

THE INTENTION TO ADOPT GREEN PESTICIDE AMONG OIL PALM PLANTERS: REVIEW OF THE EXTANT LITERATURE

MOHAMMED NIZAR KHIR AZMAN^{1*} and BAMINI KPD BALAKRISHNAN^{1*}

ABSTRACT

Pests and diseases can cause costly and irreparable harm to crops, especially oil palm. There are many methods that planters can adopt to manage them, and green pesticides can serve as an alternative solution. Preliminary research is carried out by adopting the theory of planned behaviour or TPB [attitude, subjective norms and perceived behavioural control (PBC)] for a sound conceptual framework. This paper, therefore, investigates the determinant factors affecting Malaysian oil palm planters to adopt green pesticides. A comprehensive literature review was used as the methodology. The Malaysian Sustainable Palm Oil (MSPO) was proposed as a moderator to optimise the planters' intention. Overall, 12 research propositions, recategorized in TPB, were discussed in this paper and identified as the factors affecting the oil palm planters' intention to adopt green pesticides. The proposition will lead to future empirical findings which are anticipated to facilitate the industrial transition toward utilizing environmentally-friendly pesticides.

Keywords: green pesticide, MSPO, oil palm planter, sustainability, TPB.

Received: 7 July 2022; **Accepted:** 3 March 2023; **Published online:** 20 March 2023.

INTRODUCTION

The Food and Agriculture Organization (FAO) of the United Nations (UN), has launched several guidelines for the 2030 Agenda for Sustainable Development including nurturing healthy ecosystems and supporting the sustainable management of land, water and natural resources while ensuring world food security (Food and Agriculture Organization, 2022). According to Malaysia's 12th National Plan, the country's ecosystems are continuing to deteriorate because of insufficient conservation efforts and a lack of appreciation for natural resources. The presence of several agencies enforcing diverse rules provides considerable challenges to natural resource management and the environment. Furthermore, governance challenges including limited enforcement capabilities, insufficient reporting and monitoring and R&D weaknesses.

In response to these efforts, the Malaysia's 12th National Plan produced a 2021-2025 strategic direction that includes new rules to be enacted, as well as amendments to relevant legislation such as Act 127, the Occupational Safety and Health Act of 1994, and the Poisons Act of 1952. The new laws require notification and reporting on the manufacturing, import, export, use and management of hazardous chemicals and substances.

As the biggest part of the agriculture sector in Malaysia, oil palm has become the major contributor to pesticide consumption. Oil palm estates are often encouraged to practice Integrated Pest Management (IPM) and Good Agricultural Practices (GAP). Regardless, no comprehensive IPM model was available within the field (Dara, 2019). As people create, promote, or employ IPM methods with various connotations, the definition is constantly modified and altered based on an individual's pest management goals and methods, and generalised across appropriate circumstances. GAP, on the other hand, encourages the employment of biological, cultural and mechanical approaches, but in emergency cases, pesticide application must be done less detrimentally to the environment (Bailey, 2014; Turan and Karaosmanoğlu, 2019).

¹ Faculty of Business, Economics and Accountancy, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia.

* Corresponding author e-mail: tatakhirazman@gmail.com and bamini@ums.edu.my

The UN FAO's annual report on import statistics of pesticide compounds demonstrates that these two essential agricultural practices have not yet succeeded significantly in reducing the use of synthetic pesticides. FOA UN recorded 4.2 million tonnes of pesticide use worldwide in 2019, as depicted in *Table 1* ("World Food and Agriculture – Statistical Yearbook 2021"), whereas Malaysia consumed about 47 805 tonnes as mentioned in *Table 2* (FAOSTAT, 2022).

Green pesticides remain a novel phenomenon among local commodity planters due to the heavy reliance on chemical pesticides as an affordable and effective pest eradication method (Dilipkumar *et al.*, 2020; Schreinemachers *et al.*, 2017; Terano *et al.*, 2015). As it turns out, green pesticide acceptance on a global scale pesticide is only 1% compared to its counterparts (Nnamonu and Onekutu, 2015; Walia *et al.*, 2017), and despite growing worldwide interest, commercial applications of green pesticides remain limited (Smith *et al.*, 2021). On the bibliometric analysis conducted in

2019, Scopus databases show that green pesticide research present a significant increase in the last three decades with studies mostly dominated by India, the United States and China (Sinha, 2012; Smith *et al.*, 2021) whilst Malaysia is still far to be included in the topics. Contributing to the global expansion in the use of green pesticides include the rising awareness of the harmful effects of synthetic pesticides on the environment (Kamaruzaman *et al.*, 2020; Komorowicz *et al.*, 2010; Zaidon *et al.*, 2018), the growing demand for a sustainable alternative (Adinew, 2014; Feng and Zhang, 2017; Kaur and Kaur, 2017; Koul *et al.*, 2008; Mossa, 2016; Sharma *et al.*, 2011; Singh and Singh, 2016), government laws on biodiversity conservation (Nan *et al.*, 2019), and the efforts of pressure groups (Haddi *et al.*, 2020).

Therefore, this research aimed to examine the factors influencing oil palm planters' intention to adopt green pesticides from current literature and present conceptual discussions for future investigation.

TABLE 1: GLOBAL STATISTIC OF PESTICIDE CONSUMPTION

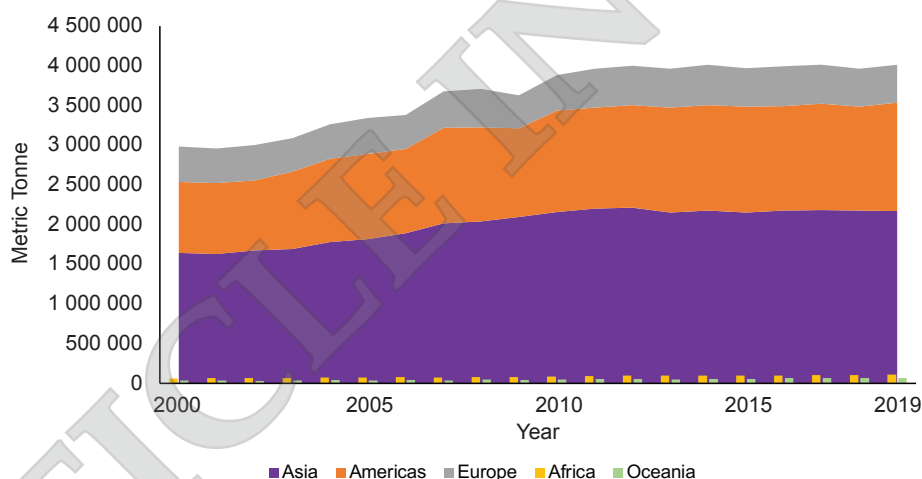
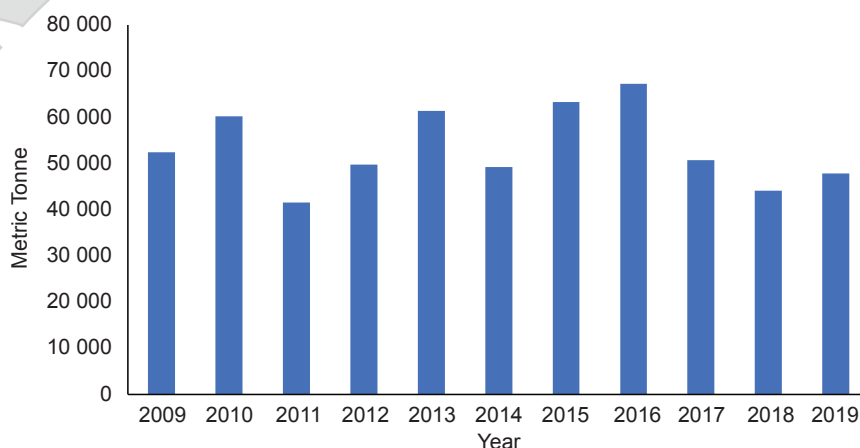


