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A Foresight Study of Agricultural Robot Implementation in Agriculture Field Malaysia

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Abstract

As we are aware, the agriculture sector is a backbone sector that mainly produces food and goods through small scale cultivation, farming, animal husbandry, fishing and forestry. As farmland narrows and human population is increasing, there needs to be innovation in agriculture or methods to deal with the problem. However, lack of employment and higher average age of workers have contributed to the increase production costs which in turn affect Malaysia's position in production and export especially the world's major commodities. This study aims to identify the key drivers behind agricultural robot implementation and explore its potential impact on agriculture field in the future. The target respondent was selected and cover mainly in Johor. The results of the STEEPV analysis indicate that the economical factor is the most critical driver in agricultural robot implementation on future agriculture field, followed by technological, social, values, environmental and political factors. A total of 10 merged key drivers were identified. A total of 382 questionnaires were distributed to the stakeholders in agriculture field in Johor with response rate of 36.39%. The study found that political decisions and policy development and value creations and collaboration have the highest impact and the highest uncertainty. Four scenarios were proposed at the end of the study. The four scenarios were prospering of harmonious innovation, fragmented progress, top-down regulation and policy gridlock.

1. Introduction

In the new global economy, nowadays agriculture has become a central issue for Malaysia because it does not produce enough food its population and industries (Kuen, 2022). As we are aware, the agriculture sector is a backbone sector that mainly produces food and goods through small scale cultivation, farming, animal husbandry, fishing and forestry. As farmland narrows and human population is increasing, there needs to be innovation in agriculture or methods to deal with the problem. According to Rodzalan *et al.*, (2020), agriculture is one of important sector in Malaysia which contribute to the national GDP and provide employment for the society.

In the modern era that has entered the industrial era 4.0, digitalization has also penetrated agriculture such as agriculture robots. In addition, with the further implementation of future agriculture robots, it can greatly help of agricultural work to be faster and more efficiently. Agricultural robots also enable precision agriculture, in which resources are distributed more efficiently, leading to significant savings in resources use (Ghafar *et al.*, 2021). Moreover, the use of sophisticated machines and robotics technology can increase quality and productivity. The further advance agricultural robots will play an increasingly important role in the agriculture sector in our country.

Economics firm shows that increasing the use of robotics technology will open job opportunities and expand a country's economy. It can assist in the transformation of produce more organic and healthy agriculture because with agricultural robots will it decrease the use of hazardous chemicals directly such as by producing certain nutrients according to the detector readings to make the plants healthier, preserved and quality for the future.

1.1 Research Background

In the new global economy, the technical terms for robot is like a system develop and designed based on a dynamic interaction between several areas of knowledge in a transdisciplinary process, where theoretical and practical knowledge of kinematics, dynamics, design of mechanisms, sensing, movement planning, control theory, programming, systems architecture and methods in Artificial Intelligence (A.I.) reasoning interact to allow the machine to perform specific tasks defined by its design (Daniel, 2019).

Increasing technological progress modern demands the agricultural sector to follow the progress that occurred on the dynamic of technological development in the industry. To be able to apply the agricultural system modern should also be supported by resources humans that can adapt to changes in agricultural technology. This matter requires cooperation between the younger generation which is more focused in the field of technology with the more familiar conventional farmers field and existing obstacles, up to produce synergy to increase food production in the country. By incorporating technology into agriculture, this will attract the interest of generations young people and students to start studying farming in the field of technology agriculture. The adoption of AI in the hotel industry has been gaining significant attention in Malaysia, particularly in Melaka, a popular tourist destination known for its rich cultural heritage and historical sites. The Malaysian government has identified the tourism industry as a key driver of economic growth and has been actively promoting the adoption of advanced technologies, including AI, to enhance the competitiveness of the country's hotel industry (Malaysia Digital Economy Corporation, 2017).

1.2 Problem Statements

As we are aware, agriculture sector is playing the biggest role in Malaysia economic growth. Hence, there is certain issue related to agriculture robots that are practiced in Malaysia. For example, the use of Farmo Robot is a versatile mobile robot used in the agriculture sector to increase work efficiency and reduce the number of workers required. The Farmo Robot uses a remote control and a wireless camera system. Farmo is one of the pilot projects under the National Innovation & Technology Sandbox (NTIS) (Kementerian Sains, Teknologi, 2023). However, according to Malaysia Now (2022), the development of artificial intelligence (AI) technology for industrial revolution 4.0 makes it difficult for Malaysia to offer automation systems to global manufacturing companies. This is because our country does not have existing automation expertise. In addition, there are requires a lot digital infrastructure such as 5G technology but Malaysia still facing the problem of developing 5G.

