The Development of Agro-based SMEs through Technology Transfer from Government Research Institution

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INTRODUCTION

Small and medium enterprises (SMEs) play significant contribution to the economic development of Malaysia. They represent 97.3% of the total 645,136 business entities in Malaysia, provide 65% of job opportunities for the people, contribute around 19% of the total export value and 35.9% of the GDP in 2014. The development of SMEs in Malaysia is driven by higher demand for consumer products, especially foods by local consumers; and electronic and manufacturing products by international consumers. In spite of its higher development growth, SMEs in Malaysia are still facing many issues and challenges. The key challenges faced by the Malaysian SMEs are access to financing, legal and regulatory environment, human capital development, market access, infrastructure and the development of new products through innovation and technology. This paper focuses on how innovation and technology are developed by government research institutions and transferred to agro-based SMEs in Malaysia.

SMES IN MALAYSIA

Small and medium enterprises (SMEs) are important for economic development in Malaysia. The SMEs create jobs and employment for the people, manufactured goods and products for local consumption and generate income from international trade activities. The contribution of the SME sector to the national economy has led the government to make SME development as a key national agenda. SMEs are the key players for economic development towards a high-income nation by 2020.

The Malaysian Economic Census 2011 indicates that there are 645,136 SMEs operating in Malaysia, (Department of Statistics, 2011). The service sector is dominating SMEs in Malaysia with 580,985 establishments (90%) in 2014. Meanwhile, 6% of the total SMEs (37,861 establishments) were in the manufacturing sector, followed by 3% in the construction sector (19,283 establishments). The remaining 1% (6,708 establishment) operates in the agriculture sector, while 0.1% in the mining and quarrying sector. The major change was seen in the share of SMEs in the agriculture sector which had decreased significantly from 6.2% in 2005 to 1% in 2010, mostly due to the exclusion of farmers and small holders who represent a big community in the agriculture sector. In other words, agricultural activities that are not registered under the company act are not included in the definition of SMEs in Malaysia.

In Malaysia, the introduction of the Malaysia New Economic Policy (NEP) in 1970 emphasised on equal opportunities in the creation of businesses and enterprise communities. This policy was further strengthened and improved in every five-year Malaysia plan. Currently, in transforming Malaysia into high-income country and as an entrepreneurial nation, the Malaysian government has continuously encouraged the involvement of people, especially women and youths to engage in entrepreneurship. Malaysia's future progress depends on the development of SMEs and towards achieving its Vision 2020, to become an industrialized nation by 2020 (Khan and Khalique, 2014).

Definitions of SMEs

In the Malaysian context, SMEs are defined as business entity incorporated under Companies Act 1965; or registered under ROBA (1956) or LLP Act 2012; or registered under respective authorities in Sabah and Sarawak; or registered under respective statutory bodies for professional services provided. In general, SMEs are defined according to its size, turnover and activities, which comprise of two broad categories as follows:

- Manufacturing sector which has the sales turnover not exceeding RM50 million (US$12 million) or full-time employees not exceeding 200 workers.
- Services and other sectors which have the sales turnover not exceeding RM20 million (US$4.8 million) or full-time employees not exceeding 75 workers.

This enterprise can be broken down into three types of enterprises such as micro, small and medium enterprises (MSME). The details are shown in Table 1.

Table 1. Definition of MSMEs by size of operation in Malaysia

Category	Micro	Small	Medium
Manufacturing **Services & Other Sectors**	Sales turnover must be less than RM300,000 (US$71,500) or employs less than five full-time employees	Sales turnover from RM300,000 (US$71,500) to less than RM15 million (US$3.6 million) or employs between five and 75 full-time employees Sales turnover from RM300,000 (US$71,500) to less than RM3 million or employs between five and 30 full-time employees	Sales turnover from RM15 million (US43.6 million) to not exceeding RM50 million (US$ 12 million or employs full-time from 75 to not exceeding 200 Sales turnover from RM3 million (US$714,300) to not exceeding RM20 million (US$4.76 million) or employs between 30 and 75 full-time employees

Source: SME Corp (2015)

SMEs in the agriculture sector

Agricultural entrepreneurship is seen as a job that can generate people's incomes, especially the youth and women. It is also perceived as a dimension which offers agricultural sustainability. The involvement in entrepreneurial activities in agriculture can reduce unemployment, improve national food supply and overcome the poverty incident. Indirectly, it can reduce the country's reliance on food imports and ensure food security. Small and medium enterprises in the Malaysian agriculture sector refer to the business activities involving crop production, animal production, hunting and other related service activities, fishing and logging and aquaculture.