TABLE 2: MALAYSIA'S STATISTIC OF PESTICIDE CONSUMPTION



LITERATURE REVIEW AS METHODOLOGY

The goal of a literature review is to examine, critique, and synthesise the literature on a specific study issue for new conceptual frameworks and perspectives to emerge. Semi-structured or integrative literature reviews enable researchers to create their standard and thorough strategy to guarantee that the suitability of the literature is adequately addressed to answer their research question while being transparent about the process (Snyder, 2019). Since the issue of green pesticides has not yet reached maturity in Malaysia, it is possible to examine the pertinent literature and use a well-known theory to conceptualise a new idea that can be implemented in the Malaysian oil palm context.

Theory of Planned Behaviour

Icek Ajzen's development of theory of planned behaviour (TPB) in 1985 remains a widely utilised scholarly reference worldwide. The predictive power of its theoretical validity has been demonstrated in multiple behavioural domains with over 2000 experiments (La Barbera and Ajzen, 2021). The immediate antecedent of behaviour in TPB involves the intention to execute desired actions. In this vein, intention essentially determines the initiation of action (Ajzen, 2015, Bosnjak *et al.*, 2020). The extent to which individuals possess real control over personal behaviour depends on the capacities to overcome such intricacies and the availability of enabling variables: Experience and external support. As the amount of existing behavioural control significantly affects the influence of intention on behaviour in line with TPB, high behaviour regulation abilities are associated with increased behaviour performance possibilities.

The TPB encompasses three determinant factors that affect intentions: Attitude (A) towards the behaviour, subjective norm (SN) concerning the behaviour and perceived behavioural control (PBC). A concrete intention to engage in action is only established when the perceived control over conduct is sufficiently strong despite the motivations from positive attitudes and subjective norms. Intention to participate in a certain behaviour denotes the proximal antecedent of voluntary action and could be appropriately described as a behavioural disposition or readiness to behave in a specific manner following a suitable condition (Ajzen and Dasgupta, 2015). The latest development of TPB in 2019 is represented by Figure 1 showing that Attitude and Subjective Norm has a direct impact on the intention, while perceived behavioural control (PBC) is moderating both Attitude and Subjective Norm while affecting indirectly the actual behaviour.

Attitude

Perceivably, attitude towards action involves the easily accessible ideas of potential behavioural consequences or behavioural beliefs (La Barbera and Ajzen, 2021). A behavioural belief implies an individual's subjective likelihood, where participating in the desired action would result in specific outcomes or experiences. Meanwhile, attitude denotes a person's positive or negative emotions, thoughts, or assessment of a topic or object. In this regard, attitude is crucial in determining the engagement objectives in a particular behaviour that could change based on circumstances (Ajzen and Dasgupta, 2015; Imani *et al.*, 2020).

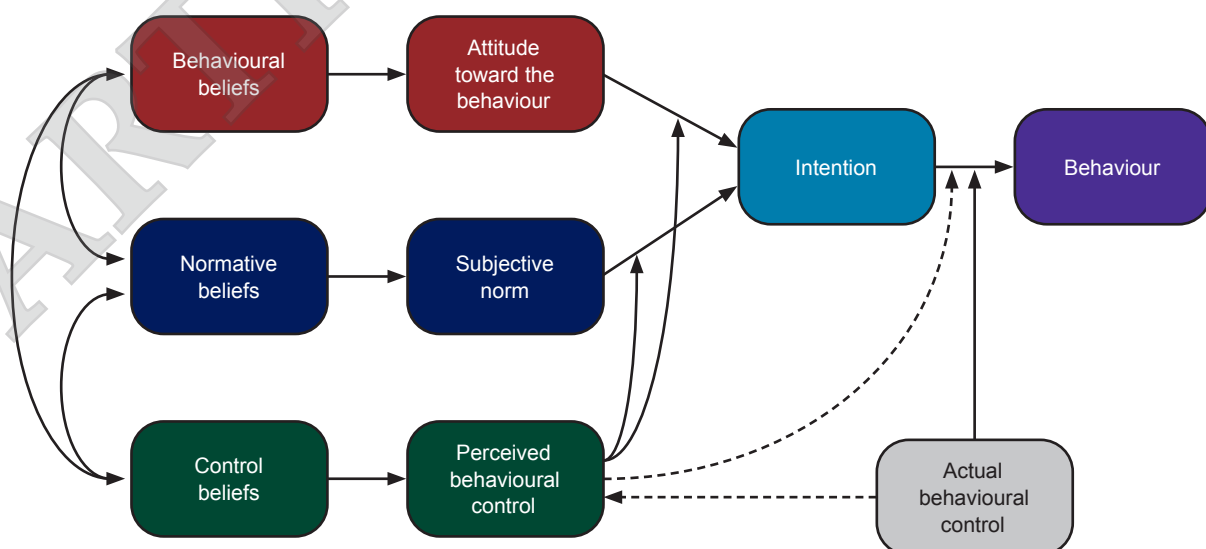


Figure 1. Schematic representation of TPB (Bosnjak *et al.*, 2020)

Knowledge denotes a frequently utilised study variable that facilitates purchase intention. From a business perspective, knowledge implies information about an entity, situation, or phenomenon that is studied or experienced by individuals. Notably, the essentiality and regrettable paucity of knowledge in decision-making processes have been examined in various studies (Haron *et al.*, 2005). Knowledge in environmental studies is defined as an individual's level of information involving environmental issues and their capacity to understand and evaluate social and environmental implications. For example, knowledgeable individuals directly affect the decision-making process, while people with insufficient information tend to disengage from sustainability behaviour (Haron *et al.*, 2005). Interestingly, Ajzen opined that knowledge does not directly influence the recent TPB development in terms of accurate information (Ajzen 2015, Bosnjak *et al.*, 2020). Contrarily, beliefs are often formed following incomplete, inaccurate, prejudiced, paranoid, self-centric, or irrational information. As the most essential TPB element indicates the extent to which individual beliefs encourage or discourage the execution of intention, this study aimed to examine if knowledge determined stronger oil palm planter attitudes and preferences to utilise green pesticides.

Subjective Norm

As the second TPB indicator, subjective norms or beliefs indicate the normative expectations of significant others that induce perceived social pressure. The two primary subjective norm constructs are injunctive and descriptive norms. Injunctive normative belief is the anticipated or subjective likelihood involving the behavioural acceptance or rejection of referents or groups while descriptive normative belief indicates the extent to which significant others engage in the behaviour (Ajzen, 2020).