Furthermore, the cost to import some of the technology use in the agricultural robots are too expensive. The statistics of automation and robotics system market in agricultural application is expected to be projected from USD 7.4 billion in 2020 to USD 20.6 billion by 2025 throughout the world (Mahmud *et al.*, 2020). Other than that, is farmers Lack of expertise among agricultural workers and farmers' resistance to incorporating the newest technologies in their crop regions, especially the elderly. According to Mahmud *et al.* (2020), some of the farmers are afraid to invest their money into technologies that may not benefit them in the future.

However, in future agricultural robot will have opportunities be good in agriculture field in Malaysia as it enables to increase work efficiency with less energy and cost (Mahmud *et al.*, 2020). Agricultural robots can easily carry out all the main farming tasks, negating the need for human labor. In addition, agricultural robot can increase profit even though the investment is costly, but it is only one-time generally investment. Agricultural robot also can help farmers to maximum their productivity. For example, with the accurate soil reports it helps farmers to understand the sustainability of crops and maximize production while maintaining quality (TractorJunction, 2021).

Therefore, to achieve the research objectives the issues challenges and trends of agricultural robot implementation in agriculture field is determined. Furthermore, the key drivers of agricultural robot implementation in agriculture field also determined. Consequently, the future scenario of agriculture robot implementation in agriculture field is identified.

1.3 Scope of the Study

The focus of this research was to identify the drivers of agricultural robots on future agriculture filed. The scope of this study was limited to agricultural industry related to agricultural robots. The respondents to this research study would be stakeholders of agriculture industries. The target respondent was selected and covered mainly which is farmers in Johor, agricultural industry organizations and agricultural equipment manufacturer in Johor. To identify the drivers of intention to use agricultural robots in Malaysia, this research has gathered information from news, blogs, books, journals and any article that applicable to the subject matter were analyzed and evaluated. The questionnaire will be prepared and given to the stakeholders' agriculture in Johor.

1.4 Significance of the Study

The research would take place in agriculture field and aims to identify the acceptance of agricultural robot implementation on future agriculture field in Malaysia. This implementation will greatly benefit the future agriculture field. Agriculture robot systems generate increased production and efficiency in process that greatly increase the yield of crops (Danial, 2019). This benefit comes tied to another, perhaps even more important one such as decrease in the cost of production. Robotic systems can be safer than the current conventional systems of agriculture production. Therefore, this research will be contributing to future research of agricultural robots.

2. Research Methodology

This chapter describes and extensively explains the adopted research methodology throughout the research process. The methodology that was carries out in this research coherent foresight methodology. This study comprehensively designs to determine the key drivers of agricultural robot implementation, the future image of the implementation of agricultural robot in agriculture field, the issues, challenges and trends of the implementation of agricultural robots in future agriculture field.

2.1 Research Design

The research design of this study was descriptive research. The questionnaire method was used for data collection process as the quantitative method was chosen. The questionnaire developed by the research using STEEPV analysis to determine the relevant drivers of agricultural robot implementation on future agriculture field. The questionnaire was distributed to the potential respondent which is farmers in Johor, agricultural industry organizations and agricultural equipment manufacturer in Johor. Next, the analysis of impact-uncertainty was conducted to complete the development of various scenarios.

2.2 Data Collection

Data collection is a method for gathering and preparing the data needed for the research. The primary data might be gathered from a few different sources. In this study, researcher can carry out questionnaires to gather information. Therefore, this study makes use of self-administered data acquisition through survey questionnaires. STEEPV analysis was used to develop the questionnaire used to collect primary data.

2.3 Population and Sampling

Sampling is the process of selecting enough the right components from a population so that a study of the sample and an understanding of its properties or characteristics allow us to generalize such properties or characteristics to the elements of the population. Sampling will be used in selecting respondents. In this study, researcher used the probability sampling that every member of the population has a chance of being selected.

