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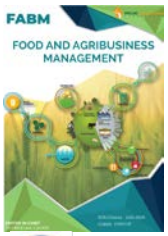

RESEARCH ARTICLE

AGRICULTURE RISK MANAGEMENT: A CASE STUDY ON ROCK MELON FARM IN SEPANG, SELANGOR, MALAYSIA

Wira Abu Bakar[a] and Rabihah Md Sum[b]*

[a]*Malaysian Agriculture Research and Development Institute (MARDI)*
[b]*Faculty of Science and Technology, Universiti Sains Islam Malaysia (USIM)*
**Corresponding Author e-mail: rabihah@usim.edu.my*

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ABSTRACT

The objectives of this study are to identify risks faced by farmers in agriculture project and investigate their risk management practices. The subject of investigation was a rock melon farm in Sepang, Selangor Malaysia. The participants consisted of four farmers and two officers. Data was collected using semi-structured interview questions and analyzed using content analysis. The study finds agriculture risk management can be divided into two groups: agriculture project risks and agriculture production risks. Agriculture project risks are events causing project failure. The risks are created by farmers and risks arise from project operations Risk factors created by farmers are farmers' attitude, lack of knowledge/training, lack cooperation among farmers and farmer refuse to follow procedures. Risk factors from operations are farm management, insufficient fund/capital, undiversified farm activities, failure to achieve KPI and follow procedures. Agriculture production risks are events causing low productions. The risks arise from machineries efficiency and farming technologies. Risk factors for machinery efficiency are immature machineries technology, and suitability of machines for local crops and small farm size. Risk factors for technology are unsuitable technology for local farming, technology too expensive for small farm and technology transfers from developed countries. The participants view risk management process as consisted of risk identification, risk evaluation/risk analysis, risk assessment and risk treatment. Their risk management strategies to mitigate risks are production diversification, keeping a logbook on farming activities, obtaining skill and knowledge in farm management, job multitasking by farmers and having a comprehensive risk management guidelines.

KEYWORDS

Agriculture Risk Management, Farm Risk Management, Risk Management, Agriculture, Case Study.

1. INTRODUCTION

Since independence 62 years ago, agriculture is the basis and major focus of Malaysia's economic growth. Before 1970s, agriculture contributes substantially to Gross Domestic Product (GDP). In 1950s, the sector contributes close to 50% of the country's GDP. However, by 2009, its importance has been reduced to below 10% (Istikoma and Rahman, 2015) and declining further to 8.1% in 2016. The major agriculture contributor to GDP is plantation crops such as oil palm and rubber. While food crops such as rice and other local fruits contribute only 19.5% to GDP (Jabatan Perangkaan, 2017). Logically, the global requirement for agriculture is expected to expand in tandem with the growing population. However, in reality the two variables do not seem to match. The contribution of the agriculture sector to the country's GDP appears to be declining.

Malaysians are encouraged to venture into agricultural programs, particularly in developing idle lands. These agriculture programs not only able to increase the country's agriculture production, the programs can also be sources of income to the individuals. Therefore, to help farmers and land owners to venture into agriculture programs, Malaysian government put in a lot of supports in the development of the food crop sector. The supports are in terms of subsidies and support programs. Such as direct participation of the Department of Agriculture Malaysia and the Ministry of Agriculture and Agro-based Industries in supporting farmers in developing agricultural land. In addition, other ministries such as Ministry of Rural Development and Ministry of Economic Affairs, and government agency such as the Performance Management and Delivery Unit (PEMANDU) also provides support programs for Malaysians to venture into agriculture programs. The National Key Economic Area (NKEA) for Agriculture aims to grow Malaysia into a developed nation by 2020, plays an important role to double the agriculture sector's gross national income (GNI) contribution. The aim is to grow the agriculture contribution from RM 20.2 billion in 2009 to RM49.1 billion by 2020, through 16 Entry Point Projects (16EPPs) and business opportunities. The agriculture's NKEA objectives includes placing a higher value for Malaysia's produce and increasing agriculture productivity.

Despite government support programs and subsidies, agriculture contributions to Malaysia economy continue to decline. The fault is not because of the ineffectiveness of the programs. Rather, the agricultural sector is vulnerable to many natural and unnatural risks such as drought, floods, fire, rain, pest, diseases, attacks from wild animals, and variability in input and output prices. The risks affect the total yield of agricultural production from a farm or plantation. A study defines agriculture risk as uncertain events that have the chances to cause losses or yield variability

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(Choudhary et al., 2016). The U.S. Department of Agriculture (USDA)'s Economic Research Service states the agricultural sector faces a wide spectrum of challenges and risks. Risks faced by the sectors are as follows.

