Agro-Innovation – Path to Agricultural Entrepreneurship: Feasibility Study

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Receivd: 18 feb 2019 Reviewed: 4 April 2019 Accepted: 6 May 2019

Abstract

Technology changes will always be for the better, not only to the end users but also to the intellectual property owners of the technology and the implementers of the technology. The objective of this paper is to study the feasibility and viability for entrepreneurs to become service providers for the dispensation of fertilizers, pesticides, fungicides and supporting services such as aerial crop reconnaissance using Unmanned Aerial Vehicles (UAV) or drones. The methodology used for this study is SWOT Analysis. Both primary and secondary data is used for this analysis. This study finds that paddy farming employing drones is feasible. The beneficiaries of this study shall be the government, by way of lowering financial cost to subsidise the paddy planting, the farmers who no longer need the services of migrant workers, thus saving production cost, and finally the drone service providers and their downstream business associates who can engaged themselves in very lucrative businesses.

Keywords:Agro innovation, unmanned aerial vehicles,organic ferilizers, entrepreneurs

Introduction

The total area of paddy field in Malaysia is 689,730 hectares (Ricepedia, 2015) The yield in Malaysia is 4.04 mega-ton / hectare (mt/hectare). On the contrary, it has been reported that the Chinese ethnic rice farmers in the Sekinchan area in Selangor average about 9 (mt/hectare) (Muthiah, 2016).

Paddy farming has traditionally been a very labour-intensive activity. One of the bigger problems is the need to address farm labour shortages. (Bloss, 2014). Bloss further stated that robots and many new and innovative methodologies for performing traditional agricultural tasks of all types are now available. Tasks such as dispensing of fertilizers, pesticides, fungicides and weed killers are very important jobs to achieve the standard for good agricultural practises which will ultimately lead to producing a higher yield. For these tasks, the Unmanned Aerial Vehicles (UAVs) is probably the solution.

With a recorded yield of 4.04 mt/hectare, the rice production self-sufficiency level (SSL) stood at 72% (Insight, 2018). As a result of the shortfall of 28% of the SSL, Malaysia imported 900,000 metric tons of rice in 2016 worth RM1.57 billion. (Levels, 2017). Compared to other countries in South East Asia, Malaysia is lacking behind. See Fig. 1 below.

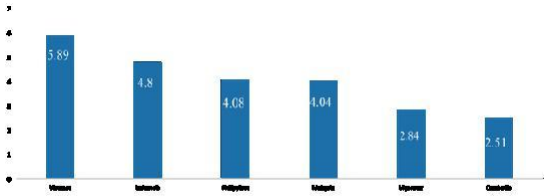

Fig. 1 Paddy Yield in South East Asian Countries. Source Levels (2017)

The current use of mechanization in rice farming is limited to ploughing using tractors to prepare the land before planting and mechanical harvesters. The rest of the chores are done using human labour, most of whom are workers from Indonesia, Myanmar, and Bangladesh. In short, rice farming using the present method is very costly in production.

Issues and Problems

The issue faced by the paddy farmers in Malaysia is the low yield at 4.04 mt/hectare, compared to the 9.0mt/hectare at Sekinchan (Muthiah, 2016). From the issues of low yields and the high production cost, the problems that arose can be summarised as: Low income for the farmers; low quality of life for the farmers and their families; not attractive for the younger generation to work on the farm. To augment the small income from the paddy farming, farmers are forced to take on secondary jobs elsewhere. This, in turn, will cause them to further neglect their paddy farm.

Numerous studies have been conducted in more agriculturally advanced countries for wheat, millet, corn, and vegetables with success. However, very little studies have been conducted on the use of state-of-the-art mechanization and especially UAVs for paddy farming in Malaysia.

Objectives

The main objective of this paper is to study the feasibility for entrepreneurs to become service providers for the dispensation of fertilizers, pesticides, fungicides and supporting services such as aerial crop reconnaissance.

The specific objectives are to investigate if use of UAVs or drones to lower production cost without compromising on the yield is feasible, to investigate if the present fertilizer subsidies can be dispensed by UAVs and if in the negative to investigate substitute fertilizers, pesticides and fungicides that can work with UAVs, and to investigate feasibility of providing financially viable services and downstream business to the farmers.

Scope and Limitation of Study

This study shall only cover the farmers' ability to practise good agricultural practices leading to higher yield and the ability to replace migrant labour by using UAVs, which at the same time will lower the production cost. Other related factors such as government policies and other aspects of agro-innovation shall be studied at a later time.

Literature Review

Government Fertilizer Subsidies

In the seventies, farmers in the rural areas of Malaysia were generally poor (Economic Planning Unit, 2010). More than two third of Malaysians, are Malays or Bumiputeras. In the poorer northern parts of Malaysia, quite a significant number of villagers are rice farmers. There exists a stigma then, where the association between farming and rural life creates a somewhat negative image of agriculture (Jan, 2011). As a result of this negative stigma,farming is seen as a job fit only for the poor. It is rare for members of the younger generation to aspire to be farmers, hence the urban migration. The government on the other hand, and without any doubt, see farming as a vital economic activity in rural areas.