In this research, researchers already choose the population of all stakeholder in Johor that farmers in Johor, agricultural industry organizations and agricultural equipment manufacturer with an estimated total size 58,048 person in 2022 (Department of Statistic Malaysia). So, the researcher's sampling for this research is 382 stakeholders will be involved in this study.

2.4 Research Instrument

The main instruments that have been used in this research is questionnaire. The questionnaire consists of four parts which are Section A, B, C and D. It is shown in Table 1.

Table 1 *Structure for the question*

Section	Item
A	Demographic information of the respondents.
B	The importance of factors/drivers of agricultural robot implementation on future agriculture field in Malaysia
C	The impact of factors/drivers towards agricultural robot implementation on future agriculture field in Malaysia
D	The uncertainty of factors/drivers towards agricultural robot implementation on future agriculture field in Malaysia

2.5 Data Analysis

There are three analysis will be used to analyze the data which are descriptive analysis, reliability analysis and impact-uncertainty analysis. The use Descriptive analysis, also known as descriptive statistics, is a type of data analysis used to analyze the collected data from the questionnaire on the foresight study of agricultural robot on future agriculture field in Malaysia. SPSS statistical software was used to analyze the collected data from the questionnaire and the mean value obtained was used to simplify the study.

Reliability analysis refers to a collection of statistical techniques and methods for evaluating the consistency or reliability of data, measurements, tests or systems. Cronbach's alpha is the most commonly chosen measure of internal consistency. The alpha coefficient of the scale determined by the researchers must be at least 0.070 or higher to be enough for the scale.

A descriptive outcome was used to analyze impact-uncertainty. This study investigates the ambiguity of the implementation of agricultural robot on future agriculture field in Malaysian. The primary drivers of the impact uncertainty analysis are the factors with the greatest impact and uncertainty.

3. Literature Review

The agriculture sector in Malaysia is a supplier of food resources, with paddy and rice being the largest contributors. Issues such as land shortages, land management, seed and fertilizer quality, disease attacks, lack of water resources, and most rice farmers need to be addressed. MARDI, a company related to agriculture, is playing a key role in the technology value chain by bringing advances in agriculture. The Federal Agricultural Marketing Authority (FAMA) is responsible for selling agro-food items and providing access to agricultural and agro-based field products at reasonable costs. However, Malaysia still lacks capital to absorb modern technology and is dependent on external technology to help approach the fourth industry. Bed former agricultural robots are used to make boundaries quickly and effectively.

Agricultural robots are robots used for agriculture purposes, such as weed control, seed planting, harvesting, environmental monitoring and soil analysis. They help farmers increase production and lessen their reliance on labor-intensive field work. Robots have a positive impact on agriculture, with farmers using them in a variety of ways to improve their practices. According to TractorJunction (2021), the world population will reach 10 billion by the end of 2050. Emerging technologies are likely to change the tourism business, particularly the hotel sector, over the next 75 years, according to Buhalis (2020). Hotels worldwide have realized the need of using new digital technologies to promote constant growth and income (Sharma *et al.*, 2020). AI is improving hotel service delivery (Sharma *et al.*, 2020).

According John *et al.* (2021) suggest that modern equipment, precision agriculture and robotic systems can make farms more profitable, efficient, safe and environmentally friendly. Japan is known for its advanced technology in agriculture, such as the cabbage-harvesting robot in Hokkaido. American agricultural technology has also advanced since the 19th century, helping to raise agricultural productivity and quality. Advances in agricultural technology have improved the packaging, processing, transportation and marketing of agricultural produce in America. The Netherlands has become the second-ranked country for the largest agricultural product exporting country in the world with an export value of 72.8 billion Euros. Research is key to the advancement of agriculture in the Netherlands, such as the Weed Whacker agricultural robot, which uses computer vision and machine learning methods to identify and classify weeds and crops.

The robotic industry was developed to replace dangerous, repetitive and dirty work done by humans. Malaysia has implemented Farmo Robot, a versatile mobile robot used to increase work efficiency and reduce the number of workers required. Additionally, machinery for leveling land plots equipped with equipment and components for determining the leveling index of the land is important to attract young farmers. Precision agriculture is an information-based technology that integrates suitable agricultural techniques to control on-farm variability. It can increase and encourage large-scale commercial operations in the form of collective or estate farming systems. Fertilization activities are usually done by themselves or hired laborers without knowing the level of soil fertility and the condition of the trees, leading to unbalanced fertilization rates, environmental pollution, and high costs.