- Production risk. Production risk is the uncertainty in the natural growth processes of crops and livestock. Agriculture production implies an expected outcome or yield. Variability in outcomes creates risk to farmers' ability to achieve financial goals. Production risks are events causing unpredictable yields or outcomes. For examples, weather, disease, and pests are risks affecting both the quantity and quality of commodities produced.
- Price or market risk. Price or market risk refers to uncertainty on the prices producers will receive for commodities or the process they must pay for inputs. The nature of price risk varies significantly from commodity to commodity.
- Financial risk. Financial risk arises when farm owners borrow money. Hence, creating obligations to repay debt. Financial risks occur due to rising interest rates, the prospect of loans being called by lenders, and restricted credit availability.
- Institutional risk. Institutional risks occur from uncertainties surrounding government actions or policies. For examples, changes in tax laws, regulations for chemical use and rules for animal waste disposal. These risks can have major impact on agriculture project.

Risks in agriculture are pervasive and complex (Aditto et al., 2012). The risks force farmers to confront variability of yields, unstable output and input prices, and radical changes in production technology. Price volatility of inputs and outputs, climate change, international trade restrictions, and new and more stringent food safety standards further increase risks in the agricultural industry (Broll et al., 2013). In a study on hybrid maize farmers' in Pakistan, finds agriculture risks are mainly due to the variability of climate, the density of biological disease, production seasonality, the different geographical production areas and consumer of agricultural production (Akhtar et al., 2018). investigates global farmer's perceptions of agricultural risks (Duong et al., 2019). The study finds weather-related risk, biosecurity threats and human risks are significant risks perceived by farmers. The variability of product and input prices tend to be larger in agriculture than in other sectors. Agricultural commodity markets are quick to react to prices due to changes in supply. Price spikes can easily occurs, because most agricultural products can be stored when prices are low and sold later when price is high (OECD, 2014). Disease outbreaks and adverse weather events, such as floods and droughts, contribute to supply variability. The events negatively impact producer incomes, markets, trade and consumers. Furthermore, risks in agriculture are interconnected. Certain risks compound and offset each other. For example, if the prices of inputs (such as fertilizer) and outputs (such as agricultural commodities) move in the same direction, the impact on net returns is reduced. In contrast, production risks can be partially offset by price movements. As when crop yields are low but crop prices are high. In such a situation, revenues are more stable. Hence, for agriculture production risk, it is the net risk effect on income that matters.

The Organization for Economic Co-operative and Development (OECD) proposes that the agriculture risks are grouped into three layers of risks. Each risk layers requires different risk management strategies. The followings discuss the layers.

- Normal variations in production, prices, and weather. These are normal risks that can be directly manage by farmers. The risk management strategies include diversification of production or the use of production technologies to reduce yields variability.
- Infrequent but catastrophic events. These events may affect many or all farmers over a wide area. These risks are usually beyond farmers' capacity to cope. For example, a severe and widespread drought, or, the outbreak and spread of a highly contagious disease. The risk management strategies require government intervention.
- In between normal and catastrophic risk layers. These risks are managed using market tools. Such as agriculture insurance, futures markets or co-operative arrangements between farmers. Examples of these risks include hail damage and variations in market prices.

Ideally, the government supports and subsidies should support farmers and increase the contribution of the agriculture sector to Malaysian's economy. However, in reality agriculture's contribution to Malaysian's economy has been declining over the years and the country still depends on imported food crops. The fault is not because of the ineffectiveness of the support programs. Rather, agriculture sector is exposed to the highest level of risk exposure and many of the exposures are beyond farmers' control (Mateos-Ronco and Server Izquierdo, 2020). If these risks are not accurately identified and managed, the impact will be further declining in agriculture production yield, losses of income to farmers and continual dependent on imported food crops. Against this backdrop, this study investigates risks faced by an agriculture project in Malaysia. The objectives are to identify risks faced by the farmers, the impact of the risks and their view and opinion on risk management in agriculture.

1.1 Agriculture Risk Management

Agriculture risk management can be divided into agriculture project risk and agriculture production risks. The following sections discuss the two risks.

1.1.1 Agriculture Project Risks

Agriculture project is an activity to provide people with food, clothing, medicine and other useful products as well as some important ecosystem services. An agriculture project is fragile and subjects to risks that are often unpredictable and outside human control (Austin and Baharuddin, 2012). Agriculture project risks are the cumulative effect of the uncertain occurrences adversely affecting project objectives (Petravicius, 2005). According to 2012, agriculture project risks can be classified into business risk and financial risk (Aditto et al., 2012). Business risk can be divided into five components: production risk; marketing risk; institution, policy and legal risk; human or personal risk and technological risk. Financial risk occurs when farmers make a bank loan and are exposed to variations in interest rates. Agriculture project risks can come from outside of the operation, from the operation itself and can even be created by the farmers (Oatess, 2016).

