Land Use Policy 79 (2018) 575–584

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

A solution for the sunset industry: Adoption of Green Fertiliser Technology amongst Malaysian paddy farmers

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ARTICLE INFO

Keywords:
TPB
Farmers' perceptions
GFT
Agricultural innovation
Malaysian paddy farmers

ABSTRACT

Modernising agricultural activity is a key to boost the production level at high efficiency. The paddy industry in Malaysia has been blighted with underproduced yield, which can be intervened with the adoption of Green Fertiliser Technology (GFT) amongst farmers. In this paper, the researchers have measured the intention level of farmers to adopt GFT based on the psychological aspects based on the Theory of Planned Behaviour(TPB). This study is a continuation of the previous studies by observing the direct and, more importantly, the indirect effects of the psychological aspects. Surveys were conducted in the main rice granary areas in Malaysia, such as Integrated Agricultural Development Authorities (IADA), Kemubu Agricultural Development Authorities (KADA), and muda Agricultural Development Authorities (MADA). To check the effects of the psychological factors, the partial least squares – structural equations modeling (PLS-SEM) approach was used to check the significance of those factors towards the intention to adopt GFT amongst those farmers. The results have shown that direct and indirect attitude and indirect subjective norm, as well as direct-indirect perceived behavioural control, have a positive and significant influence on the intention of adopting. More importantly, the results have established behavioural beliefs, normative beliefs, and control beliefs to correspondingly affect attitude, subjective norm, and perceived behavioural control. Overall, the study represents a guidance for key stakeholders to promote sustainable agriculture methods and innovations. These results advance theoretical understanding of GFT and potentially contribute to predicting Malaysian paddy farmers behaviour.

1. Malaysian agriculture: an introduction

Agriculture in Malaysia involves fishery, livestock rearing, and crops planting. The process also encompasses other stages of production, including processing and waste management. Agriculture remains an integral part of the society because of its role of supplying food to the population as well as being an effective tool in overcoming poverty (Shaffril et al., 2010). Agriculture, thus, is an evergreen sector for those roles above. The 2007 global economic meltdown has triggered many Asian countries, Malaysia has no exception, to focus on developing agriculture as a major component of income contributor. It is seen in the government's relentless efforts to assist the agricultural sector, as mentioned in every Malaysian Plan by allocating a large sum of the budget for the sector. For instance, in the Ninth Malaysia Plan (RMK-9), the government has stepped up the efforts to boost activity in the agricultural sector, by establishing state-of-the-art projects, including TKPM (Permanent Food Production Parks), HIP-ZIA (High Impact Project-Aquaculture Industrial Zone), Agropolitan, and other contract farming projects. The government is very much aware of the sector's potential, especially in improving the rural community, particularly the socio-economic development of the community. Hence, finding a solution to constant challenges concerning production innovation must be the key priority of the government.

1.1. Reaping the benefits of innovation: Farmer's perspective

Equipping farmers with information and communications technology (ICT) skills and knowledge has a great potential for solving

Abbreviations: GFT, Green Fertiliser Technology; TRA, Theory of Reasoned Action; TPB, Theory of Planned Behavior; FBI, Farmers Behavioral Intention; FAO, Food and Agriculture Organization; ATT, attitude; SN, Subjective Norm; PBC, Perceived Behavioral Control; SAP, sustainable agricultural practices; IADA, integrated agriculture development area; KADA, Kemubu Agricultural Development Authority (Kelantan); MADA, Muda Agricultural Development Authority; MARDI, Malaysian Agricultural Research and Development Institute; AVE, average variance extracted; HTMT, Heterotrait-Monotrait; PLS-SEM, partial least square-equation modeling

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https://doi.org/10.1016/j.landusepol.2018.08.033
Received 16 July 2018; Received in revised form 20 August 2018; Accepted 20 August 2018

many of the challenges they are facing in their agricultural tasks. Numerous efforts have been made to encourage the use of technology amongst farmers, from as simple as utilising the agro-based website for quick assistance and knowledge addition. Agro-based websites are purposely designed to be user-friendly and informative. The Ministry of Agriculture and Agro-Based Industry, for example, propagate information on their websites that can be used by the farmers. The study of (Gakuru et al., 2009) pointed out that ICT resources are very helpful to the farmers. The farming community has access to relevant information, products, and services by surfing the websites above. Koirala et al. (2016) mentioned the importance of promotion to use ICT resources, which remains very much needed since the agriculture community largely depends on mouth-to-mouth information from people within their immediate surroundings to obtain information (Hassan et al., 2009a). According to Adnan et al. (2017c), ICT resources provide a simple solution of communication and collaboration amongst farmers, extension officers, and agricultural agencies beyond the distance barrier (Adnan et al., 2017a,d). Additionally, ICT resources are very cost effective, even cheaper than telephone usage. Farmers can use ICT resources with flexibility in terms of time and choosing materials, further allowing them to establish networks with related personnel, be it development agencies or other farmers (Obiechina, 2004). Adnan et al. (2017b) in the meantime, argued that ICT lays out the chances for farmers to explore new markets and reach new customers using the Internet. A successful example of the use of ICT in agriculture is “mobile telephony,” which provides the farmers with relevant news, such as the market trend for commodities and weather forecasts (Baumüller, 2012). These kinds of innovations prove to be advantageous to farmers. Consequently, these contribute indirectly to them by offering the opportunities to improve their standard of living. The national policy, in general, focuses on reducing the reliance on unskilled foreign workers by encouraging the agriculture industry players to infuse capital-intensive agricultural mechanisation technology. A study carried out by Truong (Chi, 2008), focusing on the innovation adoption in the Mekong Delta was selected for reference. The Mekong Delta region is widely-known for its huge and productive plantation region for paddy in the ASEAN region. Some technologies developed, for example, Integrated Pest Management (IPM), “three reductions-three gains”, and row seeding, have been popularly known to increase production yield. For instance, row seeding technology reduces the number of seeds used, and also simplifies the handling process for the plantation of paddy, and higher pest resistance. Another method developed is the System of Rice Intensification (SRI) which has been proven to produce high rice yield by improving transplanting practices, sunlight and nutrient absorption, and a more effective root system (Shamshiri et al., 2018). Lastly, a rice dryer has been developed which is intended to reduce the amount of hired labour required post-harvest as well as the loss of grain as a result of sun drying.