3.1 enefits and Challenges of Agricultural Robot

As we are aware, to implement new technology such as robotic technology in certain industries will have its advantages and disadvantages. Nevertheless, agricultural technology robots have also its advantages and for our country agriculture industries. First and foremost, the advantages were with agricultural robots has enabled farmers to manage the crop production efficiently with less energy and cost (Mahmud *et al.*, 2020). The level of efficiency of robot is also higher when compared to humans and it is proven that the assistance can increase crop yields just like the agricultural industry in developed countries that use a lot of robot assistance in routine affairs on a farm. Agricultural robots can easily carry out all the main farming tasks, negating the need for human labor. Farmers become more independent because of not needing to rely on manual work. In addition, agricultural robot can increase profit even though the investment is costly, but it is only one-time generally investment. But, from that investment, farmers can reduce operating expenses and increased productivity guarantee that this investment will pay off in the long run.

Moreover, agricultural robot benefit is can help farmers to maximum their productivity. For example, with the accurate soil reports it help farmers to understand the suitability of crops and maximize production while maintaining quality (TractorJunction, 2021). Agricultural Robot in agriculture field assists farmers in practically every way and help them save time and energy. At the same time, with agricultural robot farmers can save the precious resources by ensure the best possible use of resources like water, chemicals and many more through the monitoring. Additionally, they aid in reducing resource waste and preserving it for future generations. Furthermore, with agricultural robot we can attract youth talent to grow in this agriculture field. Youth generation were fascination with modern technology and artificial intelligence has been going on for a while. Because of these developments, more youth farmers can make a living through agriculture.

The implementation of agricultural robots in agriculture is not easy due to cost, lack of infrastructure and technical expertise, and the threat of losing one's job. Additionally, farmers need to maintain customer satisfaction and meet rising demand for more food of higher quality. Additionally, society has expectations of farmers to reduce their impact on the environment, increase the nutritional content of crops, and minimize chemical residues.

3.2 STEEPV Analysis

In this section, all issues, challenges, and trends from the STEEPV analysis. STEEPV analysis was used to identify the key drivers of agricultural robot implementation on future agriculture field. Table 2 shows the output of STEEPV analysis.

Table 2 *Output of STEEPV analysis*

Factors	Total
Social	13
Technological	18
Economic	26
Environmental	9
Politic	3
Value	9
Total	78

The data from the STEEPV analysis reveals that technological and social factors are the most significant drivers of agricultural robot implementation on future agriculture field. Economic factors also play a role, but to a lesser extent. Meanwhile, value, environmental, and political factors have minimal influence on agricultural robot implementation on future agriculture field.

3.3 Table with Merged Issues

This research has identified major issues, challenges and trends for future image of agricultural robot implementation on future agriculture field in Malaysia. All merged issues, challenges, and trends are shown in Table 3. The key drivers identified highlight the factors that could influence society's acceptance towards the agricultural robot implementation on future agriculture filed in Malaysia through the process of STEEPV analysis. STEEPV factors are derived from issues, challenges and trends related to the agricultural robot in agriculture field that was found through journals, news, internet articles and books.

Table 3 *Table with merged issues, challenges and trends*

No.	Issues, Challenges, and Trends	Key Drivers
1.	The adoption of agricultural robots aims to increase labour efficiency, optimize workforce utilization and address labour shortages in agriculture.	Labour efficiency and workforce optimization
2.	The implementation of complex technology in agricultural robotic requires a workforce with specialized skills.	Skilled workers and specialist skills
3.	Agricultural robots offer efficient operations and productivity benefits by enabling timely and precise tasks, minimizing operational constraints and optimizing output.	Efficient operations and productivity benefits

4.	Simplified work routines and intuitive interfaces are essential to ensure a smooth transition and widespread acceptance among farmers.	Easy implementation and ease of operation
5.	Agricultural robots contribute to environmental sustainability by faciliting precision management practices.	Environmental sustainability and precision management
6.	The development of agricultural robotics involves continuous innovation and technology borrowing from other industries.	Technology borrowing and robotics technology development
7.	The adoption of agricultural robots offers cost-saving opportunities for farmers.	Cost reduction and cost-benefit analysis
8.	The implementation of agricultural robots can have a political impact, necessitating policy development and regulations to address ethical, safety and social concerns.	Political impact and policy development
9.	The integration of agricultural robot requires collaboration among various stakeholders, including farmers, manufacturers, researchers and policymakers.	Value creation and collaboration
10.	The use of agricultural robot ensuring the protection of workers, preventing accidents and safeguarding data and systems from vulnerabilities are crucial challenges that need to be addresses.	Health, safety and security