According to the Promotion of Investments Act 1986, the term ‘company’ or enterprise in relation to agriculture include agro-based cooperative societies and associations, and sole proprietorships and partnerships engaged in agriculture. In the agriculture sector, the growth of the value-added sub-sector (processed products) was at a higher rate of 17.2% compared to the overall growth in the agriculture sector of 2.1% (SMECorp, 2015). This is caused by the better performance of agricultural crops, such as vegetables, fruits, paddy and livestock, which are mainly cultivated by SMEs as well as better SME performance from the fishing, and forestry and logging sub-sectors.

SMEs in the agricultural sector recorded 2933 establishments in 2011 (Table 2). Most of these SMEs were in the crops sub-sector with 2,047 establishments (69.8%), followed by fisheries, with 329 establishments (11.2%), Livestock with 287 companies (9.8%) and forestry and logging with 270 establishments.

Table 2. Number of agriculture SME establishments by sub-sector and size, 2011

Sub-sectors	Small	Medium	Total SMEs	Percentage
Crop	1,413	634	2047	69.8
Livestock	179	108	287	9.8
Fisheries	261	68	329	11.2
Forestry and logging	88	182	270	9.2
Total	1,941	992	2933	100

Issues and Challenges

SMEs in Malaysia are facing many challenges in achieving economies of scale and to sustain their competitiveness in local and global markets. The most critical issue that hinders the SMEs from Malaysia to compete in the international markets is their dependent on input (input-driven) instead of being knowledge-driven (Muhammad Khalique *et al*. 2011). On the other hand, among the challenges faced by the SMEs are the low level of technological capabilities, lack of skilled human capital, and low level of research and development (R&D) (Masri, 2013). Moreover, Gunto and Alias (2014) also stated that management ability and skilled work force; access to finance and markets; inability to exploit economies of scale and lack of bargaining power; low level of technology and limited access to international markets are the key constraints faced by SME practitioners. Their market orientations are centred only towards the domestic market and thus, making them at a disadvantage to compete in the international level. This indicates that government programs and incentives still have room for improvement, and its ability to deliver and its effectiveness should be enhanced to address these issues.

Another constraint is the use of machines and equipment by the SMEs which are not inclusive in their overall business operations (Masri, 2013). This results in a relatively low production capacity. If SMEs use machines and technology in their production operation, it could improve product quality. As a result, these SMEs will be able to compete with manufacturers of similar products in the market.

Technology is needed not only to upgrade the product quality and durability, but also in the areas of packaging, labelling, storage, transportation and certification. The production premises also need to be upgraded, and practices must conform to meet international standards such as Good Hygiene Practice (GHP), Good Manufacturing Practice (GMP) and Hazard Analysis Critical Control Point (HACCP).

The development of agro-based SME through technology transfer

In the current business environment, technology is undeniably important to improve the competitiveness and performance of SMEs. Therefore, it is crucial for SMEs to take relevant steps to modernize and improve their operations in order to improve efficiency and productivity.

Technology is the basis for SMEs to face competition in the globalization era as it is an important factor in differentiating the product and determining product quality. By inculcating the use of technology, SMEs will be able to bring their products and businesses to the international market. The Information Technology and Innovation Organization of Malaysia reported that technology could increase productivity by 38%, as well as 20%

increase of the GDP (Low, 2007). SMEs should focus on innovation and technology development. This is in line with global direction, where growth among SMEs must be driven by technology and innovation. The emergence of new technologies and products has affected the way business is conducted. However, the Central Bank reported that the level of investments in R&D is very low among business entities in Malaysia. For example, only 0.5% of business organizations invested in R&D in 2013. The low levels of investments in R&D and productivity among SMEs need to be addressed by the government. If this is left unchecked, it will result in negative impact on the development of the SMEs itself. Hafsah (2015) stated that the low level of technology usage is the main constraint faced by entrepreneurs, especially SMEs to move forward.