1.1.2 Agriculture Production Risks

Production risks are the most uncertain and potentially devastating to farmers. Previous studies find the major source of production risks are weather, climate changes, pests, disease, fire, wind, technology, genetics, machinery efficiency and the quality of inputs. A study finds typical sources of these risks related to weather and climate (temperature and precipitation), pests and diseases (Komarek et al., 2020). A study finds that production risks comes from the unpredictable nature of the weather and uncertainty about the performance of crops or livestock (Hardaker et al., 2015). A scholar analyzes literature-related risk in agriculture (Duong et al., 2019). The study finds production risk is a significant risk documented by the literature. Production risks occurs due to uncertainty of rainfall, variability in temperature, and bad or unpredictable weather conditions. All farmers face production risk irrespective of their locations and crops (Mittal, 2012). Geographical locations, public stewardship and economic strength are the main determinants of differences in risks to agricultural production in different kinds of countries. Farmers also perceive weather and climate change as the main risk, followed by biosecurity threats, human risk, and market risk.

A study classifies agricultural production risk into four groups. The first group are risks from weather fluctuations, crops and animal diseases and pests (Janowicz-Lomott et al., 2014). The second group is price risks. Price risks arise from price variability. The third group is disaster risks. Disaster risks arise from flood, droughts and hurricanes. The fourth group is technological risk. Technological risks are the result of continuous development and adaptation of new techniques and method in production.

Climate change and globalization increases production risks (Castro et al., 2014). Climate change increases the variability of precipitation and frequency of droughts and floods. The consequence, significant drops in crop yields (De Clercq et al., 2018). Under climate change scenario, reports decrease in maize production in Iran is highly projected (Huang et al., 2017). Any unexpected changes in climate such as changes in temperature, rainfall, sunlight and humidity has consequences to crop yield and affected agriculture projects as a whole (Castro et al., 2014).

1.2 Agriculture Risk Management Process

The objective of agriculture risk management is to reduce the chance to end up in an economically vulnerable situation. Agriculture risk management enables farmers to anticipate, avoid and react to threats and

shocks. Efficient agriculture risk management preserves the standard of living of those depending on farming, strengthen the viability of farm businesses, and created an environment facilitating investment in the farming sector (Baquet, 1997). A study proposes that the key to effective risk management is an appropriate system for recording events that occur on the farm. Risk management system or process is an important aspect in risk management (Janowicz-Lomott et al., 2014). A scholar develops a risk management process of agriculture project. The process is based on the standardized risk management process of ISO 31000:2009 Risk Management Process develops by International Standard Organization. Figure 1 presents the risk management process (Leppala, 2016). A researcher outlines 5-steps agriculture risk management processes. Step 1 is conducting preliminary farm risk context analysis. Includes checking the main safety and security risks categories and possible risk events on farms. Step 2 is conducting detail process evaluation or checklists on the main functions in a farm and risk analysis with the risk matrix. Outlines objective and focus setting connected to the farm business strategy, assets, environment, human resources and production tasks. Step 3 is choosing risk control tools and develop implementation plans for the risk controls. Step 4 is monitoring the implemented plans. Step 5 is communicating with advisors and benchmarking the effectiveness of the risk control plans with other farmers. A researcher develops a five-step agriculture risk management process. Figure 2 presents the process. A researcher agriculture risk management processes are as follows (Kahan, 2008). Step 1 is identifying the sources of risk. Step 2 is identifying the possible outcomes that could occur if the risks materialized. Step 3 is decide possible outcome for each risk management strategy. Step 4 is assessing the consequences for each outcome. Step 5 is evaluate trade-offs between the cost of risk and gains.

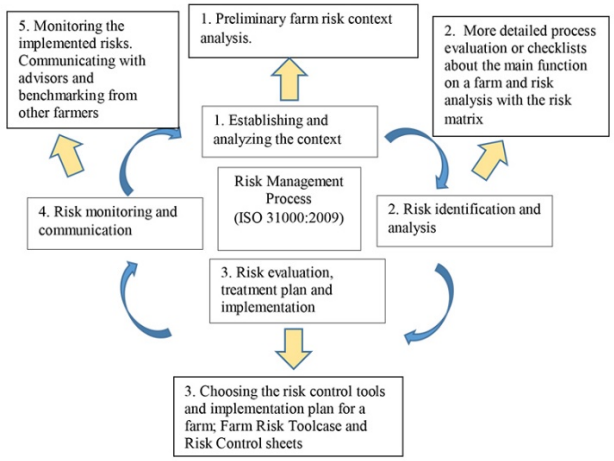

Figure 1: Agriculture risk management process by Leppälä (2016)