4. Result and Discussion

4.1 Result

4.1.1 Response Rate

There are a total of 382 respondents were selected for this study as the targeted respondents but only 139 out of the 382 sample size responses were gathered, meaning that the study's response rate is 36.39%.

4.1.2 Reliability Test

Table 4 *Result of reliability in real study*

	Cronbach's Alpha	Number of Items	Number of Respondents
Pilot Test	0.920	30	24
Real Study	0.840	30	139

Table 4 indicates that the pilot test's Cronbach Alpha, with 24 respondents is 0.920. The result achieved is outstanding and exceeds 0.9, indicating the reliability of the study and its potential for continuation. For real study with the total of 139 respondents, the Cronbach Alpha value is 0.840 which indicates the good and high reliability for the variable.

4.1.3 Demographic Information

Table 5 *Demographic analysis*

		Frequency	Percentage (%)
Gender	Male	74	53.2
	Female	65	46.8
Age	30 years old and below	30	21.6
	31 – 35 years old	48	34.5
	36 - 40 years old	46	33.1
	41 – 45 years old	6	4.3
	46 – 50 years old	6	4.3
	50 years old and above	3	2.2
Race	Malay	68	48.9

	Chinese	40	28.8
	Indian	31	22.3
Education Level	SPM	14	10.1
	STPM	5	3.6
	Matriculation	5	3.6
	Diploma	55	39.6
	Degree	51	36.7
	Masters	5	3.6
	PhD	3	2.2
	Others	1	0.7
Monthly Income	Below RM3000	66	47.5
	RM3001 – RM4000	72	51.8
	RM4001 – RM5000	0	0
	RM5001 – RM6000	1	0.7
	RM6001 – RM7000	0	0
	RM7001 – RM8000	0	0
	RM8001 – RM9000	0	0
	RM9001 and above	0	0
	Farmers	29	20.9
Type Stakeholders	Agriculture Organization	88	63.3
	Agriculture Manufacturer	21	15.1
	Others	1	0.7
District	Batu Pahat	82	59
	Johor Bahru	12	8.6
	Kluang	5	3.6
	Kota Tinggi	5	3.6
	Kulai	7	5
	Mersing	4	2.9
	Muar	7	5
	Pontian	6	4.3
	Segamat	5	3.6
	Tangkak	6	4.3
Heard the use of agricultural robots	Yes	134	96.4
	No	5	3.6
Considered the use of agricultural robots	Yes	134	96.4
	No	5	3.6
Intention to implement agricultural robots	Yes	133	95.7
	No	6	4.3
Implemented in agriculture	Immediately	25	18
	4 – 6 years from now	35	25.2
	7 – 9 years from now	54	38.8
	In 10 years from now	25	18

The demographic background of respondents in the agriculture stakeholder field in Johor including farmers, agriculture organization, agriculture manufacturer and others. The majority of respondents are male with 53.2% being male and 46.8% female. The group age of 34.5 percent of the respondents were 31 years old until 35 years old followed by 36 until 40 years old (33.1%), 30 years old and below (21.6%), 41 until 45 years old (4.3%) same to 46 until 50 years old (4.3%) and lastly 50 years old and above (2.2%). The race of respondent reports that Malay respondent is the highest respondent (48.9%) followed by Chinese (28.8%) and Indian with 22.3 percent. The education level of respondents shows most of the respondent (39.6%) is having a Diploma education. This is followed by bachelor's Degree with 36.7 percent, SPM (10.1%). Next, for STPM, Matriculation and masters is having the same percent which is (3.6%). For education level of PhD is 2.2 percent and lastly others with agriculture certificate with 0.7 percent. For monthly income of respondent, majority of the respondent had monthly income between RM3001 until RM4000 (51.8%). This is followed by respondent whose monthly income below RM3000 with (47.5%). Lastly only 0.7 percent with monthly income RM5001-RM6000. The rest monthly income is not in the respondent list.

