THE EFFECTIVENESS OF TECHNOLOGY INNOVATION THROUGH FERTIGATION METHOD IN AGRICULTURE AT MELAKA.

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'I declare that I have read this thesis, and in my opinion, it is sufficient in scope and quality for the Bachelor of Technology Management (Innovation) degree award.'

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DECLARATION OF ORIGINAL WORK

"I at this moment declare that this thesis is entirely my work with project title "The Effectiveness of Technology Innovation Through Fertigation Method in Agriculture at Melaka" and except a few clarifications and passages where every source is cited.

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DEDICATION

I would like to dedicate my gratitude to my dear parents, who have supported me both spiritually and monetarily.

Azhar Bin Ahmad

Sharifah Zaima Binti Ahmad

Thanks to my supervisor and panel for guiding me through my research study.

MRS. ADILAH BINTI MOHD DIN (Supervisor)

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Thank you so much for always being understanding and my friends who supported and assisted me; without their support and blessing, this study would be difficult to accomplish in the time allotted. Thank you very much.

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ABSTRACT

This study will be conducted to examine the level of effectiveness of technological innovation through fertigation methods in agriculture in Melaka. Fertigation is an agricultural practice that increases crop productivity by using water and nutrients in a controlled manner. The application also prevents the harmful effects of manure leaching on roots, soil, and groundwater. Food crops can be grown in infertile soils or urban areas when used in soilless systems with substrates and media such as rock wool, perlite, vermiculite or peat. It also removes impurities and increases production by preventing soil -borne diseases and increasing the number of growth cycles without the need to add nutrients or soil conditions. Furthermore, fertigation in rain protection systems allows the planting of crops in places where heavy rain, sunlight, or wind prevents the cultivation of conventional crops for the required food crops. Fertigation of vegetables such as chillies, cucumbers, and tomatoes, as well as high value fruits is common in Malaysia. This research was targeted to the farmers who used fertigation method in Melaka. This research adopted qualitative approach with collected sample of 4 respondents in Melaka, Malaysia through interview method. The data was analyzed by using thematic analysis. From the thematic analysis result, these research findings showed that all of the research objective have been met based on the themes that have been developed. Lastly, several recommendations were suggested such as do the research with other method in agriculture, using another method in getting the data and widening the research setting.

ABSTRAK

Kajian ini akan dijalankan untuk mengkaji tahap keberkesanan inovasi technologi melalui kaedah fertigasi dalam pertanian di Melaka. Fertigasi ialah amalan pertanian yang meningkatkan produktiviti tanaman dengan menggunakan air dan nutrien secara terkawal. Aplikasi ini juga menghalang kesan berbahaya larut lesap baja pada akar, tanah, dan air bawah tanah. Tanaman makanan boleh ditanam di tanah yang tidak subur atau kawasan bandar apabila digunakan dalam sistem tanpa tanah dengan substrat dan media seperti bulu batu, perlit, vermikulit atau gambut. Ia juga menghapuskan kotoran dan meningkatkan pengeluaran dengan mencegah penyakit bawaan tanah dan meningkatkan bilangan kitaran pertumbuhan tanpa perlu menambah nutrien atau keadaan tanah. Tambahan pula, fertigasi dalam sistem perlindungan hujan membenarkan penanaman tanaman di tempat di mana hujan lebat, cahaya matahari, atau angin menghalang penanaman tanaman konvensional bagi tanaman makanan yang diperlukan. Fertigasi sayur-sayuran seperti cili, timun, dan tomato, serta buah-buahan bernilai tinggi adalah perkara biasa di Malaysia. Penyelidikan ini disasarkan kepada petani yang menggunakan kaedah fertigasi di Melaka. Penyelidikan ini menggunakan pendekatan kualitatif dengan mengumpul sampel seramai 4 orang responden di Melaka, Malaysia melalui kaedah temu bual. Data dianalisis dengan menggunakan analisis tematik. Daripada hasil analisis tematik, dapatan kajian ini menunjukkan bahawa kesemua objektif kajian telah dipenuhi berdasarkan tema yang telah dibangunkan. Akhir sekali, beberapa cadangan telah dicadangkan seperti melakukan kajian dengan kaedah lain dalam bidang pertanian, menggunakan kaedah lain dalam mendapatkan data dan meluaskan persekitaran penyelidikan.