Chemical based herbicides, pesticides, and fertilizers are also widely used in Malaysian farms. Weeds are the biggest single problem that can reduce yields by up to 90 percent. Similarly, rodents, insects, and fungi will also further reduce yield. Nearly all herbicides, insecticides, fungicides, and rodenticides were given to the farmers as government subsidies, are chemical-based, as they are cheaper and more easily available (Jan, 2011) However, it is known that chemical-base herbicides, insecticides, fungicides, and rodenticides have their own environmental problems.

It was concluded that the overall policy implication indicated that paddy production in Malaysia cannot be sustained without fertilizer subsidy and the farmers are not willing to buy their own fertilizer (Ramli, 2012).

The present government subsidies per hectare of paddy is two hundred and forty kilograms of granular chemical-based fertilizers, worth RM600.00, and RM320.00 worth of both liquid and powder form of pesticides and fungicides making a total of RM920.00.

At this stage, this researcher wishes to state that granular fertilizers are only dispensed manually or by using back-pack mechanical blowers. Either way, the workers have to tread into the field to apply a more even dispense of fertilizers. This causes damages to the rice plants which in turn will reduce the yield. Migrant labours are used to dispense the fertilizers. Likewise, the dispensation of pesticides and fungicides are done by migrant workers and incur costs to the farmers.

Granular fertilizers presently can only be dispensed by hand or blowers on the backpack. The more advanced UAVs are able to dispense fertilizers, pesticides, and fungicides in liquid form in a single operation. Hence, if the plan is to use UAVs then the granular fertilizers have to be discarded and instead replaced by liquid fertilizers. There are now available in the market liquid form of fertilizers, pesticides, and fungicides that can be dispensed in one operation, thus saving time, labour and cost. One such liquid form of fertilizers, pesticides, and fungicides have been produced by a Thai scientist and available in the market.

The important aspect of this Thai product is, it is organic, and can be sprayed onto paddy fields in mist form using UAVs. This researcher has experience with these Thai products dispensing with DJI Argas MG1 Auto Copter Drone. The more frequently used mix is 6 millilitres each of the fertilizer, pesticides, fungicides, and vaccine using stem cell technology to repair and prevent damages from diseases, to 20 litres of water. Each hectare would require 40 litres of water. Using the 6ml to 20 litres mix for each hectare the requirement shall be 48 millilitres.

Dispensing of Fertilizers by UAV or Drone

The most popular brand of UAV for agriculture in agriculturally advanced countries is the DJI Argas MG-1. This is a quadcopter with eight engines. Manufacturer specification is as shown in Table 1 below.

Table 1: Capabilities of DJI Argas MG-1

Payload	10 litres or 10kg
Dispensing time	20 minutes per hectare
Maximum flying time per day	4 hours due to battery constraint
Productivity per day	12 hectares per day
Cost per hectare for 1 season	RM220 per hectare

In summary, with the current system, the government contributes RM920.00 worth of fertilizers for 1 hectare per season, whereas the proposed system the government only contributes RM175.00. It is evident that there is a saving of RM745.00 (RM920.00 – RM175.00) per hectare per season using the proposed system.

Methodology

The total size of rice fields in Malaysia at 689,730 hectares (Ricepedia, 2015) is too voluminous for the purpose of this study. Instead, a parcel of 240 hectares, which normally is about the size controlled by a Persatuan Peladang Kawasan (PPK) will suffice and if successful can be replicated throughout Malaysia.

As this study is more inclined towards entrepreneurship the SWOT Analysis as developed by Albert Humphrey in the early nineties shall be used as an instrumentation to resolve this problem.

Data Analysis

Primary data are collected from field surveys and open-ended interview questions with local farmers, officers of government paddy agencies and migrant workers at survey sites, while secondary data are gathered from reliable sources such as statistical report and manufacturer's specifications of both UAVs and fertilizers. Both primary and secondary data are analysed using content analysis and further analysed using the strategic management tool - SWOT methodology.

SWOT Analysis

Table 2: SWOT

Strength	**Weaknesses**
* The support from the Ministry of Agriculture and Agro-based Industries and supporting agencies can be counted upon if this project can bring in a higher yield and at a lower production cost. * If this project requires some changes in land use and financial policies, the Government can be counted to give full support. * The country has a vast pool of young technocrats who are able to operate new machines such as the UAVs. * Dependency on migrant workers shall be minimised. * If the project can benefit farmers financially and socially it will be easily accepted. * Any business projects that can achieve the same or better benefits at a lower production cost compared to an existing system, will ultimately earn a fatter margin and be readily accepted by its clients. * This is a business opportunity that has never been offered seriously to the customers and with government support will be a sure success. *Products of farming using organic fertilizers will have a higher demand in the world	* Mind sets of older farmers need to be changed and this will not be easy. It may take time but will not be of much problems if they can see with their own eyes that the new technologies give them better yield and better money and with lighter workload. * There is going to be a reverse migration of the younger generation from the urban areas back to their villages. There is bound to be minor cultural problems but not difficult to deal with. * These younger generations migrating back to the villages will have higher level of education in engineering, chemistry and administration. The local population may take time to readjust their way of living. * Initially the district middle level workers in the agriculture industries may not cooperate with the new technocrats, but time will change. * If fertilizers subsidies are replaced by the fertilizer service providers, some farmers may not be too happy with the change as there is empirical knowledge on pilferages with fertilizers.