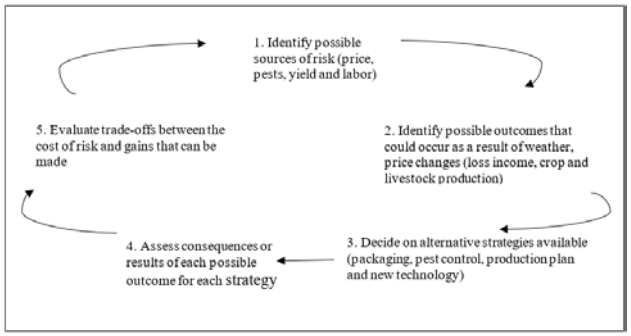

Figure 2: Risk management process by Kahan (2008)

1.3 Risk Management Strategies in Agriculture

Table 1 presents the summary of risk management strategies or mechanisms. Risk management strategy is an important aspect in risk management. These strategies comprise of a variety of responses to lower the probability of an adverse event occurring and/or reduce the adverse consequences if the event occurs in a farm (Ullah et al., 2016). A researcher classify common response mechanism in risk management strategies into risk reduction, risk mitigation or risk coping. Risk reduction strategy is to reduce the probability of risk occurrence (Holzmann et al., 2001). In risk reduction strategy, A researcher propose several mechanisms such as application of advanced cropping technique, crop diversification and intercropping. Risk mitigation strategy is to reduce the potential impact of risk. Examples of risk management strategies are crop rotation, using pesticides, crop sharing, crop insurance, forward contract and diversification (Mokhaukhau, 2020). Risk coping strategy is to relieve the impact of the risk once it has occurred. Examples of risk coping strategies are reducing consumption pattern, selling real assets and borrowing from financial institutions. The risk coping strategies adopted by farmers can be divided into formal and informal strategies (Akhtar et al., 2019). The formal strategies are provided by the public institution and informal strategies are implemented by famers at the firm level. Examples of formal strategies are agriculture credit, crop insurance and input subsidies. Examples of informal strategies are income diversification, crop diversification and selling of assets.

A researcher classifies agriculture risk management strategies into four categories. (1) Risk mitigation or risk reduction strategy (Demeke et al., 2016). The purpose of these strategies are to limit the impact of disasters and prevent risks. (2) Risk transfer strategy. The purpose of risk transfer strategies is to transfer potential financial consequences of particular risks from one party to another financially capable party. (3) Risk coping strategy. Risk coping strategies are actions taken after the shocks to mitigate the impacts of the risks. (4) Failure rang strategy. This strategy is designed for catastrophic risks that occurred frequently. Implying the activity under consideration needs to cease and households need to adjust to a new form of livelihood. A researcher proposes the following three strategies for farmers to reduce risk (Bairwa, 2013). The strategies depend on the farm situation and risk-bearing willingness and ability. (1) Enterprise diversification. Diversification means participating in more than one activity. By having more than one income producing activates in a farm business, the chance of a large loss from a risk is reduced. (2) Production contract. Production contracts enable the contractor (the buyer of the commodity) considerable control over the agriculture production process. (4) Marketing contracts. Marketing contracts between a buyer and a producer that set a price for a commodity before harvest or before commodity is ready to be marketed. Marketing contracts reduces risk exposure to price variability.

Table 1: Common risk strategies in agricultural risk management

Strategies	Farm/community
Risk Reduction	• Adoption of advanced cropping techniques (fertilization, irrigation, resistant varieties, pesticides) • Crop diversification and inter-cropping • Plot or farm diversification • Mixed farming • Diversification of income source • Buffer stock accumulation of crops or liquid assets • Technology
Risk Mitigation	• Crop sharing • Sharing of agricultural equipment, irrigation sources, etc. • Informal risk pool • Diversification in production • Investment in human, physical and real assets
Risk Coping	• Crop insurance • Agriculture credits • Input subsidies • Reduced consumption patterns • Deferred/low key social and family functions • Sale of real assets • Reallocation of labour • Mutual aid (borrowing from neighbours/ family)

Risk management strategies help farmers to mitigate risk before they occurred (Chaudhary et al., 2016). According to a researcher, effective risk management strategies have the following benefits to agriculture producers (Demeke et al., 2016). The strategy enables farmers to invest in high payoff activities instead of low-risk and low-return outcomes and invest in more resilient and dynamic farming systems. Effective risk management strategies enable farmers to undertake longer-term investment, for examples investment in land improvement or

infrastructure and to have access to loans to finance procurement of inputs and investment.