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LIST OF ABBREVIATION

IoT	Internet of Things
ASO	Automated System Operation
WFPF	Water And Fertilizer Production Functions
WPF	Water Production Functions
MARDI	Malaysian Agricultural Research and Development Institute
GDP	Gross Domestic Product
MAFI	Ministry of Agriculture and Food Industry
pH	potential Hydrogen
WiFi	Wireless Fidelity
LCD	Liquid Crystal Display
EMH	Efficient Market Hypothesis
GPS	Global Positioning System

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CHAPTER 1

BACKGROUND STUDY

1.1 INTRODUCTION

Around 2010, an evolution of precision agriculture was detected in numerous technologies, including low-cost microprocessors, Cloud-based systems, crucial data analysis, advanced automation capabilities, and onboard computers. This transformation began concurrently with a comparable development in the industrial sector known as Industry 4.0. As a result, the phrase Agriculture 4.0 is used in agriculture to describe the vision of future output. Agriculture 4.0 refers to the integrated internal and external network of agricultural activities, which means that digital formats exist for all sectors. Intelligent agriculture and digital farming are two additional frequent concepts linked with Agriculture 4.0, predicated on the rise of intelligent technology and gadgets in agriculture that open the way for the following changes via remote-controlled decision-making systems. The fundamental goal is the adaptation of production systems, crop enhancement and efficiency, water usage optimization, and phytosanitary products, with roots in precision farming. Satellites and drones are basic instruments used today and in the future to acquire the data needed to promote agricultural development and explore the future potential.

Fertigation is the process of delivering dissolved fertilizer to crops via an irrigation system. Both nutrients and water may be adjusted and managed to get the highest potential yield of the marketable crop from a given quantity of both inputs when paired with an effective irrigation system. An irrigation system receives fertilizer.

Commercial growers are the most prevalent users. Fertigation, rather than standard fertilization, is said to address the plant's nutritional shortages more efficiently. According to standard fertigation, fertilize lawns 4-5 times a year, or at least twice a year.

Technology innovation is a new or better product or procedure with considerably different technical qualities than previously. New items or processes in the application that have been brought to market are known as implemented technical product innovations. A product or procedure is deemed innovative if it provides specific benefits to the question; these benefits do not have to be novel to other firms or the market. Semi-Radical, Incremental, and Disruptive technologies are three types of technical advancements. This type of technology is usually based on prior technological expertise. It does, however, use knowledge in ways that set it apart from previous generations.

Fertigation technology is known as a revolutionary agricultural technology that controls water and fertilizer with great efficiency. It has been shown that fertigation technology may boost agricultural production and quality, and several research has been conducted to measure the influence of water and fertilizer inputs on crop outputs. The relationships between resource inputs and crop yield can be represented using the water and fertilizer production functions (WFPF) or water production functions (WPF). Fertigation technology involves spraying water-soluble nutrients into irrigation systems from reservoirs. In most cases, injectors and a pressure-controlled valve are used.

According to the Malaysian Agricultural Research and Development Institute (MARDI), Agriculture is one of the country's most significant industries, and according to the most recent data in 2019, it is the country's third-largest GDP contributor (7.1 per cent, or RM101.5 billion), trailing only the mining and quarrying industry. Exports climbed by 0.9 per cent from RM114.5 billion in 2018 to RM115.5 billion in 2019, while imports increased by 0.9 per cent from RM93.3 billion in 2018 to RM93.5 billion in 2019. (0.2 percent increase). This sector's trade balance improved by 4.1 per cent in 2019, from RM21.1 billion in 2018 to RM22.0 billion in 2019.

1.2 BACKGROUND OF STUDY

Fertigation is an agricultural practice that increases crop productivity by applying water and nutrients in a regulated manner. This application also prevents the harmful effects of fertilizer leaching on the roots, soil, and groundwater (Na Lin et al., 2020). Food crops may be grown in infertile soils or urban areas when employed in a soilless system with substrates and media such as rock wool, perlite, vermiculite, or peat. It also eliminates dirt and boosts production by preventing soil-borne illnesses and increasing the number of growth cycles without the need to replenish nutrients or condition the soil. Furthermore, fertigation in a rain-shelter system permits crop cultivation in places where severe rain, sunlight, or wind prevents conventional crop cultivation of the needed food crops.

Fertigation of vegetables such as chillies, cucumbers, and tomatoes, as well as high-value fruits such as rock melons, is common in Malaysia (Mardi, 2020). Crop yields of up to five times per unit area have been attained, contributing to its growing public interest and attractiveness. MARDI is vital in developing novel approaches that are adapted to the needs of local food crops, as well as exploiting the benefits of the fertigation system to expand into farming non-local food crops that would otherwise be impossible to cultivate using conventional methods. In Melaka, the fertigation method is one of the favourite methods used by farmers there. The fertigation system not only facilitates the work of watering the trees but also helps ensure that the trees get enough water either during the dry season or otherwise. Among the crops that are often grown using this method are chilli and eggplant.