market even though priced slightly higher	
Opportunities * Any change for the better and at the same time save government money giving huge subsidies will be grabbed	Threat * It is empirical knowledge that a business organization in the northern state of Malaysia is aggressively
by the newly installed government. * It will open up blue-collar job opportunities to thousands of young local technocrats. * Opportunities will be available to young entrepreneurs to conduct businesses as service providers and other downstream businesses. * With a higher yield at lower production cost, a self-sufficiency level in excess of 100 % is achievable.	pursuing a similar service. The essence of time in launching this business is important. * If this project is initiated and controlled by the government, the likelihood is that, no threat would exist.

Findings

This study finds that by using UAVs instead of the present manual migrant labour, there is a lot of savings in times and costs. The cost for the dispensation of fertilizers, pesticides, and fungicides is cheaper and more efficient than the current dispensation by migrant workers. Hence, the use of UAVs in the paddy growing industry is both sellable and will be very well received by the farmers.

Not only that, we can do away with migrant workers and instead use locals for blue collar jobs. This study established the viability and feasibility of businesses opportunities for our budding entrepreneurs.

To support the statements in the two above paragraphs, let us assume an area of 240 hectares would require fertilizers, pesticides, and fungicides application.

Case One (Old Method)

Twenty men equipped with the present method of dispensing (mechanical blowers), fertilizers, pesticides, and fungicides given as government subsidy. The time required for 20 men to complete the job in an area of 240 hectares shall be 20 days.

Case Two (The Proposed Method)

Table 3: Case One (Old Method)

No.	Items	Cost (RM)
1.	Fertilizers (12 bags per application)	600.00
2.	Pesticides	160.00
3.	Fungicides	160.00

4.	Labour for applying fertilizers	144.00
5.	Labour for applying pesticides and fungicides	150.00
Total		1214.00

Four men with 2 UAVs, using drone friendly fertilizers, pesticides and fungicides which can be applied in one operation, the time required to complete the job shall be 10 days.

Cost

The next consideration is cost. For the purpose of comparison, the same area size of 240 hectares shall be used.

Notes: The number of fertilizers, pesticides, fungicides and their costs for 1 hectare for 1 season

Table 4: Case Two (New Method)

No.	Items	Cost (RM)
1.	Drone services	220.00
2.	Fertilizers	175.00
Total		395.00

In summary, with the present system, it takes 20 days with 20 men working to apply fertilizers, pesticides, and fungicides, while with using UAVs it takes 10 days with 4 men with 2 drones to apply same. Worthwhile noting that the cycle for the application of fertilizers, pesticides, and fungicides is 15 days, except between day 30 to day 50 which is 20 days. This being the case one would definitely need more than 20 workers to work in an area of 240 hectares. On the other hand, by using 2 drones with 4 men, the time taken is only 10 days. From the study, we find that there is a saving of labour and costs for paddy production. These savings gives the opportunity to the farmers to practise good agricultural practices resulting in higher yield. Higher yield and lower production cost translate into more income for the farmers. Without a doubt, the objectives of this research are achieved and research questions answered

From the entrepreneur perspective, a paid-up capital of RM300,000.00 is sufficient to start a business with 2 drones, employing about 7 technical and 3 admin staff. Summary of financial figures derived from detail forecasted profit and loss over a period of 2 years by month are as shown in Table 5.

Table 5: Summary of Start-up Cost, Forecast of Profit and Loss for Each Year

No.	Items	Price (RM)
1.	Suggested paid-up capital	300,000.00
2.	Expected sales per month	69,800.00
3.	Monthly expenditure	28,500.00
4.	Gross profit per month	41,300.00
5.	PBT at end of year 1	194,400.00
6.	PBT at end of year 2 onwards	547,900.00

Details of forecasted profit and loss in spreadsheet are available but intentionally omitted here because of its business confidentiality.

Findings

It is recommended that the government, takes a serious view on this study to overcome the problems of shortage of labour, high production cost which resulted in lower yield thus directly will influence the rice self-sustainable level of the nation. The government is encouraged to start a pilot project and when successful replicate to other rice fields in the country. The older rice farmers must open up to new technologies instead of depending on decade-old practices. The younger generation must erase the perception that paddy farming is a low-class job which will now be reclassified as blue collar jobs. The government must be daring enough to invest a small sum of RM 300,000 to start this pilot project. For this amount, the return on investment on 240 hectares is RM353,500.00 a year. The total size of paddy land in Malaysia is 689,730 hectares. Simple arithmetic can generate the total income if implemented nationwide. Furthermore, thousands of young Malaysians will be blessed with blue collar jobs. By the grace of Allah: Who Dares Wins.

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