A researcher investigates price risk perceptions and management strategies in five European countries, Netherlands, Spain, Bulgaria, France and German (Assefa et al., 2017). Data is collected using in-depth interviews with semi-structured question. A researcher uses content analysis to determine price risk perceptions and management strategies of the food chain players. The study finds price risk management strategies are dependent on the risk recipient. For farmers, they prefer adaptive strategies. Similarly, wholesalers and processors, tend to focus on adaptive strategies. Adaptive strategies enable them to secure stable margins regardless of price movements. The retailers' main focus is to secure a continuous supply of quality produce for their customers, rather than to reduce price volatility. The results show that wholesalers, processors and retailers are in a better position to deal with risks from price volatility compared to farmers. A study investigates risk assessment in decision-making in Santa Catarina, Brazil (Bacic et al., 2006). The aim is to determine attitudes towards uncertainty and risk in making decisions. Data is collected using individual semi-structured interviews. The respondents are five officers and 20 farmers. The study finds, farmers use multiple strategies to avoid or mitigate risks in changing land use. The farmers practice slow changing of the land usage, planting over the entire feasible period, avoid large investment, diversify production, increase or improve the current activity and avoid crop with high production risk. The study also find that farmers and officers had different levels of knowledge, analytic capacity, economic conditions, perspectives and needs. [40] investigates the usage of climate information services (CIS) by men and women farmers for climate risk management in Ghana. The study uses focus group discussion and semi-structured questionnaire interviews. The findings show that 85.2% farmers are aware of climate change. The use of CIS is influenced by gender. Men are particularly responsive in adopting CIS for climate risk mitigation compared to women farmers.

A researcher investigates the role of government in managing risk in agriculture production in Poland. The study analyzes normative acts, reference books and international analyses and reports (Lipinska, 2016). This study find that the role of the state in supporting the income of agricultural producers is significant. However, it should not be used until the instruments implemented by a farmer are effective. This study suggests the government to not provide support to deal with normal risk because managing normal risk should be under the farmers themselves. A researcher investigates global farmer's perceptions on agricultural risks and risk management strategies (Duong et al., 2019). The findings from this study indicate that diversification of crop and animal production, and pests and disease monitoring and prevention are the preferred agricultural risk management strategies employed by farmers. A scholar investigates risk and risk management in agriculture in Netherland. The study uses field survey questionnaire to collect data (Huirne et al., 2000). They find that contagious animal diseases and death of farm operators are the major sources of risk for livestock farmers. They also find that producing at the lowest costs and buying insurance are the most significant risk management strategies. A study investigates major sources of risk and the effectiveness of the risk management responses in rural smallholder farm households in the semi-arid region of Northern Ghana (Asravor, 2019). The study uses Likert scale questions to rank risk perceptions and management strategies of the farmers. The study finds that variations in crop yield, fertilizer prices and crop price are the most relevant sources of risk. Stabilizing household income by growing different crops, storing feed/seed reserves and spreading sales are the most effective risk management strategies.

2. Materials and Methods

2.1 Research Approach

This is a case study approach. The research focuses on single entity, a rock melon farm in Sepang, Selangor Malaysia.

2.2 Data and Data Collection

This study uses primary data. Data is analysed to understand risks faced by farmers and strategies to handle the risks. This study used semi-structured interview to obtain the data. The interviews are conducted between the 2nd of November and13th of November in 2018. The face-to-face interviews with the participants are conducted at the project site in Sepang, Selangor. Each interview lasted approximately 30-45 minutes

2.3 Unit of Investigation

The subject of investigation is a rock melon farm, located at Sepang, Selangor, Malaysia. The agriculture land of the farm belongs to Ministry of Defence (MINDEF). The land is originally an idle land that is developed into agricultural projects using a high-tech agricultural system.

2.4 Research Participants

Data is collected from two groups of participants. The first group are farmers working in the farm. The second group are officers from Malaysian Agricultural Research and Development Institute (MARDI). MARDI is an institute under the Ministry of Agriculture and Agro-based Industry that is responsible for agricultural research and development in Malaysia. The officers are in charge of monitoring the rock melon project. The total number of participants is six. Four farmers and two MARDI officers. The farmers group are coded as R1, R2, R3 and R4. Table 2 presents demographic background of the farmers.

Table 2: Demographic background of farmers

No	Particulars	R1	R2	R3	R4
1	Age	29	25	33	61
2	Race	Malay	Malay	Malay	Malay
3	Education background	University degree	Primary school	Primary school	Diploma
4	Work experience (years)	5	5	15	37
5	Farm experience (years)	5	5	6	4
6	Land area (acres)	0.4	7	1	5.7

The two respondents from the MARDI group are coded as R5 and R6. Demographic background of each participant is presented in Table 3.