The government recognized the inability of SMEs to carry out R&D or to innovate due to lack of financial capability. Thus, government research institutions such as MARDI have been given the mandate to generate and transfer new technologies that can enhance the capability of SMEs in Malaysia. It is the responsibility of the government research institutions to provide appropriate technology to SMEs to enable them to compete in the domestic and international markets.

Technology transfer from government research institutions to private firms

Recognizing the importance of SMEs in economic development, the Malaysian government introduced many initiatives and formulated many policies that can enhance the competitiveness of the SMEs. The government also established the SMEs Master plan in 2012 to align SME development to a broader national aspirations of achieving a high-income economy by 2020 via innovation-led and productivity-driven growth. The Master plan aims to create a globally competitive SMEs across all sectors that enhance wealth creation and contribution to the social well-being of the nation. In line with the Master plan, MARDI developed appropriate technologies that can enhance the efficiency of business operations, productivity of labor and quality of SME products. These technologies are commercialized exclusively to SMEs. The technologies created new competitive position of the small and medium enterprises and enabled them to compete in the international markets. The adoption of technologies has transformed the small and medium enterprises in Malaysia toward a more competitive business in domestic markets and created wealth for the entrepreneurs. Innovation and technology are the key success factor for the SMEs. They are the most important and critical resources for the SMEs to thrive in a competitive environment.

Technology transfer means bringing the technology from laboratory to the market. Technology transfer is a process whereby a technology is developed by research organization such as government research institutions and adopted by other organizations such as SMEs to gain profit. It is a commercial attempt to gain profits from the technological innovation by packaging it into suitable products, processes and services and selling these in the marketplace. Technology transfer is a 'man-to-man' activity. It uses more resources and demands full commitment from technology generator and entrepreneur. This is the most expensive and critical stage as it involves two different organizations that practice different work cultures, procedures and systems. The government research institutions are often linked to the bureaucratic system, while the private firms aim for business profitability. This is especially true for SMEs because they lack resources and capital. The faster they get the profit, the better.

A successful technology transfer depends on creating a team of people that combines research with good business acumen. The process of technology transfer links the technology and knowledge of the researcher to entrepreneurs. It begins with a feasible technology, followed by marketing conditions that focus on marketing strategies and financing. The combination of these elements will determine the success of technology transfer. In transferring technology from a government research institution to the private firm, trust between the technology generator and the recipient is a pre-requisite for sharing knowledge

that will likely lead to the success of technology transfer. The ability to create trust between them breaks the communication and it is because of this that the knowledge cannot be fully shared.

Technology transfer: MARDI's experiences

The Malaysian Agricultural Research and Development Institute (MARDI) is a statutory body under the Ministry of Agriculture and Agro-based Industry. It was established in 1969 and has been mandated to conduct research and development (R&D) in all crops except industrial crops (rubber, cocoa and oil palm) and livestock. The overall objective of the establishment of MARDI is to develop and transfer new and improved agricultural technologies in the field of agriculture, food processing and agro-based industry for the transformation of the agricultural sector in Malaysia. The MARDI adopts a total and integrated research approach focusing on selected strategic and important commodities, such as rice, fruits, vegetables, floriculture, and livestock, to develop appropriate and complete technology packages for the agricultural industry. At the same time, MARDI also developed biotechnology and processed food technology for the development of entrepreneurs in Malaysia.

Technology transfer is MARDI's second core function. All technologies developed by MARDI must be transferred to benefit farmers, SMEs and society in the country. The technology is useless until it benefits the users. MARDI defines a technology transfer as a process to facilitate and expedite the creation and dissemination of technology for adoption by users. Technology transfer system in MARDI has evolved from a simple dissemination of technology through technical papers to a combination of hands-on training, consultancy and a complete package of technology transfer that includes the physical technology such as machines, new variety of crops, and new agricultural or processed products. The other one is intangible technology such as new knowledge and skills and monitoring system. Most of the technologies were developed mainly in the laboratory or research stations. After the technologies were fully recognized and certified by the Technical Committee, they are ready to be transferred to target groups that include farmers and entrepreneurs. The model of technology transfer by MARDI is presented in Fig. 1.