In Alor Gajah, Melaka, a farmer has joined the fertigation program under MARDI. He has planted a total of 250 poly bags of crops who of which were chillies and the balance of 150 more is eggplant. After harvesting, he managed to market about 81 Kg of chillies and 30 Kg of eggplant. He also managed to get about RM 1,188 by joining these programmes (Mardi, 2019). This kind of programme can help farmers out there to manage their crops and they can generate income by using the fertigation method in agriculture.

1.3 PROBLEM STATEMENTS

Today, the demand for food supplies is rising every year. It is because of the growth rate of a country and the increasing rate of birth. If the growth rate of a country is high, so the purchasing rate will also increase. It is estimated that the world population will reach 9 billion by 2050. Supplying the food needs of the growing population will be possible by using agricultural land more efficiently, applying advanced agricultural technologies, genetic studies, irrigation, and balanced fertilization widely. (Karaşahin et al., 2018) To fulfil the demand and supplies of food industries, technological innovation was introduced in the agriculture sector. Technological innovation is not only used in large-scale farming but also used for small farms such as hydroponics, fertigation, and aquaponics. This research is conducted to study the effectiveness of technology innovation in agriculture through the fertigation method.

However, there are some problems in setting up this fertigation method in agriculture. One of the problems The initial investment costs are high in the installation of the fertigation system. It includes installing the system, buying fertilizers, electricity and so on (V Martínez-Alvarez, 2020). Furthermore, the high initial costs and ongoing upkeep of the equipment may be a concern for some farmers.

Next, the irrigation materials. Two primary concerns with irrigation materials are clogged emitters and a lack of consistency in water and fertiliser delivery. These can be significant issues when design, component selection, maintenance, and administration are insufficient. However, if these difficulties are addressed properly, congestion and lack of consistency can be reduced (Elisa et al., 2018).

1.4 RESEARCH QUESTIONS

Research questions are required to gather the relevant knowledge needed to achieve the purpose. This research helped to understand the effectiveness of technology innovation through fertigation in agriculture. The following are the question:

I. What technology innovation has been adopted in fertigation method?
II. How performance expectancy of technology innovation in fertigation method?
III. What effort expectancy of technology innovation in fertigation method?

1.5 RESEARCH OBJECTIVES

This research intends to aim at addressing the effectiveness of technology innovation through fertigation in agriculture. There are three objectives of this research to attain the goal. The objectives are:

I. To study the adoption of technology innovation in the fertigation method.
II. To examine the performance expectancy of technology innovation in fertigation method.
III. To analyze the effort expectancy of technology innovation in the fertigation method.

1.6 SCOPE OF STUDY

The scope of the study is around Melaka. This study was selected in the area of Melaka to study the effectiveness of technology innovation in agriculture through the fertigation method. The focus of this study is to discuss the adoption of technology innovation in fertigation method. It also focusses to examine the performance expectancy and effort expectancy of technology innovation in the fertigation method. In this research, farmers were interviewed to collect data about technology innovation in agriculture. The crops that are often planted in Melaka are chilies and eggplant.

1.7 LIMITATION OF STUDY

First of all, the researchers investigated individuals who may have faced the issue due to insufficient access to such interviewees in the context of technological innovation. In terms of limited access, the researcher must change the study design and restructure. The disputes that arise from personal matters are also one of the shortcomings of this study. In agriculture, there are many methods that have been used such as hydroponic and aquaponics. But, in this research, the method has been limited and focuses only on the fertigation method. It also involved the farmers in Melaka.

1.8 SIGNIFICANT OF RESEARCH

By conducting this research, the researcher can understand clearly the effectiveness of technology innovation in agriculture. Besides that, the researcher also can clarify the relationship between technology innovation and the agriculture industry. Hence, this research paper can act as a future reference for other researchers that plan to conduct research that relates to technology innovation in the agriculture industry. In addition, this study gives some benefit information to companies that want to utilize technological innovation to expand their business. It also benefits for the Ministry of Agriculture and Food Industry (MAFI) and the Malaysian Agricultural Research and Development Institute (MARDI)

1.9 SUMMARY

The framework of this chapter is the introduction of the study overall. It introduces the topic of the study including background, the problem statement, the research questions and research objective, the scope of limitation of the study as well as the importance of the research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The concepts of innovation and technology are sometimes used interchangeably since they are closely connected. This phrase is frequently used to refer to science, method, or knowledge. The technology focuses on the application of knowledge and the science of doing things better. For example, technology can arise from the use of science to boost the productivity of a management process or goods by adding value, simplifying the process, diversifying the use of products or equipment, and adding value to the process. From a wider perspective, Eckhardt and Shane (2011) referred to technology as a specific means that can be used to accomplish a specific objective, especially to optimize the utilization of resources.