Table 3: Demographic background of MARDI officers

No	Particulars	R5	R6
1	Age of respondent (years)	39	40
2	Race	Malay	Malay
3	Gender	Female	Male
4	Workplace	MARDI	MARDI
5	Work experience (years)	13	15

2.5 Development of Interview Questions

The interview questions follow. A study uses Central Research Question-Theory Question-Interview Question (CRQ-TQ-IQ) pyramid model developed by [49] to develop interview questions for their study (Sum et al., 2017). Pyramid model proposes the progression from the Central Research Question (CRQ) differentiated into Theory Question (TQ) and specific Interview Question (IQ) (Wengraf, 2001). Figure 3 presents the Wengraf CRQ-TQ-IQ Pyramid Model for this study.

Figure 3: Wengraf CRQ-TQ-IQ Pyramid Model

2.6 Data Analysis

Data from the interview is analysed using content analysis. The content

analysis is conducted using an aided qualitative data analysis software namely NVivo12. Analysis of the data aims to achieve the research objectives i.e. risks faced by farmers in agriculture project, impact of the risks and farmers' view on risk management process. Content analysis identifies key points of the interview transcripts (Erlingsson et al., 2017). To conduct content analysis is by screening the interview transcripts and asserting significant statements representing the theory questions (TQ) and central research questions (CRQ). To conduct the data winnowing process is sorting the data into categories (coding) highlighting the significant results from the raw transcript. Figure 4 shows an example of coding process. Figure 4 consists of farmers feedbacks on the questions, what are the issues and problems preventing them from achieving their farming objectives. The feedbacks are categorised into three i.e. demotivation, lack of knowledge and no cooperation/understanding among farmers. These categories are named risk created by farmers.

	Demotivated	Lack of knowledge or training	No cooperation/no understanding among farmers
Farmer 2	memang effect emosi lah emosi masa kerja memang penting aa sbb kita kerja pun melibatkan fizikal benda kerja tengah-tengah panas aaa pastu fikir dapat hasil kecil je memang tak dapat reward sendiri pastu memang takdelaa rasa macam incare	nak kata saya sebenarnya lebih pada knowledge to produce the best bagi saya kalau kita ada buah yang cantik orang akan cari so that	usahawan tak bagi kerjasama yang ni nak buang pokok yang ni baru nak masuk pokok sedangkan kita dah cakap kat dia yang paling sesuai tanaman rockmelon dengan cili ni dekat sini adalah tanaman secara serentak.
Farmer 3	dan satu lagi emosi memang down lah bila kita buat tak capai target kita takde keuntungan takde duit nak reward diri	kekurang ilmu pun boleh jadi gak coz bertani ni ada je masalah baru tiap hari yang kita akan facing...	dalam satu kawasan kita takde kerjasama antara usahawan lain contohlah lot belah sini dia buat pokok kita kat belah sini baru nak masuk anak pokok bila buang sini automatic penyakit kat sini akan datang sebelah sini.

This coding process in order to develop and assign 'Code' (theme) from interview transcript.

Figure 4: Example of the content analysis process (coding) for risk created by farmers

3. RESULTS

The content analysis produces four main themes. The themes are agriculture production risks, impact of low production output to agriculture project, agriculture project risk, and risk management process.

3.1 Theme 1: Agriculture Production Risks

Table 4 presents agriculture production risks. Agriculture production risks are events or situations causing low production output. In this case study, agriculture production risks are risks causing low production output of rock melons. According to the farmers, the risk factors for agriculture production risks are machinery efficiency and technologies. For machinery efficiency, the risk factors size of land area, advance machineries (current one might not be suitable) and machineries that suit local crops. For technology factors, the risk factors are a technology that suits local context, time saving technologies, and technologies that are too expensive for small farm. Similarly, the officers identify machinery efficiency and technologies are risks for agriculture production. For machinery efficiency, both MARDI officers highlight immature technology as the risk factor for machinery efficiency. For technology, the officers emphasize the farm needs technology transfer from developed countries to increase production output. This finding highlights the fact that the agriculture officers from government institution (in this case, MARDI) are aware that agriculture industry in Malaysia lacked high-tech machineries and requires technology transfer.