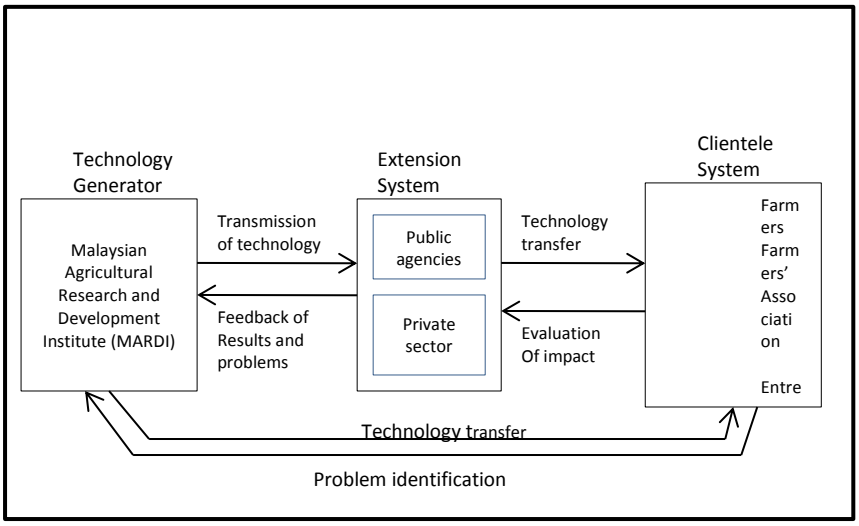

Fig.1. Model of Technology transfer from MARDI to its clients

Generally, R&D outcomes are not directly transferred from MARDI to its stakeholders. The first stage is the transfer to extension agencies such as the Department of Agriculture (DOA), Farmers' Organisation Authority (FOA) and private firms. It is only after this stage that the technology is transferred to stakeholders or users such as farmers, farmers' associations, entrepreneurs and public agencies. In other words, technology is transferred from MARDI to

extension systems before it finally reaches the clientele system or technology users. However, in certain cases, especially in food-processing technology, it is transferred directly to the SMEs.

In MARDI, technology transfer is classified into two categories: first, is called commercialization of MARDI's intellectual property rights (IP), patent, trademarks and technology formulation or trade secret to private firms, and in return, they pay royalties to MARDI. MARDI provides a license to intellectual property and know-how associated with the transferred technology. The second category is called, transfers of public good technology freely to any SMEs, generally they are SMEs under MARDI's guidance. Both categories involved with the scaling-up of products from prototype to commercial production. The technology generator or research officers share all information on the technology developed. The difference is that the former requires the private firm to pay royalty and used the IP exclusively, while the latter is a free technology but any private firm can use the IP freely. The commercialization of technology usually is determined by the novelty of the technology, the commercial value and the potential markets. The technology transfer, on the other hand, is a common or simple technology that can benefit micro enterprises that lack financial capital.

Between 2010 and 2014, MARDI has successfully commercialized more than 50 technologies by licensing its IP. These technologies are commercialized to medium enterprises that have capitals to start the business venture. At the same time, MARDI transferred it technology effectively to 177 micro and small enterprises, which have received technical guidance from MARDI. 125 companies were categorized under the Entrepreneurship Guidance Scheme, while 52 under the Entrepreneurship Adoption Scheme. One of the companies has recorded sales between RM250,000 to RM1.0 million (USD59,520 to USD238,100), while 28 companies achieved total turnover ranging from RM100,000 to RM250,000 (USD23,810 to USD59,520) per annum. Meanwhile, 48 companies using technology generated by MARDI have entered the export market. In the context of technology transfer to Micro and Small enterprises (free technology), MARDI used four criteria of appropriate technologies for these target groups:

- Inexpensive - affordable for small enterprises
- Compatible with entrepreneurs need- the technology must be simple and adaptable to most environments.
- Relatively easy to learn and less complicated
- Easy to operate, less maintenance and low in maintenance cost.