As previously mentioned, subjective norms denote social pressure in determining specific behaviours (Ajzen, 1985). Past research revealed a purchase intention-actual green product purchase behaviour correlation at both personal and social levels (Eze and Ndubisi, 2013; Liu *et al.*, 2012). Regardless, subjective norms were found to be either completely unrelated to purchase intention (Connell, 2010) or only denoted indirect effects (Gadenne *et al.*, 2011; Salazar *et al.*, 2013). As such, it is inadvisable to omit the elements from this research given the evident association of subjective norms with TPB. Planters' pro-social behaviours correspond to the perceived social pressure from subjective norms within the pesticide and sustainability contexts (Wang *et al.*, 2018).

Contrary to injunctive norms, descriptive counterparts emphasise actual individual actions (Dessart *et al.*, 2019). The widespread belief that individuals either perform or disregard specific behaviours significantly impacts how people behave in a given circumstance (Ahn *et al.*, 2020). Adoption of green pesticides might be a catalyst as a good practice from a sustainability standpoint, despite the lack of explicit regulatory compliance for green pesticide usage in actual practices. Notwithstanding, the adoption would rely on other affected situations, such as pest attack severity, cost-effectiveness, and other circumstances for holistic considerations.

Perceived Behavioural Control

As the third TPB construct, PBC reflects individual perceptions of the relative ease of or difficulty in performing favoured behaviours and potential access to necessary resources and opportunities (Ajzen, 1991; 2015). The PBC is hypothetically grounded on access control-oriented beliefs that relate to the availability of conducive conditions that assist or hinder behaviour execution. The possibility of a specific facilitating or inhibiting factor in a scenario of interest is indicated as a controlling factor (Ajzen, 2020). Although past studies often considered PBC to be equivalent to attitude and subjective norms, recent debates on TPB emphasised PBC as a moderator of both components (Bosnjak *et al.*, 2020; La Barbera and Ajzen, 2021). Additionally, research on various contexts demonstrated that strong PBC increased the relative significance of attitude and decreased the relative importance of subjective norms to predict intention (Barbera and Ajzen, 2020; Canova and Manganello, 2020; La Barbera and Ajzen, 2021). As such, this research strived to bridge the existing gap with PBC in TPB to forecast oil palm planters' green pesticide adoption behaviour.

Past studies revealed that PBC primarily impacted the willingness to buy and environmentally friendly product consumption (Ma *et al.*, 2012; Wang *et al.*, 2014), while other counterparts contradicted the findings (Arvola *et al.*, 2008). Other studies found no conclusive proof of a PBC-green purchase intention correlation following research scarcity (Joshi and Rahman, 2015). Given the retainment of PBC as an indicator in this novel green pesticide research based on its sound establishment in TPB compared to other green (organic food) consumption studies, this study may produce distinct results.

Malaysian Sustainable Palm Oil (MSPO)

The MSPO is a standard certification scheme owned by the Malaysian Palm Oil Certification Council (MPOCC), an independent organisation established in December 2014. The MPOCC is

accountable for the MSPO certification scheme development and implementation in Malaysia to highlight various sustainability principles for both independent and organised smallholders (Singh and Kumaran, 2016). Although MSPO certification was voluntary at the early implementation stage, the Malaysian government made the certification compulsory as of 1 January 2020 (Kumaran, 2019, 2021). The MSPO encompasses seven primary goals under sustainability principles, such as economic viability, social acceptability and ecological efficiency (Parveez *et al.*, 2021; Singh and Kumaran, 2016).

The Malaysian Palm Oil Board (MPOB) functioned as a working committee between 2011 and 2013 during the early stage of MSPO development to finalise the relevant standards before being delivered for public comment, submitted to SIRIM Berhad (Standard Development Agency or SDA), incorporated into the final draft, and adopted as the Malaysian Standard (MS) by the Department of Standards. The MSPO was approved by the Honourable Minister of Science, Technology, and Innovations in September 2013 and launched by the Deputy Prime Minister during the 2013 MPOB International Palm Oil Congress and Exhibition (PIPOC) (Singh and Kumaran, 2016). The MSPO system has since benefited the oil palm industry in multiple ways, such as environmental protection, safer working conditions and contributions to local sustainable development. The system has also fulfilled the demand for Certified Sustainable Palm Oil (CSPO) from environmentally sensitive markets following Kumaran (2019). Although the MSPO certification accreditation from MPOCC is valid for five years, each registered member must undergo a surveillance audit to ensure standard compliance (Kumaran, 2021).

Through MSPO standard requirements, it is possible to infer that the oil palm industry is encouraged to use environmentally friendly pesticides. From another perspective, training on pesticide handling must be frequently performed to overcome workers' lack of knowledge (Damalas and Eleftherohorinos, 2011; Ye *et al.*, 2013). Malaysia on the broad view of the workforce employed foreigners in oil palm estates. These foreign workers are having minimum educational backgrounds. Furthermore, they are presumably utilising languages that differ from their employers, causing employer-worker communication barriers. Hence, workers must undergo multiple training sessions to be aware of the minimum requirements for injury avoidance when spraying chemicals despite Personal Protective Equipment (PPE) being provided. Employees would benefit from green pesticide usage following its minimal toxicity and low health risk due to intoxication. A viable alternative, such as

the implementation of green pesticides is practically necessary to mitigate chemical hazards (worker intoxication). Current global studies are also seeking novel solutions, such as replacing synthetic pesticides with biological control (Cederlund, 2017; Fiola and Gill, 2017; Maizatul-Suriza *et al.*, 2017; Rajmohan *et al.*, 2020) serving these reasons while also being a long-term strategy for protecting workers' well-being.

RESULTS AND DISCUSSIONS

As the first characteristic emphasised in the attitude domain, resistance to change is perceived to be significantly associated with individual personality. Following the Big Five personality theory, individuals with low openness to novel experiences generally tend to resist change (Dessart *et al.*, 2019; George and Zhou, 2001). Under the behavioural momentum theory, behaviour resembles a mass-like quality in line with Newton's second law of gravity. The application of an external force to a moving object proportionally alters the object's velocity based on the degree of applied force and is inversely proportional to the item's mass (Craig *et al.*, 2014; Nevin and Grace, 2000).

In this vein, behaviour demonstrates a mass-like aspect that induces resistance to change and reinforces delivery in a stimulus setting towards the 'behavioural mass'. In the green pesticide adoption context, oil palm planters would choose to continue utilising synthetic pesticides or adhering to the conventional traditions taught by their seniors. Green pesticides are observed as novel modifications in place of traditional practices that cause explicit and implicit changes in daily routines and procedures, disruption in personal comfort zones, ambiguities and even perceived threats with insufficient knowledge of green pesticide application compared to current counterparts. Inevitably, the aforementioned implications instigate planters' resistance to change (Oreg, 2006; Özdemir-Güngör and Camgöz-Akdağ, 2018) and blatant disregard for green pesticides as a viable alternative. Thus, the first proposition is presented as follows:

Proposition 1: Oil palm planters' resistance to change influences the intention to adopt green pesticides

The second attitude involves risk tolerance. Past research on sustainability demonstrated risk tolerance to strengthen sustainability practice adoption (Trujillo-Barrera *et al.*, 2016), specifically in terms of budgeting. In other words, risk tolerance implies the degree to which people could tolerate uncertainty while making financial decisions (Grable, 2016). For example, risk could denote

attitudes that potentially impact the economic decisions of individuals with varying degrees of risk tolerance, particularly in consumption (Sharma and Chatterjee, 2021). As the end-users engaged in product purchase, usage and disposal, oil palm planters need to first evaluate all the possible risks associated with green pesticide pre-purchase. Grable (2016) indicated that financial planning models, investment appropriateness assessments and consumer choice frameworks significantly influence the essentiality of risk tolerance. In this vein, an individual's risk tolerance implies the ability to manage ambiguities. Given that planters' lower risk tolerance increased high green pesticide adoption possibilities, the second proposition is presented as follows:

Proposition 2: Oil palm planters' risk tolerance influences the intention to adopt green pesticides

Environmental awareness (EA) and environmental concern (EC) imply two types of knowledge conceptualisation. The EA definition corresponds to Altin *et al.*, (2014) connotation as the awareness of environmental issues and active engagement in environmental organisations. Inadequate knowledge and education, negative feelings and thoughts instigate low awareness levels that impact optimal sustainability adoption (Karatekin, 2014). Past local studies demonstrated that high EA levels did not imply significant environmental behaviour levels as a single predictor (Mei *et al.*, 2016) in line with a study conducted earlier in 2013 (Klöckner, 2013). Therefore, high EA is predicted within the oil palm community following industrial criticisms over several allegations from non-governmental organizations and western countries. The oil palm plantation sector is often associated with adverse claims, such as deforestation (Ferdous Alam *et al.*, 2015; Meijaard *et al.*, 2020), the welfare of endangered animals (orangutans and Sumatran rhinos) (Frank Vogelgesang, 2018), the transboundary haze that lowers air quality (Mohd Noor *et al.*, 2017), the violation of indigenous peoples rights to water sources through persistent chemical pollution (Leong *et al.*, 2007) and other environmental issues. The essentiality of EA in this study represents individuals' environmental knowledge, attitudes, beliefs and abilities in alleviating environmental issues. Thus, the third proposition is presented as follows:

Proposition 3: Oil palm planters with EA will have intentions to adopt green pesticides

Essentially, EC indicates an individual's consciousness of environmental vulnerabilities and the subsequent limitations of natural resources

(Kalafatis *et al.*, 1999). On a global scale, the recent EC notion indicates individuals' environmental concerns for the sake of human health and well-being rather than environmental degradation (Lou and Li, 2021; Nicolopoulou *et al.*, 2017). Following past research, gender indicated moderation effects on EC where males required more EC exposure compared to females in encouraging green purchase intention (Chen and Zhang, 2021; Dagher *et al.*, 2015; Malik *et al.*, 2019). Individual attention to value information, specifically regarding the level of concern for the environment, other human beings and animal welfare varied gender-wise (Dagher *et al.*, 2015; Eagly and Wood, 2012).

The role of gender is primarily highlighted in EC as the local oil palm industry is dominated by high-ranking males, such as managers and agronomists. Past research also indicated EC to be affected by location as individual preferences differed based on place of origin. For example, people from developed countries reflect higher EC than counterparts from other nations (Paul *et al.*, 2016), as individual attitudes are heavily influenced by culture (Singh and Gupta, 2013). Furthermore, the individuals (specifically Malaysians) are engaged in work with no time to perform environmental behaviours (Ramayah *et al.*, 2010). As EC could become a vital antecedent towards green pesticide adoption in oil palm plantations following the impacts of consumers' decisions regarding environmentally friendly purchase behaviours (Jain and Kaur, 2004, Kalafatis *et al.*, 1999), the fourth proposition is presented as follows:

Proposition 4: Oil palm planters with EC will have intentions to adopt green pesticides

High expectations of conduct in line with social acceptance or disapproval compel individuals to engage in socially acceptable or undesirable behaviours (Harris *et al.*, 2020). In the research setting, green pesticide adoption is highly recommended to all planters towards public acceptance as an example to other planters. As social acceptance or rejection is perceived to be highly influenced by injunctive standards rather than descriptive norms, the fifth proposition involving injunctive norms is presented as follows:

Proposition 5: Oil palm planters' friends or family will influence the intention to use green pesticides

As green pesticide adoption should be regarded favourably and as a norm for sustainable practices to induce a positive mood and planter's work performance, the sixth proposition involving descriptive norms is presented as follows:

Proposition 6: Agricultural sustainability efforts inspire oil palm planters to adopt green pesticides

Another component under subjective norm is the signalling motive. Although sustainability practices in the oil palm plantation sector potentially increase end user's acceptability of edible oil usage worldwide, consumers tend to emphasize eco-friendly goods to enhance the public image (Kushairi *et al.*, 2017; Nambiappan *et al.*, 2018; Sundaraja *et al.*, 2020). The presence of social pressure necessitates sustainable product (palm oil) development, particularly in European nations (Dessart *et al.*, 2019; van Dijk *et al.*, 2016). For example, the European farmers' effective mitigation of deforestation impacts and optimal environmental stewardship resulted in widespread product acceptance by end-users (Dessart *et al.*, 2019). Following the European sustainable practice adoption model, Malaysian oil palm planters could adopt green pesticides following end users signalling motives to reflect a positive public image or status and fulfil consumer expectations of sustainable palm oil. Signalling motives have been empirically reflected in multiple consumer behaviours based on a systematic review where consumers selected organic food to avoid harmful ingredients, synthetic pesticides, chemicals, additives and non-genetically modified organisms (GMOs) within developing countries (Kushwah *et al.*, 2019). The planters in this study chose to utilise green pesticides following market demand as a signalling motive to cultivate the culture of high-quality oil palms in line with fundamental agricultural principles. Hence, the seventh proposition based on signalling is presented as follows:

Proposition 7: Oil palm consumers signalling motives significantly impact oil palm planters' intentions to adopt green pesticides

Self-efficacy under Bandura's (2010) social learning theory is defined as the self-evaluation of a course of action for task accomplishment and objective attainment. Past research revealed PBC to reflect a similar meaning to self-efficacy regarding the personal convictions to perform particular activities involving physical and mental preparedness (Dang and Chou, 2019) and the degree of confidence in executing specific conduct (Ho *et al.*, 2020).

Reliable and relevant information is essential for oil palm planters to adopt a sustainable practice toward optimal performance levels. As planters potentially originate from a diverse set of knowledge, competence and experience, measuring the degree of self-efficacy towards green pesticide adoption is crucial to forecast readiness levels. Individuals with high self-efficacy levels tend to be

more competent and confident and make robust, persistent and genuine decisions (Dang and Chou, 2019). Ajzen acknowledged PBC and self-efficacy to be essentially similar in subsequent assessments as both elements measure people's confidence in specific activity performance. The PBC functions by enabling the participants to assess behavioural capacities and control over activities (Ajzen, 2019). As such, the eighth proposition involving self-efficacy is presented as follows:

Proposition 8: Oil palm planters are confident in the ability to adopt green pesticides

The green brand knowledge process offers information that catalyses consumers' ecological awareness (Aulina and Yulianti, 2017). Following (Akdeniz *et al.*, 2013) study on consumer behaviour, consumers tend to rely on product information to comprehend multiple options or feel confident about their decision-making abilities. In this vein, product knowledge is important to address sales opportunities and strengthen confidence in making consumer-oriented decision. As end-users who purchase, utilise and promote green products, oil palm planters are expected to act on similar behaviours following Akdeniz's prediction. Green brand knowledge acknowledges the fact that customers are drawn to a particular brand due to product familiarity and comprehension (Goodwin, 2000). Thus, the planters' intentions to adopt green pesticides could depend on product knowledge and familiarity and the acquisition of relevant information, skills, or experiences for green pesticide application in the field. The paucity of research involving the effect of green brand knowledge on green purchasing behaviour subsequently reflects the lack of a definitive outcome in this field (Joshi and Rahman, 2015). Thus, the ninth proposition is presented as follows:

Proposition 9: Oil palm planters with knowledge of utilizing green pesticides intend to implement them completely in the field

A common misconception regarding green pesticides is the high cost following price variations and ineffectiveness in pest eradication compared to their traditional counterparts. Based on past studies, people who perceived sustainable practice adoptions to be easily potentially engaged in such practices (Dessart *et al.*, 2019). Likewise, the lack of technical skills, time and necessary equipment would instigate the reluctance to adopt. Cost and benefit factors have catalysed work completion or goal pursuits (Hattie *et al.*, 2020) and affected planters' preference to utilise green pesticides based on 1) economic value, 2) adoption incentives, 3) personal pleasure, 4) environmental commitment

and 5) self-competence (modified from past research) (Eccles and Wigfield, 2020). As 'green' labelled products are often costlier at the point of market penetration following the absence of large-scale manufacturing (Berger, 2019), the high cost adversely impacts green choices, attitudes and dissuades people from making purchases (Joshi and Rahman, 2015).

Perceptions of green pesticides as premium-price products compared to conventional counterparts inevitably encourage planters to comply with old practices. Following past studies, Asian agricultural communities were more sensitive to potential losses compared to their Western counterparts (Cherian and Jacob, 2012; Dessart *et al.*, 2019). Additionally, the high costs countered ethical issues and reduced the attitude-behaviour gap in green product purchasing (Connelly *et al.*, 2011; Gleim *et al.*, 2013) while low green product pricing encouraged consumer purchasing (Eze and Ndubisi, 2013; Weisstein *et al.*, 2014). As perceived costs and benefits substantially influence oil palm planters' green pesticide adoption. Thus, the 10th proposition involving perceived costs and benefits is presented as follows:

Proposition 10: Oil palm planters who intend to adopt green pesticides will be influenced by the cost of implementing them

Profit maximisation is a corporate goal like the palm oil market growth worldwide and end-user market development. On another note, palm oil producers are compelled to execute sustainable production following consumer preferences. Thus, sustainable practices should be optimised by incorporating green pesticides as a fundamental concept to mitigate environmental effects. Perceived risk denotes the sense of insecurity associated with technological adoption and adversely impacts individual intentions (Hong *et al.*, 2020). For example, people typically exercise cautious behaviour when managing purchasing decisions at corporate levels. Moreover, the implementation of the Integration Management System (MSPO integrated with the Occupational Safety and Health Management System ISO45001:2018 and Quality Management System ISO 9001:2015) in oil palm plantations has catalysed risk-based thinking at all operational levels, including pesticide application. Specifically, risk-based thinking implies anticipating scenarios for risk and opportunity assessments and the potential impacts on objectives to preserve or improve intended outcomes (Ezrahovich *et al.*, 2017).

In line with previous studies, perceived risks encompass several constructs: 1) ecological risk (environmental threats, such as killing non-target animals, low biodiversity, and targeted pest resistance), 2) the economic risk that potentially instigates economic losses, 3) ethical risk that

relates to ecological risk, 4) health risk through conventional pesticide usage and 5) social risk that could alter social norms, values and beliefs (Xu *et al.*, 2020). Another component of perceived risk is human health concerns. Green pesticides serve to mitigate the risk of undesirable environmental effects, such as direct or indirect non-target organism poisoning, low biodiversity, and soil and water pollution (Basantia, 2017; Basantia and Rathore, 2017; Karunamoorthi, 2012a; Mobki *et al.*, 2014; Singh and Singh, 2016; Mahmood *et al.*, 2016). For example, pheromone traps for particular insects do not require human exposure to pesticides as the trapping method implies minimal work and limited chemical exposure (Ahmad *et al.*, 2017; Baker *et al.*, 2020; Marshall *et al.*, 2017; Ramle *et al.*, 2005; Stenberg, 2017). Palpably, perceived risk is a significant antecedent that facilitates oil palm growers' readiness toward green pesticide adoption. In this vein, the 11th proposition is presented as follows:

Proposition 11: Oil palm planters' intention to use green pesticides will be influenced by the minimal hazards associated with their use in the field

In a study conducted in 2018, MSPO certification increased oil palm yields by 19% among Malaysian smallholders compared to the output pre-certification, thus resulting in an additional net profit of RM489/ha based on the average fresh fruit bunch (FFB) price in the year of 2018 (Arshad *et al.*, 2020). The data in this research are unsuitable for generalization following the small sample of certified MSPO smallholders due to low participation in the early stage of MSPO certification. Nevertheless, multiple avenues are offered for future studies as MSPO accreditation is compulsory in the local oil palm sector following its mandatory implementation in 2020. As MSPO facilitates planters and oil palm plantations towards sustainability and profitability following Arshad *et al.* (2020), the certification scheme could moderate attitudes and subjective norms to optimise the green pesticide adoption among oil palm planters. As such, the 12th proposition is presented as follows:

Proposition 12: The MSPO plays a role as PBC to influence the planter's intention to adopt green pesticides

Findings and discussion for above mention propositions are summarized in Table 3.

Figure 2 depicts the conceptual framework or suggested model for the study, which comprises components in the TPB that is reflectively related to each relevant variable. The dotted line reflected the moderating impact of Perceived Behavioural Control on Attitude and Subjective Norm, which also

influenced intention indirectly. This research model will be assessed by utilising the Partial Least Square-Structural Equation Model (PLS-SEM) technique. PLS-SEM is employed for several reasons, but the most significant is that the model includes second-order components that affect the TPB and focuses on theory development and prediction rather than theory testing, as is advised if Covariance Based-

SEM is used. The interrelationship between all the variables will simultaneously be modelled using the SmartPLS software. All constructs are multi-items and conceptualized as (1) formative for the first order and (2) reflective for the second order. Reflective constructs aim to identify measures that are correlated, have unidimensionality and are expected to have strong internal consistency.