Table 4: Agriculture production risks

Agriculture Production Risks							
Machinery Efficiency				Technology			
Size of land area	Advanced technology	Machines suitable for local crops	Immature machinery technology	Technology suitable for local context	Time savings technology	Technology too expensive for small farm	Technology transfer from developed countries

3.2 Theme 2: Impact of Low Production Output to Agriculture Project

Table 5 presents the impact of low production output to agriculture project. Theme 1 agriculture production risk discusses risks causing low production output. For this case study, low production output means the production output of rock melons does not achieved the targeted output. Theme 2 discusses the impact of low production output to agriculture project. Table 5 presents the impact of low production output to agriculture project. From the results, impacts of low production on agriculture project are financial stress and reduced performance. All six respondents from both groups' state that the most important impact is financial stress, followed by reduced performance. Two impacts under financial stress are insufficient fund and reduced workers productivity. Two impacts under reduce performance are project did not survive and marketing problems. The consequence of insufficient find is reduction in capital for next crop cycle. Insufficient fund causes farmers to use poor planting materials to reduce input costs. Poor planting materials affected the production for the next crop cycle. A researcher states the use of poor planting materials and soil infertility reduces crop yield (Ibeawuchi et al., 2009). Inadequate use of agricultural inputs such as good quality seeds and inorganic fertilizers reduces the amount of production. Reduction in agriculture project performance affected marketing. The consequence, farmers are not able to implement contract farming. Contract farming is an agricultural production carried out according to a pre-planting agreement. In the agreement, the farmer commits to producing a product in an agreed quantity and quality, and the buyer commits to purchasing it (Chen et al., 2009). Low production creates difficulties for the farmers to implement contract farming because farmers and buyers are uncertain on the production quantity and quality (Minot et al., 2016). Further, financial stress affects farmers' productivity. According to the farmers, not having income or receiving lower income, creates personal financial stress and affect their productivity. The consequence reduced workplace morale and diminished productivity (Joo et al., 1998).

Table 5: Impact of low production output to agriculture project

Impact of Low Production Output			
Financial stress		Reduce performance	
Insufficient fund for next crop cycle	Reduced productivity	Project failure	Marketing problems

3.3 Theme 3: Agriculture Project Risk

Table 6 presents agriculture project risks. Agriculture projects risks are events, situations, or people actions that cause project failure. For agriculture project risk, the risks are risks created by farmers and risks from project operations.

For the farmers, the main risks arise from project operation. Factors deriving risks from project operations are farm management, insufficient funding, inability to pay workers' wage and inability to sustain or survive. The farmers refer to inside operations as the financial management of the farm. Similarly, for the officers, the main factors influencing agriculture production risk are risk from project operation; follow by risks created by farmers. Risks from operation are undiversified farming activities, financial conflict (insufficient capital), not achieving milestone (key performance index (KPI)), farm management, management of worker and inability to pay workers' wages. Risks created by farmers are lack of knowledge and experience, refuse to follow MARDI's officers advises or standard operating procedure (SOP), farmers' negative attitude and dependence on subsidy from government. According to the officers, the main factor is diversification. The officers suggest several diversified business scopes such as producing other produce, plant nursery and other plantations.

Table 6: Agriculture project risk

Agriculture Project Risks							
Project Operations				Created by Farmers			
Farm management	Insufficient funding	Inability to pay workers' wages	Inability to sustain/survive	Demotivation	Lack of knowledge/ training	Refuse to follow officers' advices	Depending on government subsidy
Undiversified farming activities	Financial conflict	Workers' management	Not achieving KPI/milestone	Not following SOP	No cooperation/ understanding among farmers	Farmers' negative attitude	

3.4 Theme 4: Risk Management Process in Agriculture Project

Risk management process in agriculture involved several steps. Farmers view risk management process in agriculture consisting of four steps. The steps are risk identification, risk assessment, risk evaluation and risk treatment. Risk evaluation is the most important to the farmers, followed by risk treatment, risk identification, and risk assessment. According to the farmers, risk management can be implemented in three ways; farm management, multitasking (workers have another job) and keeping farm activities record in logbook. For risk treatment, the techniques are diversify farming activities depending on land suitability, the importance of optimal usage of land area, the need of comprehensive guideline and cultivation strategy. According to the officers, risk management process is risk analysis, risk assessment and risk evaluation.