Working experience of respondent shows majority of the employee have been working in the organization for 3 until 5 which is 51.8 percent. 33.8%of the employees have been working from less than 3 years and followed by 6 until 8 years working experience with 11.5 percent. Lastly, 9 years and above working experience with 2.9%. Majority of the respondent is from type stakeholders of agriculture organization with 63.3%. Next, type stakeholders from farmers with 20.9% and followed by agriculture manufacturer with 15.1 percent. Lastly other type of stakeholders such as agriculture student with 0.7 percent. Majority of the respondent is from Batu Pahat district with 59%. Next, followed by Johor Bahru (8.6%), Kulai and Muar have the same percentage which is 5% of respondent. Pontian and Tangkak district also have the same percentage of respondent which is 4.3%. Followed by Kluang, Kota Tinggi and Segamat district (3.6%). Lastly, Mersing district which is 2.9% of respondent. Most of the respondent 134 respondents (96.4%) have heard the use of agricultural robots in agriculture field while the rest never heard about agricultural robots for the use in agriculture filed with percentage 3.6 percent. Probability consideration of respondent towards the use of agricultural robots in agriculture field. 96.4 percent of the respondent agreed that agricultural robots will be considered in selection and recruitment in the future for agriculture field while the rest (3.6%) will not not be considered to implement this technology in the future. Majority of the respondents (95.7%) have the intention to implement agricultural robots for agriculture field future in Malaysia while the rest (4.3%) do not have any intention to implement this technology for company in the future. Majority of the respondent (38.8%) predicts that agricultural robots to be implemented in agriculture field in 7 until 9 years from now. Next, 25.2 percent predict in 4 until 6 years from now. Lastly 18 percent of respondent choose the immediately and in 10 years from now for the prediction to be implement the agricultural robots in future agriculture field in Malaysia.

4.1.4 Impact-Uncertainty Analysis

The table shows the corresponding mean for each driver in impact-uncertainty analysis

Table 6 *Mean of the 10 leading drivers on level of impact and uncertainty*

No	Drivers	Impact	Uncertainty
D1	Labor efficiency and workforce optimization	4.19	3.12
D2	Skilled workers and specialist skills	4.23	2.50
D3	Efficient operations and productivity benefits	4.18	2.48
D4	Easy implementation and ease of operation	4.26	2.16
D5	Environmental sustainability and precision management	3.68	2.81
D6	Technology borrowing and robotics technology development	4.04	2.42
D7	Cost reduction and cost-benefit analysis	4.13	2.69
D8	Political impact and policy development	4.42	2.30
D9	Value creation and collaboration	4.41	2.36
D10	Health, safety and security	3.79	2.67

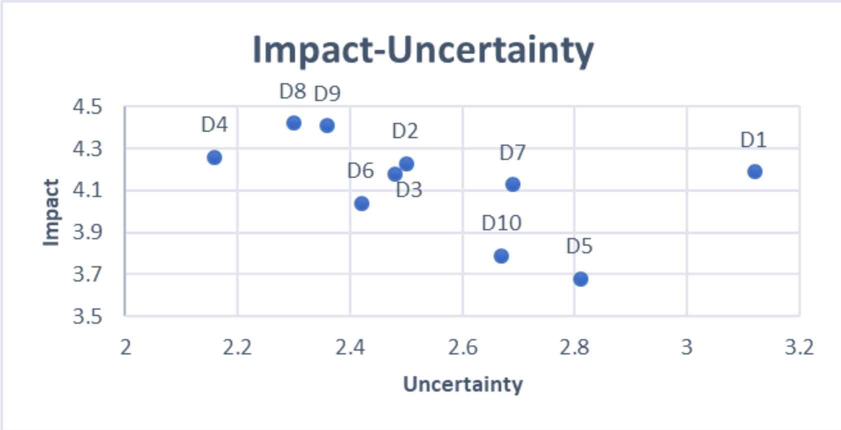

Fig. 1 *Impact-uncertainty analysis*

The impact-uncertainty analysis is crucial for determining the highest impact and uncertainty outcomes. The table lists all variables used in the analysis, with the top two coordinates having high impact and uncertainty being D8 (4.42,2.30) and D9 (4.41,2.36). The top two drivers, technology capability and political impact and policy development and value creation and collaboration were selected for scenario analysis. These two drivers had been selected as the top drivers and will be used to generate the scenario building in the next chapter.