The development of agro-based micro enterprises

MARDI has been mandated to develop agro-based SMEs through government initiatives called Agriculture venture. The objectives of the agriculture venture program is to increase the income of the poor and hard core poor family with economic projects in the field of food crops, fisheries, livestock, processing of agricultural products, agricultural products, agri-business and agriculture services. The participants of this project were selected from the government database involving the target group or the beneficiaries of households as follows:

- Hardcore and overall poor with income less than the RM800 (US$190) a month
- The head of household, single mother, housewife of the heads of household, children, disabled persons, indigenous persons and hardcore and farmers with low or poor productivity.
- The priority is given to the head of household, single mother, and children of hardcore and overall poor
- People who have already involved in the economic projects, either as an entrepreneur, worker or land owner.

During the period of 2010-2014 MARDI has transferred its technologies and developed more than 1880 new entrepreneurs in the agriculture sector. The participants are given the option to choose a project that suits their interest, capabilities, skills and suitability of the location. However, the project must be within the scope that was specified by MARDI. The participants must take part in the motivational and skilled training provided by MARDI before they can embark on the project. This is to ensure the participants are aware about the risks and benefits from the venture, the technology that they will use, the marketing aspects and personal motivation. The projects specifically selected for the agriculture venture are as in Table 3.

Table 3. Agriculture venture projects

Sector	Example of activity/project	Example of technology transferred (machinery and infrastructures)	The value of financial assistance
Crops	Cultivation and marketing of short term crops such as sweet corn, watermelon, chili and mushroom	Mushroom house, mushroom bag, fertigation system, fertilizers and seedling.	A maximum of RM10,000 (US$2380)
Fishery	Farming and marketing of catfish, ornamental fish and farming fish in net	Pond construction, net, canvas, boat and engine	A maximum of RM10,000 (US$2380)
Livestock	Farming of village chickens, broilers and duck for egg production	Eggs, construction of chicken house and animal feed	A maximum of RM10,000 (US$2381)
Processed food	Production of traditional cake, salted fish, chips from potato and banana, traditional snack, salty eggs and beverages	Oven, mixer, raw materials and machinery	A maximum of RM10,000 (US$2381)
Agribusiness	Venture in small-scale business such as selling of ready-to-drink soya, minimally processed fruits and traditional cake	Small stall for business venture, raw materials	A maximum of RM10,000 (US$2381)
Services	Bush cutting, plow paddy field	Bush cutter, small tractor	A maximum of RM10,000 (US$2381)

MARDI received about RM18.8 million (US$4.48 million) from the government, during the implementation of the agriculture venture projects from 2010-2015, of which about 90% were used for the construction of infrastructures and the operation cost of the projects. The balance of 10% of the budget was allocated for administrative cost that includes training and traveling expenses for technical officers. MARDI transfers appropriate technology for every project. A technical officer was appointed and responsible for monitoring and supervising a maximum of 30 projects. He or she monitors the progress of the project very closely for two years and becomes his or her KPI.

In general, the processing of agro-based products were the most popular projects selected by the agriculture venture participants, followed by agricultural services such as bush cutting, provide plough services to paddy farmers and agro-based business (Fig. 2). The demand for processed food, especially frozen food is increasing every year. The frozen food industry is projected to grow between 10-15% a year for the next five years. This is a great opportunity for the entrepreneurs to venture into this industry.