4. Discussion

Table 7 summarises the results and presents agriculture risk management. In the theme of agriculture production risks, farmers and officers share common knowledge that technology and hi-tech machineries are lacking in agriculture. Therefore, creating obstacles to local farmers to expand their farms into high capacity agricultural projects. Machinery efficiency reflects the advancement of technologies used in agricultural projects. The farmers complain that their farms lacked advanced technology. They belief the lack of advanced technologies is the cause of low production outputs, and eventually to projects failure. A successful project is a project that completes on time, within the budget planned and performs exactly according to the specification or target (Wangeci, 2013). Thus, agriculture projects that fail to achieve targeted production output are failed projects. The problems highlights by the farmers and officers, establishes the need to provide farmers with suitable machines and technology, and educate them to handle the machineries and technology. Farmers in Malaysia need to adopt advanced technology and abandon traditional farming methods. A study compare lands usage based on technological support given to each region by the government to enhance farming projects in China (Chen et al., 2009). The study finds that even in land with low elasticity, with the help of various technologies, the farming projects manage to gain its required return of investment. A researcher conduct a similar study in Brazil. The study finds that technological advancement increases productivity of farming projects. A scholar state farms with higher technological support produces higher return in agricultural projects (Pereira et al., 2002). A study in farming industry in Africa by discovers that the non-ability to cope and adapt with newest technology in agricultural machineries contribute to low development growth rate (Munyua, 2000).

Among the risks factor for agriculture project are insufficient funding and risks created by farmers. The risk factor insufficient funding is similar to finding by a researcher (Ullah, 2007). He investigates agricultural financial risk in Peshawar, Pakistan. The study highlights financial problems faced by farmers in Peshawar's rural areas, where financial institutions are limited. Therefore, farmers face difficulty in making bank loans. In addition, the procedure for bank loans applications is difficult. Another study conducted in Brazil by a scholar who supports the findings (Pereira et al., 2002). According to the study, financial support from government is essential to increase productivity of a farming project. Risks created by farmers arise from factors such as demotivation, lack of knowledge or training, and no cooperation or understanding among farmers. A researcher state that knowledge and proper training in farming is essential for farmers to gain farming skills (Oztas et al., 2018). The knowledge as well as experience contribute to high productivity and reduced costs. Skills and experience has a positive influence on farmers' management ability. A researcher state that motivation is one of the factors that ensures success in agriculture projects (Veisi et al., 2017). According to the study, highly motivated farmers in Iran successfully conduct projects on organic farming. Farmer's attitudes are an important element in maintaining good agriculture production. A researcher critically discuss the need to diversify agricultural products (Waha et al., 2018). The purpose of diversification is to generate more income to farmers. Diversification is useful during the times farmers fail to accomplish the targeted sale of their produce. According to a scholar, creative minded farmers play an important role in creating a robust agricultural industry (Waha et al., 2018). A researcher discusses the subject of diversifying agricultural products at nationwide level to prevent malnutrition as well as food insecurity threat in Malawi (Mango et al., 2018).

This study had its limitations. This study only investigates rock melon farms in Sepang, Selangor, Malaysia. Malaysia has fourteen states with various background of crops grown in each state. Hence, future studies can expand to include the population of farms with different plantations. In addition, the respondents in this study are mono-race. They are all of Malay descendent. It would be beneficial to study risks faced by other farmers of Chinese, Indian descendent, or even farmers from East Malaysia (Iban, Melanau and other indigenous descendent) in their respective farms.

Table 7: Agriculture risk management

Agriculture Risk Management			
Agriculture Project Risks		**Agriculture Production Risks**	
Risk created by farmers	**Risk from project operation**	**Machinery Efficiency**	**Technology**
• Demotivation • Lack of knowledge/ training • No/Lack cooperation/ understanding among farmers • Not following SOP • Refuse to follow MARDI officers' advice • Farmers' negative attitude • Dependence on government subsidy	• Farm management • Funding • Inability to pay wages • Inability to survive/sustain • Undiversified farming activities • Financial conflict • Workers' management	• Size of land area • Advanced technology • Machines suitable for local crops • Immature machinery technology	• Technology suitable for local context • Time saving technology • Technology too expensive for small farm • Technology transfer from developed countries
Impact of Low Production			
Financial Stress		**Reduce Performance**	
Insufficient fund for next crop cycle	Reduce productivity	Project did not survive	Marketing problem
Risk Management Process			
Risk Identification	Risk Assessment	Risk Analysis/ Evaluation	Risk Treatment

5. Conclusions

The study concludes that agriculture risk management consists of agriculture project risks and agriculture production risks. Agriculture production risk is risks causing low production output. Agriculture project risks are risks causing project failure. Machineries usage and technologies are the risks faced by the agriculture industry. Technological advancement and the usage of machineries are essential in ensuring agricultural project to produce the targeted output. Low production output creates a looping problem. Low production causes financial stress and reduces productivity. Financial stress causes insufficient fund for the next crop cycle. Hence, farmers use low quality seeds and fertilizers. Resulting in lower production output. To ensure the survival of agriculture project, agriculture project managers need to manage project operation risks and farmers' risks. The risks include farm management, financial/funding management, farmers' attitude, and motivations, farmers farming knowledge and skills, non-diversification of farming activities and workers management.

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