TABLE 3: RELEVANT LITERATURE AND RE-CATEGORISATION BASED ON TPB

Factors	Source	Category
Resistance to change	(Craig <i>et al.</i> , 2014), (Nevin, 1992; Nevin and Grace, 2000), (Oreg, 2006), (Özdemir-Güngör and Camgöz-Akdağ, 2018), (Dessart <i>et al.</i> , 2019), (George and Zhou, 2001)	Attitude
Risk tolerance	(Trujillo-Barrera <i>et al.</i> , 2016), (Grable, 2016), (Sharma and Chatterjee, 2021), (Dessart <i>et al.</i> , 2019)	Attitude
Knowledge-EA	(Haron <i>et al.</i> , 2005), (Ajzen, 2020), (Kalafatis <i>et al.</i> , 1999)	Attitude
Knowledge-EC	(Altin <i>et al.</i> , 2014), (Paul <i>et al.</i> , 2016), (Ramayah <i>et al.</i> , 2010), (Singh and Gupta, 2013), (Karatekin, 2014), (Klöckner, 2013), (Mei <i>et al.</i> , 2016), (Ferdous Alam <i>et al.</i> , 2015), (Meijaard <i>et al.</i> , 2020; Meijaard and Sheil, 2019), (Frank Vogelgesang, 2018), (Mohd Noor <i>et al.</i> , 2017), (Leong <i>et al.</i> , 2007), (Lou and Li, 2021), (Chen and Zhang, 2021), (Dagher <i>et al.</i> , 2015), (Malik <i>et al.</i> , 2019), (Eagley, 2013), (Jain and Kaur, 2004), (Kalafatis <i>et al.</i> , 1999)	Attitude
Injunctive norm	(Dessart <i>et al.</i> , 2019), (Harris <i>et al.</i> , 2020), (Ajzen, 1991), (Ahn <i>et al.</i> , 2020) (Kalafatis <i>et al.</i> , 1999)	Subjective norm (Ajzen, 1985; 1991; 2020), (Eze and Ndubisi, 2013), (Liu <i>et al.</i> , 2012), (Gadenne <i>et al.</i> , 2011), (Connell, 2010), (Wang <i>et al.</i> , 2018)
Descriptive norm	(Dessart <i>et al.</i> , 2019), (Ahn <i>et al.</i> , 2020), (Kalafatis <i>et al.</i> , 1999)	Subjective norm
Signalling motive	(Nambiappan <i>et al.</i> , 2018), (Sundaraja <i>et al.</i> , 2020), (Dessart <i>et al.</i> , 2019), (van Dijk <i>et al.</i> , 2016), (Kushwah <i>et al.</i> , 2019)	Subjective norm
Self-efficacy	(Bandura, 2010), (Dang and Chou, 2019), (Ho <i>et al.</i> , 2020)	PBC (Ajzen, 1991; 2015, (Bosnjak <i>et al.</i> , 2020), (Bandura, 2010), (Caputo, 2020), (Ma <i>et al.</i> , 2012), (P. Wang <i>et al.</i> , 2014), (Arvola <i>et al.</i> , 2008), (Joshi and Rahman, 2015)
Green brand knowledge	(Aulina and Yuliaty, 2017), (Akdeniz <i>et al.</i> , 2013), (Mei <i>et al.</i> , 2016), (Goodwin, 2000), (Joshi and Rahman, 2015)	PBC
Perceived costs and benefits	(Dessart <i>et al.</i> , 2019), (Hattie <i>et al.</i> , 2020), (Eccles and Wigfield, 2020), (Berger, 2019), (Joshi and Rahman, 2015), (Biswas and Roy, 2015), (Cherian and Jacob, 2012), (Connelly <i>et al.</i> , 2011), (Gleim <i>et al.</i> , 2013), (Eze and Ndubisi, 2013), (Weisstein <i>et al.</i> , 2014)	PBC
Perceived risks	(Biswas and Roy, 2015), (Cherian and Jacob, 2012), (Dessart <i>et al.</i> , 2019), (Connelly <i>et al.</i> , 2011), (Gleim <i>et al.</i> , 2013), (Eze and Ndubisi, 2013), (Weisstein <i>et al.</i> , 2014), (Ezrahovich <i>et al.</i> , 2017), (Xu <i>et al.</i> , 2020), (Basantia and Rathore, 2017), (Karunamoorthi, 2012b), (Mobki <i>et al.</i> , 2014), (Singh and Singh, 2016), (Ahmad <i>et al.</i> , 2017), (Baker <i>et al.</i> , 2020), (Stenberg, 2017), (Sapbamrer and Thammachai, 2020), (Gunnell <i>et al.</i> , 2017), (Lee <i>et al.</i> , 2021), (Sulaiman <i>et al.</i> , 2019)	PBC
MPSO	(Arshad <i>et al.</i> , 2020), (Singh and Kumaran, 2016), (Standard MSPO Part 2 (Encrypted). Pdf, 2013; Standard MSPO Part 3 (Encrypted). Pdf, 2013). (Damalas and Eleftherohorinos, 2011; Kumaran, 2021; Rajmohan <i>et al.</i> , 2020; Ye <i>et al.</i> , 2013)	PBC

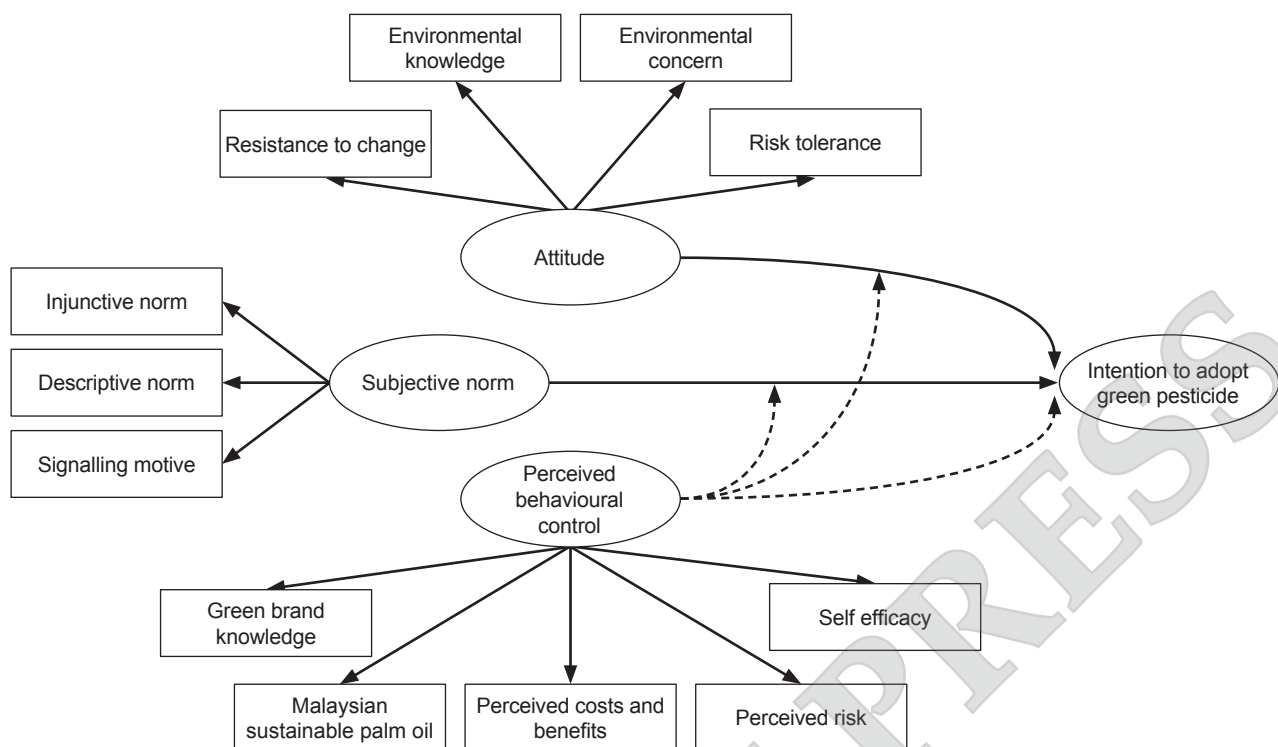


Figure 2. Conceptualised research framework for intention to adopt green pesticides among oil palm planters

CONCLUSION

This conceptualization provided the framework of determinant factors that influence green pesticide adoption among Malaysian oil palm planters. The TPB was incorporated into this study following its well-established concept that indicated power prediction over human intention or behaviour. The conceptual paper has included sufficient information on the feasibility and addressed the urgency for further development. Despite multiple breakthrough findings of green pesticides through research and development, attempts to facilitate oil palm planter adoption raised questions involving their intention levels, thus highlighting gaps in knowledge. This paper has emphasised the crucial and expanded determinant factors that could influence oil palm planters' intentions to use and the moderating role of government regulations that could enhance the intention to use green pesticides among oil palm planters. In this vein, future studies are necessary to address such questions and test the conceptualisation through empirical research that could determine the relative influence of the determinant factors on the intentions to use green pesticides. This paper and future empirical research are expected to benefit key oil palm stakeholders, signal manufacturers to market sustainable pesticide products, and catalyse government bodies or policymakers towards optimal policy implementations for sustainable and responsible consumption of pesticides in the oil palm industry.