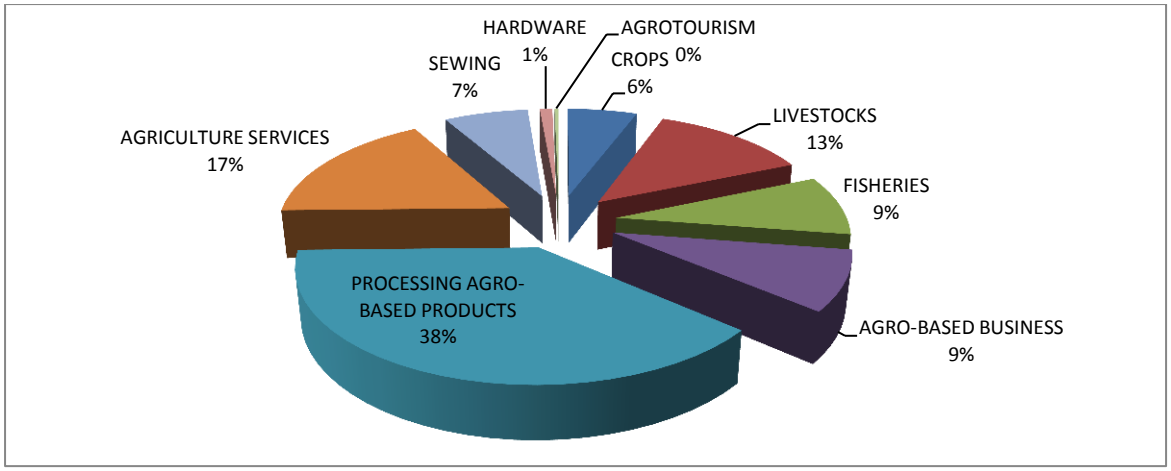

Fig. 2. Breakdown of the agriculture venture project managed by MARDI

The agriculture venture project has developed many new entrepreneurs in all sectors. For example, 20% of the participants have increased their income to more than RM2000 a month (US$476) from previously (below US$190/month). This program has successfully created more than 2000 women entrepreneurs in all business sectors, such as agriculture, processed food and services in 2014. These programs also alleviated the hardcore poor and reduce the number of poor households in Malaysia. A report by the Prime Minister Department revealed that Malaysia was now free from hardcore poverty, while the number of poverty (household with income below Poverty Income Level (PIL) has been reduced to only 0.6%, of which 0.3% are rural poverty and 1.6% urban poverty.

The agriculture venture was introduced to alleviate poverty and reduce the hardcore poverty level in Malaysia by providing employment and entrepreneurship skills to the hardcore and poor citizens. The agriculture venture program aims to increase income above the PIL which is RM830 (US$198) per month for the poor and below RM2,300 (US$548) a month for low-income earners. A report by the Ministry of Woman Development indicates that the program recorded a reduction of 55.3% of the national poverty rate. The national poverty rate, consequently, has dropped from 3.8% in 2009 to 1.7% in 2014.

In the context of agriculture venture project managed by MARDI, more than 54% of the participants had moved out from the poverty level, 35% are progressing very well and 8% moved slowly from hardcore poverty to overall poverty level (Fig. 3). Participants who are not progressing very well required more training and motivation to improve their capabilities.

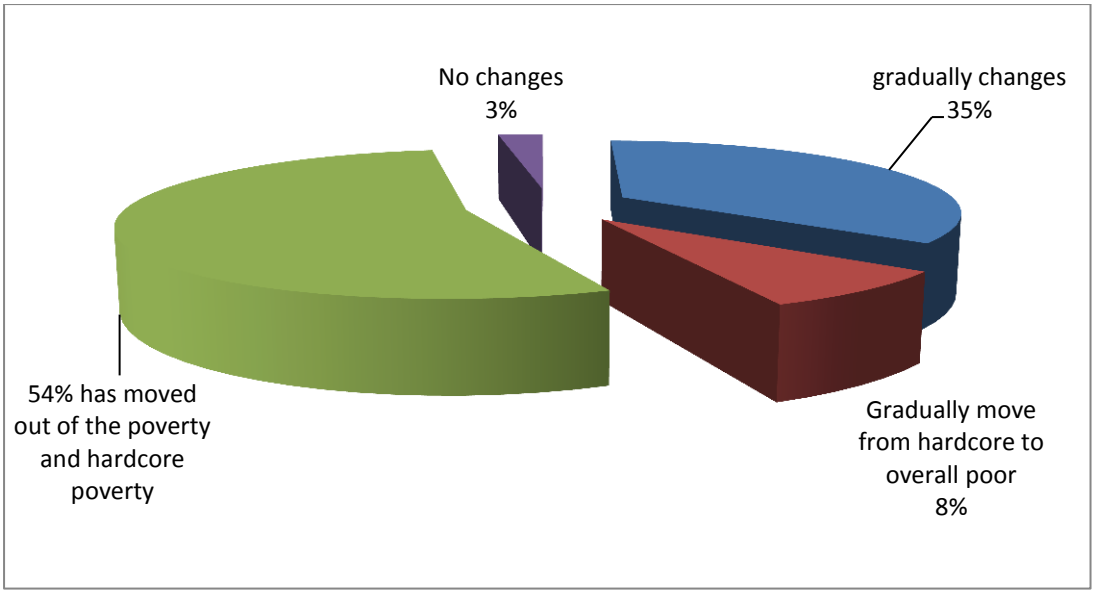

Fig. 3. The effectiveness of the agriculture venture project in the effects to reduce poverty and hardcore poverty