4.2 Discussion Based on the First Research Objectives

The first objective of this study is to identify the issue, challenges and trends of robot implementation in agriculture field Malaysia. This objective had been generated through the STEEPV analysis. It is important to determine the issue, challenges and trends of agricultural robots implementation in agriculture field Malaysia which may contribute to the potential in enhancing efficiency, precision and sustainability by automating tasks such as planting, harvesting and monitoring. The issue, challenges and trends will determine the usage of agricultural robots in agriculture field Malaysia in the future. Changes in issues, challenges and trends identified from different sources such as journals, government-related articles, the internet and non-government organizations report on agricultural robot and classifying it into social, technological, environmental, economic, political and values.

4.3 Discussion Based on the Second Research Objectives

The second objective of this study is to identify the key drivers of agricultural robot implementation in agriculture field. Based on STEEPV analysis the economical factor is the most important drivers in implementation for agricultural robots, followed by technological, social, environmental, values and political. A total of 10 drivers that already merged from the issues, challenges and trends is labour efficiency and workforce optimization, skilled workers and specialist skills, efficient operations and productivity benefits, easy implementation and ease of operation, environmental sustainability and precision management, technology borrowing and robotics technology development, cost reduction and cost benefit analysis, political impact and policy development, value creation and collaboration and health, safety and security. These 10 drivers are use for the questionnaires to distribute to all of the stakeholders in this study.

4.4 Discussion Based on the Third Research Objectives

The third objective of this research was aimed to develop the future scenario of agricultural robot implementation in agriculture field. The trend is achieved by generating scenario analysis to four different alternative scenarios based on the two top drivers selected from the impact-uncertainty analysis. These drivers that has the highest impact and being the most uncertainty drivers compare to the others is the political decisions and policy development. The highest value of drivers is 4.42 and 2.30 in impact and uncertainty respectively. Both two drivers which is D8 and D9 had been chosen to assist in predicting the possible scenario in the future.

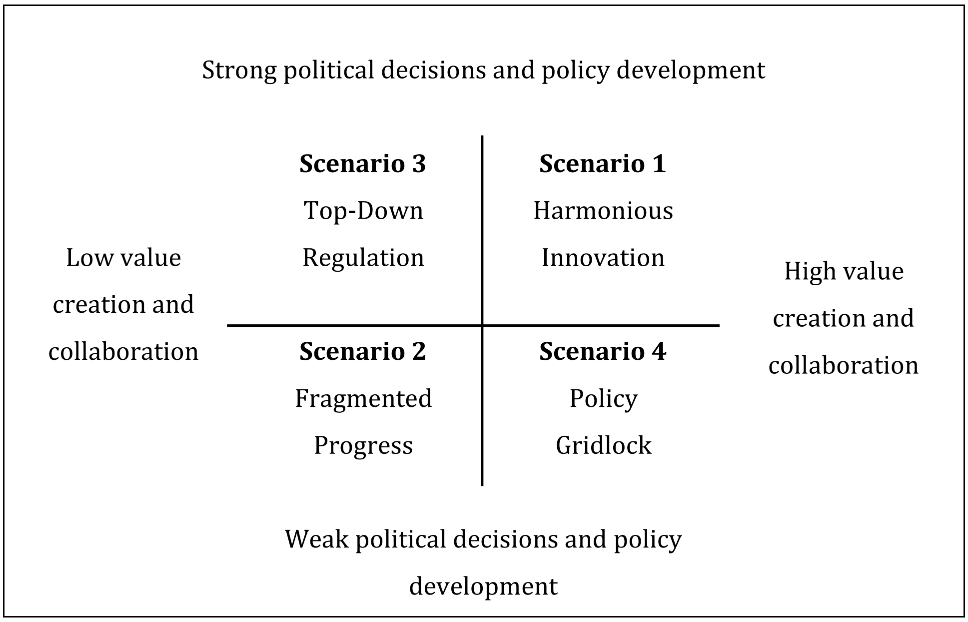

Fig. 2 *Development of four alternative scenario*

4.4.1 Scenario 1 (Harmonious Innovation)

The first scenario takes place when there is a strong political decisions and policy development with high value creation and collaboration. The success of agricultural robot implementation in agriculture field Malaysia that the stakeholders in Malaysia will fully implement the modern technology of agricultural robots in agriculture field in the coming years. A strong political decisions and policy development can ensure that the governments proactively support and invest in agricultural robotics, creating favourable policies for research, development and adoption. While a high value creation and collaboration will enable the emphasis is on sustainable and precision agriculture, leading to significant value creation with the robust collaboration between farmers, technology developers and policymakers fosters a climate of innovation.