ACKNOWLEDGEMENT

We would like to thank the OPIEJ committee for their excellent ideas and insightful thoughts that helped improve this paper.

REFERENCES

- Ahmad, M N; Kamarudin, N; Ahmad, S N; Arshad, O; Masri, M M M; Moslim, R and Kushairi, A (2017). Efficacy of pheromone trapping and aerial spraying of *Bacillus thuringiensis* (Bt) for controlling bagworm, *Metisa plana* Walker (Lepidoptera: Psychidae) in Yong Peng, Johor, Malaysia. *J. Oil Palm Research*, 29(1): 55-65. DOI:10.21894/jopr.2017.2901.06.
- Adinew, B (2014). GC-MS and FT-IR analysis of constituents of essential oil from Cinnamon bark growing in South-West of Ethiopia. *Int. J. Herbal Med.*, 1(6): 22-31.
- Ahn, I; Kim, S H and Kim, M (2020). The relative importance of values, social norms, and enjoyment-based motivation in explaining pro-environmental product purchasing behavior in the apparel domain. *Sustainability*, 12(17): 6797. DOI:10.3390/SU12176797.
- Ajzen, I (1985). From intentions to actions: A theory of planned behavior. *Action Control: From*

- Cognition to Behaviour* (Kuhl, J and Beckman, J eds.). Springer Series in Social Psychology. p. 11-39. DOI:10.1007/978-3-642-69746-3_2.
- Ajzen, I (1991). The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.*, 50(2): 179-211. DOI:10.1016/0749-5978(91)90020T.
- Ajzen, I (2015). The theory of planned behaviour is alive and well, and not ready to retire: A commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychol. Rev.*, 9(2): 131-137.
- Ajzen, I and Dasgupta, N (2015). Explicit and implicit belief, attitudes, and intentions: The role of conscious and unconscious processes in human behaviour. *The Sense of Agency* (Haggard, P and Eitam, B eds.). Oxford University Press. pp.115-144.
- Ajzen, I (2019). TPB questionnaire construction constructing a theory of planned behaviour questionnaire. University of Massachusetts Amherst, 1-7.
- Ajzen, I (2020). The theory of planned behavior: Frequently asked questions. *Hum. Behav. Emerg. Technol.*, 2(4): 314-324.
- Akdeniz, B; Calantone, R J and Voorhees, C M (2013). Effectiveness of marketing cues on consumer perceptions of quality: The moderating roles of brand reputation and third-party information. *Psychol. Mark.*, 30(1): 76-89. DOI:10.1002/mar.20590.
- Altin, A; Tecer, S; Tecer, L; Altin, S and Kahraman, F B (2014). Environmental awareness level of secondary school students: A case study in Balı Kesir (Türkiye). *Procedia-Soc. Behav. Sci.*, 141: 1208-1214.
- Arshad, F; Mashani Ahmad, S; Mohamed Salleh, K; Hashim, K; Shahrin Rahami, M; Nambiappan, B and Ismail, A (2020). A comparative analysis of agricultural practices, costs and yields of pre-and post-Malaysian Sustainable Palm Oil (MSPO) certification for independent smallholders in Malaysia. *Oil Palm Industry Economic J.*, 20(1): 36-44.
- Arvola, A; Vassallo, M; Dean, M; Lampila, P; Saba, A; Lähteenmäki, L and Shepherd, R (2008). Predicting intentions to purchase organic food: The role of affective and moral attitudes in the theory of planned behaviour. *Appetite*, 50(2-3): 443-454. DOI: 10.1016/j.appet.2007.09.010.
- Aulina, L and Yuliati, E (2017). The effects of green brand positioning, green brand knowledge, and attitude towards green brand on green products purchase intention. *Proc. of the International Conference on Business and Management Research (ICBMR 2017)*. p. 548-557. DOI:10.2991/icbmr-17.2017.50.
- Bailey, K L (2014). The bioherbicide approach to weed control using plant pathogens. *Integrated Pest Management: Current Concepts and Ecological Perspective* (Abrol, D P ed.). Elsevier Inc, San Diego. p. 245-266.
- Baker, B P; Green, T A and Loker, A J (2020). Biological control and integrated pest management in organic and conventional systems. *Biol. Cont.*, 140(September 2019). DOI: 10.1016/j.biocontrol.2019.104095.
- Bandura, A (2010). Self-efficacy. *The Corsini Encyclopedia of Psychology*. John Wiley and Sons. p. 13.
- Barbera, F L and Ajzen, I (2020). Understanding support for European integration across generations: A study guided by the theory of planned behaviour. *Eur. J. Psychol.*, 16(3): 437-457. DOI:10.5964/ejop.v16i3.1844.
- Basantia, N C (2017). Lemongrass oil: As a green pesticide. *Green Pesticides Handbook* (Nollet, L M L and Rathore, H S eds.). CRC Press. 24 pp. DOI:10.1201/9781315153131-6.
- Basantia, N C and Rathore, H S (2017). Pennyroyal oil as a green pesticide. *Green Pesticides Handbook* (Nollet, L M L and Rathore, H S eds.). CRC Press. 14 pp. DOI:10.1201/9781315153131-22.
- Berger, J (2019). Signaling can increase consumers' willingness to pay for green products: Theoretical model and experimental evidence. *J. Consum. Behav.*, 18(3): 233-246. DOI:10.1002/cb.1760.
- Biswas, A and Roy, M (2015). Leveraging factors for sustained green consumption behavior based on consumption value perceptions: Testing the structural model. *J. Clean. Prod.*, 95: 332-340. DOI: 10.1016/j.jclepro.2015.02.042.
- Bosnjak, M; Ajzen, I and Schmidt, P (2020). Editorial the theory of planned behavior: Selected recent advances and applications. *Eur. J. Psychol.*, 16(3): 352-356.
- Canova, L and Manganelli, A M (2020). Energy-saving behaviours in workplaces: Application of an extended model of the theory of planned behaviour. *Eur. J. Psychol.*, 16(3): 384-400. DOI:10.5964/ejop.v16i3.1893.
- Caputo, A (2020). Comparing theoretical models for the understanding of health-risk behaviour: Towards an integrative model of adolescent alcohol