Generally, the socioeconomic traits of the participants started to change after six months after they were involved in the agriculture venture projects. Fig. 4 shows the changes of income after the participants get involved in the project. Majority of the participants earned additional income of between RM500 and RM1000 a month (US$120 and US$240. About 25% of the participant increased their income less then RM300 a month (US$71), while some of the participants have earned more than RM 5,000 per months (US$1190).

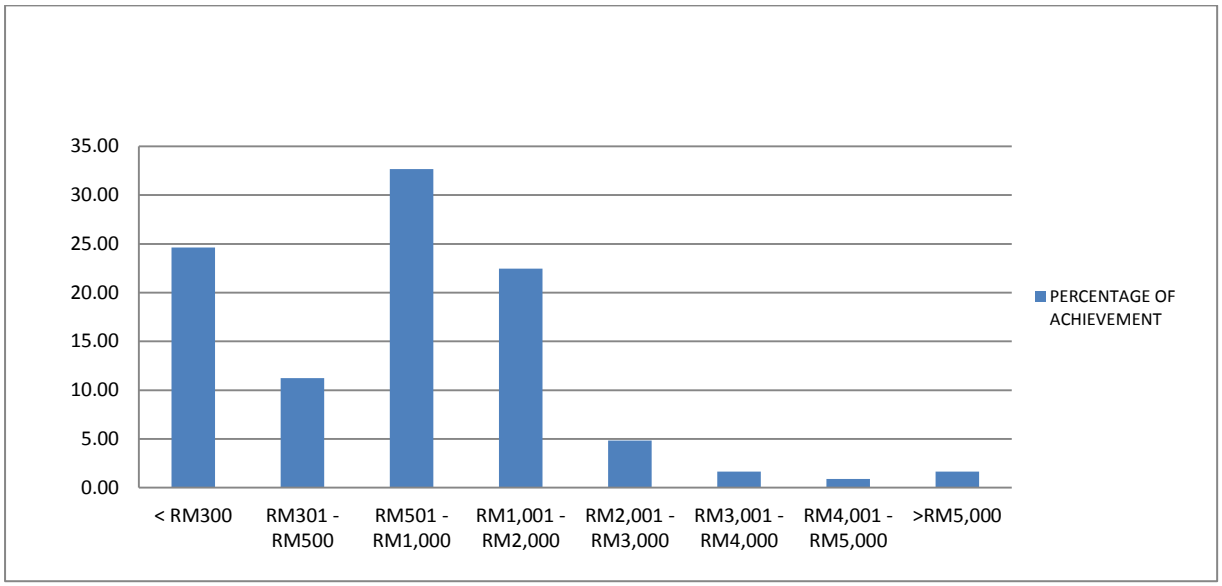

Fig. 4. The income of agriculture venture participants

CONCLUSION

SMEs are very important organizations and are considered the backbone of Malaysia's economy. The development of SMEs in Malaysia is driven by the opportunities created by higher demand for consumer products in the domestic and international markets. Moreover, the new international trade regulations such as the Asian Free Trade Agreement creates new avenues for the SMEs from Malaysia to expand their markets. However, SMEs in Malaysia are facing many challenges that hinder their advancement.

Innovation, technology and capacity development are among the most important factors for SMEs to be competitive in the domestic as well as global markets. New technologies and innovations improve the productivity, efficiency of business operations and enable the SME to offer new products to their consumers. Continuous development of new technology will enable the SMEs to compete with their competitors, especially from the developed nations that have strong financial capability and source of innovation.

In an environment of increased global competition and economic uncertainty, SMEs must have endurance, perseverance and persistence to be successful. SMEs can become a major catalyst for the country's economic development to achieve the aspirations of Malaysia's Vision 2020 to become a high-income nation.

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Date submitted: June 8, 2016

Reviewed, edited and uploaded: June 8, 2016