1.2. Current challenges to the industry

The pressing issues are demographical challenges faced by the agricultural industry in Malaysia, especially the aging trend amongst farmers. Furthermore, few authors such as (Adnan et al., 2017a,b,c,d,e,f,g; Samah et al., 2009) stated in their studies, have found that the farmers are on average around 46years old. The trend has contributed to the industrialisation effort in the country which attracts youth to migrate to urban areas and to abandon the rural areas where the agricultural activity is active. As a result of the youth migration, a severe shortage of young agricultural workers has been a common thing. The quick solution is to fill the gap by importing foreign workers (Adnan et al., 2017e,f,g). Meanwhile, another long-term solution is promoting the implementation of state-of-the-art technology. It necessarily requires higher basic knowledge and the willingness to adapt to innovation, which is more familiar within the younger generation. Therefore, the farmers, in general, have been found not to overlook the use of technology in their agricultural activities, especially ICT. Mishra and Williams (2006), pointed out that the propensity to use technology is strongly related to the regional location of the farm, the educational level of the operator, the presence of a spouse, and having off-farm business income (Burke and Sewake, 2008) supported the findings. According to the past research,(Fahmi et al., 2013; Mills et al., 2017) the higher education levels mean that the farmer gets more chance of surfing educational websites for their agro-business. The benefit of the integration of innovation into the paddy initiative is the increase in the level of production whilst keeping the whole process as efficient as possible. For instance, the application of controlled-release fertiliser as an improvement to the conventional chemical fertiliser has been introduced to the farmers. The fertiliser is expected to increase the production of paddy due to higher efficiency whilst reducing the amount of fertiliser lost due to leaching and volatilisation (Burke and Sewake, 2008; Fahmi et al., 2013). The challenge that arises is to convince the farmers to adopt a better alternative (controlled-release), even though the outcome can be a long wait, which involves risk from the farmers' points-of-view.

To increase the paddy production through sustainable agricultural development is the foremost drive of the government policy, which can be helped with the adoption of GFT. The purpose of this current research is to understand Malaysia's paddy fertiliser sector. The paddy fertiliser sector in the country is regarded as unique in several aspects. The Malaysian government has put a huge emphasis on paddy farming. Indeed, the food crop has strategic value, and paddy rice is cultivated in Peninsular and East Malaysia (Haris et al., 2013). Paddy cultivation activity in Malaysia uses about 300,500 ha of land in Peninsular Malaysia and another 190,000 ha in East Malaysia especially designated for rice production (Ahmad and Tahar, 2014). Estimates suggest that paddy cultivation activity in Malaysia employs around 300,000 farmers (Adam and El Pebrian, 2017). There are eight major cultivation sites; those are Mada muda Agricultural Development Authorities (MADA), Kemubu Agricultural Development Authority (Kelantan) (KADA), Kedah, Kelantan, and Northwest Selangor project, Seberang Perai IADA, Penang, Perak, and Katara. IADA is the main paddy producing area, which meets around 72% of the total demand for rice in Malaysia, as cited from the Ministry of Agriculture and Agro-based Industry, (MARDI, 2010). It's an enormous challenge for Malaysian government to implement GFT practices in the paddy farming. Therefore it is important to conduct research on strategies to increase GFT adoption.

1.3. Farmers' adoption of innovation

Whilst improvements regarding technology have been made, the key issue is ensuring the innovation adoption of the farmers is up to the pace of the innovation development itself. In the end, farmers are the end-consumers of the innovations. Hence, their acceptance to adopt innovations is crucial. The current GFT adoption research in Malaysia is restricted to only discuss the intention of paddy farmers towards the adoption decision (Othman and Muhammad, 2011). Besides, it has been established from previous studies that most of the farmers are unable to comprehend the “green” terminology in the context of Malaysia as well as its significance (Shamsudin, 2014). Numerous studies attempt to investigate and understand the adoption behaviours of farmers, especially when they are faced with the introduction of an innovation. With the proper hindsight of the behaviour pattern, researchers and authorities ought to make a better decision on the correct approach to introducing innovations to farmers. In this paper, the researcher will be looking at the adoption behaviours of the farmers from the perspective of the Theory of Planned Behaviour (TPB) as introduced by Ajzen and Fishbein (2005). The TPB mainly approaches the understanding of behaviour from the socio-psychological perspective. The TPB has been used as a framework for this particular paper in exploring the elements which influence paddy farmers' intentions to adopt innovations in Malaysia. According to the theory, an individual's or a group's