In addition, to implement agricultural robot political decisions and policies play a crucial role in providing funding, incentives and support for research and development in the field of agricultural robotics. A regulatory framework for the use of agricultural robots is also established by clear and encouraging policies. Policies that encourage agricultural robots must be flexible enough to change as technology and agricultural practises do (Dhanaraju, 2022). Policies are kept current and supportive of new developments through collaboration and frequent revisions. Policies that promote cooperation also make knowledge transfer and training initiatives easier. It is imperative that farmers receive education regarding the advantages and appropriate handling of agricultural robots. Cooperation facilitates the efficient transfer of knowledge.

4.4.2 Scenario 2 (Fragmented Progress)

One of most mentioned and essential challenges of using agricultural robots in the agriculture production is political decisions and policy development. Low political decisions and policy development mean there is no clear directions or support from government authorities. When there is a lack of direction, stakeholders may become hesitant to invest in or use agricultural robots. Research, development, and implementation of agricultural robots may receive little financial support or incentives in the absence of significant political backing. Technology advances more slowly and innovation is hampered by this lack of financing. On the other hand, fragmented development attempts are the consequence of low collaboration among stakeholders, including farmers, technology developers, and policymarkers. (OECD, 2021). There is a lack of shared knowledge, best practices and standards, leading to inefficiencies in the implementation process.

Low political decisions and policy development, combined with low value creation and collaboration with stakeholders, create a challenging environment for the successful implementation of agricultural robots. Overcoming these challenges requires concerted efforts from governments, industry players and farmers to establish supportive policies, encourage collaboration and realize the potential benefits of agricultural robotics.

4.4.3 Scenario 3 (Top-Down Regulation)

There are few problems if there is a low value creation and collaboration which one of these is despite strong political support, the actual implementation of agricultural robots may be slow and fragmented. The lack of cooperation and value generation suggests that farmers might not have enough incentives to embrace new technology, which would prevent their widespread adoption. Opportunities for expansion and economic development in the agriculture sector could be lost in the absence of cooperation. Furthermore, it might be difficult to establish and enforce strict policies without the cooperation of stakeholders. (Papers, 2020). Ensuring compliance could be challenging, and there might be unexpected repercussions or gaps in the policies. Implementing agricultural robots may face difficulties if strong political decisions and policies are combined with low levels of collaboration and value generation.

4.4.4 Scenario 4 (Policy Gridlock)

Finally, this scenario was occurred when there is strong political decisions and policy development yet low value creations and collaborations on agricultural robots in agriculture field Malaysia. Generally, agricultural robots will help in efficiency productivity in agriculture field in the future, but with lack of value creations and collaboration will cause various problems especially involving decision-making process. This scenario is good for agriculture field but must concern about the value creations and collaborations problem.

5. Conclusion

In conclusion, the aim of the study is to identify the issues and drivers of future image of agricultural robots implementation in agriculture field Malaysia. The research about foresight study on agricultural robots implementation agriculture field Malaysia will provide a new trend in agriculture process in the next 5 to 10 years. Besides, this study also provides the new knowledge and information as well as perception of the respondents on development of agricultural robot implementation in agriculture field Malaysia. The top two drivers which were identify from impact-uncertainty analysis has been used to build scenario building analysis. Four scenarios analysis are built to determine the proposed future image of agricultural robot implementation in agriculture field Malaysia. Every new technology will face some challenges and limitation thus both the public and private sector should give support to help develop this new future technology in Malaysia.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *N.R.B.S. and N.M.N.;* ***data collection:*** *N.R.B.S.;* ***analysis and interpretation of results:*** *N.R.B.S. and N.M.N.;* ***draft manuscript preparation:*** *N.R.B.S. and N.M.N. All authors reviewed the results and approved the final version of the manuscript.*

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