmers to maximize the yield. That makes most of the farmers especially chili producer change from conventional system to fertigation system. (Yusoff, 2012). Not only it can maximize the yield, but the yield quality could also be increase by

applying this system in agricultural practices. The high quality food products could help producer to export their product in other countries. Thus, it will increase the Malaysia economy and make Malaysia one of the major food producers in the world.

Fertigation technology will make the nutrient and water supply more efficient rather than conventional system. The high technology drip irrigation system allowed the nutrients and water being supply according to the time setting. All the plants will get enough water and nutrients needed. Therefore the planting management is more systematic and easy to control. The soilless culture had help farmers to minimize the use of area for crop production. This technology minimizes the use of limited agricultural land.

1.6 TYPE OF CROPS

Technology of fertigation is suitable for many type of crops. Fertigation methods are best suited for fruitful and leafy vegetable plants such as tomatoes, cucumber, chili, hot chili, eggplant, long bean, rock melon, strawberries and even ornamental plants. In summary, this agricultural practice is especially suitable for high-value crops in the market.

1.6.1 Vegetable

Fruit vegetables such as tomatoes, chili, cucumber, eggplant, long beans are suitable for fertigation system. Tomatoes or its scientific name *Solanum lycopersicum is a vegetable of the Solanaceae* family. Tomatoes could produce fruits after 5-6 month of planting period. It can produce 2-4 kg of yield per tree by using this fertigation system. Red chili or its scientific name *Capsicum sp*. is a fruit vegetable of the *Solanaceae* family. In Malaysia, there are two types of chili: red chili / chili and hot chili. Among the red chili varieties which are the options of entrepreneurs are Kulai 469, Kulai 461, Kulai 151, Kulai 223 and Kulai 568 while the popular hot chili preferred by the entrepreneurs are variety centil and variety bara. Same with tomatoes, chili could be harvested after 5-6 month of planting. Chilli could produce more yield than tomatoes which is 4-6 kg yield per tree. Eggplant or the other name is brinjal or aubergine (*Solanum melongena*) also in the family of *Solanaceae*. After 5-6 month, eggplant could be harvested with the yield 6-9 kg per tree.

1.6.2 Fruit

The most popular fruits rock melon and strawberry. But strawberry does not get farmers' attention rather than rock melon. Rock melon or Cantaloupes with the scientific name *Cucumis melo*species is in the *Cucurbitaceae* family. Cantaloupes range in weight from 0.5 to 5 kilograms when ripe. The cantaloupes could be harvested after 55-60 days with yield 3-5 kg per tree.

1.7 PROBLEM STATEMENTS

Most of the farmers seek to change from conventional farming to fertigation system because the technology could increase the productivity 3-5 times compared to traditional or conventional farming. Especially in chili planting most of the producer attracted to adopt fertigation technology in their farm because of the increment of productivity. The adequate water and nutrients supply is the main factor of the crops grow healthily. It is the easiest and systematic system in producing food because farmers could set the time for the irrigation system. Producer could control the amount water and nutrients supply according to type of crop, weather and planting area.

That's why government had targeted in RMKe-11 to make sure the self-sufficient level of food increase especially in vegetable production. Vegetable production is expected to increase by 1.6% in 2020. Meanwhile, self-sufficient level of vegetables is expected to grow from 90.46% to 93.63% in 2020. The government pursue to become a country that being able to supply their own food without importing from other country and maintain the food safety. As fertigation technology is able to increase the productivity, government empowering the use of this technology in agricultural practices. Through RMKe-11 government had proposed Food Crop Production Project that involving 160 farmers to adopt fertigation system in producing vegetable such as chili, cucumber, eggplant and tomatoes.

According to Ministry of Agriculture, chili that has been produced is 43,738 tonnes of chili per year. Meanwhile in tomato production 242,946 tonnes per year

of tomatoes had been produced. In eggplant production, 46,557 tonnes per year and 97,621 tonnes of cucumber had been produce in a year. In 2016, vegetable production per year had achieved 1,169,421 tonnes. The self-sufficient level of vegetable is only 91.8% in 2016 with per capita consumption 57.3 kg/year which that is a huge amount.

Especially in chili production, government had highlighted that farmers should adopt the fertigation system and maximized the productivity. As a result, the adoption of the technology had been increase. However, the chili production itself is 43,738 tonnes per year which is lower than the demand which is 88,722 tonnes of chili per year even though the use of fertigation technology is increasing. Government had recorded that the import of chilli is 48,000 tonnes of chilli per year with an estimated value of approximately RM154 million. Government had encourage all the farmers by giving an incentive and support, but the production still lower and Malaysia still need to import vegetables to meet the demand.

This situation had become a major problem as the incentive programme from government had been emphasized but the production of vegetables is still low. The adoption of fertigation system among vegetables producer had increase drastically. However, our country could not achieve self-sufficient level yet. Our country still need to import huge amount of vegetables to ensure the demand on vegetables was being fulfilled. Many questions have been arisen from this problematic situation. Did the socio-demographic of the farmers influence the rate of adoption? Also, is there any problem faced by the farmers during the adoption of fertigation system causing the productivity to be decrease?

1.8 RESEARCH QUESTION

The problem faced had raises so many questions which are:

1. Is there any association between farmers' demographic profile and the rate of adoption of fertigation technology?
2. What is the challenges faced by the farmers or producer of vegetables while adopting this fertigation technology?

1.9 OBJECTIVES OF THE STUDY

General Objective

To determine the challenges in the adoption of fertigation technology in agriculture practices among vegetables farmers in Johor area.

Specific Objectives

The specific objectives of this study are:

1. To find out the association between socio-demographic and the rate of adoption of fertigation technology.
2. To determine the challenges faced by the farmers in adopting the fertigation system.

1.10 SIGNIFICANCE OF THE STUDY

Through this study, the farmers could be more aware on the problem faced. It is to make sure that the problem faced must be taken seriously and finding a way to solve it. The awareness among farmers is very important to ensure the continuity of the adoption of this technology in agricultural practice. This study is also benefit to the producers because it could motivate the producers on keep applying this technology in producing vegetables because of the extraordinary benefits that they would get in future. Therefore, the producer did not look the challenges that they faced in adopting this system at their farm as an obstacle for them to success.

As the motivation and awareness spread widely, the farmers might be influence to each other to adopting this system in farm. Therefore, the vegetables productivity will be increase and meet the demand. So, government could save money in importing vegetables in order to fulfil the consumers' demand. This will lead to the high self-sufficient level of vegetables products. Not only that, farmers income could be increase as they could produce more than using conventional farming. Many other parties would be benefits from this study. It is the matter on how we see thing could bring changes to our lives.

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