2.2 DEFINITION OF FERTIGATION METHOD

The process of delivering fertiliser solutions along with irrigation water is known as fertigation, and it is commonly done using a micro sprinkle or a drip irrigation system (Obreza and Boman, 2008). A properly engineered fertigation system has the potential to cut fertiliser application costs by a significant amount and to deliver nutrients in quantities that are both precise and consistent to the wetted irrigation zone that surrounds the tree and contains the majority of the tree's active feeder roots. When compared to the use of standard fertiliser procedures, the practise of providing the trees with timely dosages of relatively tiny quantities of nutrients throughout the growth season provides a number of major benefits. When plants get traditional, broad applications of granular fertiliser once or twice a year, they receive a big amount of fertiliser that is more than what they need at the time it is delivered. This is because conventional fertiliser is applied in a widespread manner. This may lead to salt damage to the roots as well as excessive fertiliser losses via leaching and volatilization into the atmosphere. Additionally, it can be poisonous to beneficial soil microorganisms as well as to fauna such as earthworms. In most cases, when traditional fertiliser spreaders are used, the majority of the fertiliser is applied in places that are not penetrated by the tree roots and are located outside of the wetted irrigation zone. There is no question that fertigation allows for precise and uniform application of the nutrients to just the wetted root volume, which is where the active roots are concentrated, and that this method unquestionably increases the efficiency of application of the fertiliser to a remarkable degree, thereby allowing reduction in the quantity of fertiliser required and the production costs, as well as reduction in the potential for groundwater pollution caused by fertiliser leaching (Imas, 1999). There is not, however, a straightforward formula that can be used to determine the fertigation rates and frequency for olive orchards. The rates typically correlate to those that are utilised for granular application, however the frequency of application might vary anywhere from once every week to once every two weeks to once every month. The tree will get sufficient levels of nutrients, and the difficulties connected with salt damage and leaching losses will be reduced as a result of the more frequent application. Because fertilisation is often included into the standard irrigation plan, there is typically very little of an increase in expense associated with more frequent application.

Fertigation offers a number of distinct benefits in comparison to broadcast and band fertilisation. The fluctuations in nutrient content in soil may be minimised by receiving regular supplies of fertilisers. There is effective use of, and exact administration of, nutrients in accordance with the crop's specific nutritional needs. Fertilizers are spread out evenly across the entire volume of irrigated soil. When the soil or crop conditions are such that it would be impossible to enter the field with traditional equipment, it is possible to provide nutrients to the ground. The drip technique of fertigation is superior to other types of fertigation in a number of respects. The application of nutrients exclusively to the volume of moist soil where roots are active helps to limit the amount of nutrients that are lost as a result of leaching or soil fixation and also enhances the efficiency with which fertiliser is used. The foliage of the crop continues to be dry, which reduces the risk of pests or diseases spreading and protects it from being burned. There is no impact from the wind, and there is no runoff.

2.3 TYPES OF IRRIGATION METHOD

Irrigation is the process of applying water to soil in a controlled manner using a variety of mechanical devices such as sprayers, pumps, and tubes. The use of irrigation is common in regions that have erratic rainfall or are forecast to experience dry periods or drought. There are many different kinds of irrigation systems, all of which provide water in an even distribution throughout the whole field. Water for irrigation may originate from a variety of sources, including groundwater, which can be accessed by springs or wells, surface water, which can be accessed via rivers, lakes, or reservoirs, or even alternative sources, such as treated wastewater or desalinated water. As a consequence of this, it is essential for farmers to safeguard the water supply that they use for agricultural purposes in order to reduce the risk of contamination. Irrigation water users, like users of any other kind of groundwater, need to be cautious not to pump groundwater out of an aquifer at a rate that is higher than the rate at which it is being replenished. There are a great number of distinct kinds of irrigation systems, each of which differs in the manner in which water is dispersed throughout the field.