- consumption. *Eur. J. Psychol.*, 16(3): 418-436. DOI:10.5964/ejop.v16i3.2213.
- Cederlund, H (2017). Effects of spray drift of glyphosate on nontarget terrestrial plants- A critical review. *Environ. Toxicol. Chem.*, 36(11): 2879-2886. DOI:10.1002/etc.3925.
- Chen, M and Zhang, W H (2021). Purchase intention for hydrogen automobile among Chinese citizens: The influence of environmental concern and perceived social value. *Int. J. Hydrog. Energy*, 46(34): 18000-18010. DOI: 10.1016/j.ijhydene.2020.11.099.
- Cherian, J and Jacob, J (2012). Green marketing: A study of consumers' attitude towards environment friendly products. *Asian Soc. Sci.*, 8(12): 117-126. DOI:10.5539/ass.v8n12p117.
- Connell, K Y H (2010). Internal and external barriers to eco-conscious apparel acquisition. *Int. J. Consum. Stud.*, 34(3): 279-286. DOI:10.1111/j.1470-6431.2010.00865.x.
- Connelly, B L; Certo, S T; Ireland, R D and Reutzel, C R (2011). Signaling theory: A review and assessment. *J. Manag.*, 37(1): 39-67. DOI:10.1177/0149206310388419.
- Craig, A R; Nevin, J A and Odum, A L (2014). Behavioral momentum and resistance to change. *The Wiley Blackwell Handbook of Operant and Classical Conditioning* (McSweeney, F K and Murphy, E S eds.). Wiley Blackwell. p. 249-274. DOI:10.1002/9781118468135.ch11.
- Dagher, G K; Itani, O and Kassab, A N (2015). The impact of environment concern and attitude on green purchasing behavior: Gender as the moderator. *Contemp. Manag. Res.*, 11(2): 179-206. DOI:10.7903/cmr.13625.
- Damalas, C A and Eleftherohorinos, I G (2011). Pesticide exposure, safety issues, and risk assessment indicators. *Int. J. Environ. Res. Public Health*, 8(5): 1402-1419. DOI:10.3390/ijerph8051402.
- Dang, V T and Chou, Y C (2019). Extrinsic motivation, workplace learning, employer trust, self-efficacy and cross-cultural adjustment: An empirical study of Vietnamese laborers in Taiwan. *Pers. Rev.*, 49(6): 1232-1253. DOI:10.1108/PR-10-2018-0427.
- Dara, S K (2019). The new integrated pest management paradigm for the modern age. *J. Integrated Pest Manag.*, 10(1). DOI:10.1093/jipm/pmz010.
- Dessart, F J; Barreiro-Hurlé, J and Van Bavel, R (2019). Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *Eur. Rev. Agric. Econ.*, 46(3): 417-471. DOI:10.1093/erae/jbz019.
- Dilipkumar, M; Chuah, T S; Goh, S and Sahid, I (2020). Weed management issues, challenges, and opportunities in Malaysia. *Crop Protection*, 134, 104347. DOI: 10.1016/j.cropro.2017.08.027
- Eagly, A H; and Wood, W (2012). Social role theory. *Handbook of Theories of Social Psychology* (Van Lange, P A M; Kruglanski, A W and Higgins, E T eds.). Sage Publications. p. 458-476. DOI:10.4135/9781446249222.n49.
- Eccles, J S and Wigfield, A (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemp. Ed. Psychol.*, 61(May): 101859. DOI: 10.1016/j.cedpsych.2020.101859.
- Eze, U C and Ndubisi, N O (2013). Green buyer behavior: Evidence from Asia consumers. *J. Asian African Stud.*, 48(4): 413-426. DOI:10.1177/0021909613493602.
- Ezrahovich, A Y; Vladimirtsev, A V; Livshitz, I; Lontsikh, P A and Karaseva, V A (2017). Risk-based thinking of ISO 9001:2015- The new methods, approaches and tools of risk management. *Proc. of the 2017 International Conference "Quality Management, Transport and Information Security, Information Technologies", IT and QM and IS 2017*. p. 506-511. DOI:10.1109/ITMQIS.2017.8085872.
- FAOSTAT. (2022). <https://www.fao.org/faostat/en/#search/pesticide>, accessed on 27 November 2022
- Feng, Y and Zhang, A (2017). A floral fragrance, methyl benzoate, is an efficient green pesticide. *Sci. Rep.*, 7(1), 1-9.
- Ferdous Alam, A S A; Er, A C and Begum, H (2015). Malaysian oil palm industry: Prospect and problem. *J. Food, Agric. Environ.*, 13(2): 143-148.
- Frank Vogelgesang, U K S (2018). Building a sustainable future together: Malaysian palm oil and European consumption. *JOPEH*, 9(0): 1-49.
- Food and Agriculture Organization (2022). <https://www.fao.org/sustainable-development-goals/overview/fao-and-the-2030-agenda-for-sustainable-development/sustainable-agriculture/en/>, accessed on 27 November 2022.

- Gadenne, D; Sharma, B; Kerr, D and Smith, T (2011). The influence of consumers' environmental beliefs and attitudes on energy saving behaviours. *Energy Policy*, 39(12): 7684-7694. DOI: 10.1016/j.enpol.2011.09.002.
- George, J M and Zhou, J (2001). When openness to experience and conscientiousness are related to creative behavior: An interactional approach. *J. Applied Psychol.*, 86(3): 513-524. DOI:10.1037/0021-9010.86.3.513.
- Parveez, G K A; Ahmad Tarmizi, A H; Sundram, S; Loh, S K; Ong-Abdullah, M; Poo Palam, K D; Mohammed Salleh, K; Mohd Ishak, S and Idris, Z (2021). Oil palm economic performance in Malaysia and R&D progress in 2020. *J. Oil Palm Research*, 33(June): 181-214. DOI:10.21894/jopr.2021.0026.
- Gleim, M R; Smith, J S; Andrews, D and Cronin, J J (2013). Against the green: A multi-method examination of the barriers to green consumption. *J. Retailing*, 89(1): 44-61. DOI: 10.1016/j.jretai.2012.10.001.
- Goodwin, A M (2000). Leaving the asylum: A psychodynamic observation study of a move from a long stay psychiatric ward to the community. *Int. J. Soc. Psychiatry*, 46(1): 21-33. DOI:10.1177/002076400004600104.
- Grable, J E (2016). Risk tolerance. *Handbook of Consumer Finance Research* (Xiao, J J ed.). SpringerLink. p. 3-19. DOI:10.1007/978-3-319-28887-1.
- Gunnell, D; Knipe, D; Chang, S S; Pearson, M; Konradsen, F; Lee, W J and Eddleston, M (2017). Prevention of suicide with regulations aimed at restricting access to highly hazardous pesticides: A systematic review of the international evidence. *Lancet Glob. Health*, 5(10): 1026-1037. DOI:10.1016/S2214-109X(17)30299-1.
- Haddi, K; Turchen, L M; Viteri Jumbo, L O; Guedes, R N; Pereira, E J; Aguiar, R W and Oliveira, E E (2020). Rethinking biorational insecticides for pest management: Unintended effects and consequences. *Pest Manag. Sci.*, 76(7): 2286-2293.
- Haron, S A; Paim, L and Yahaya, N (2005). Towards sustainable consumption: An examination of environmental knowledge among Malaysians. *Int. J. Consum. Stud.*, 29(5): 426-436. DOI:10.1111/j.1470-6431.2005.00460.x.
- Harris, K; Depietro, R B; Klein, J and Jin, D (2020). The impact of social norms and risk assessment on diners' reaction to food safety concerns in restaurants. *J. Foodserv. Bus. Res.*, 23(5): 377-400. DOI:10.1080/15378020.2020.1765947.
- Hattie, J; Hodis, F A and Kang, S H K (2020). Theories of motivation: Integration and ways forward. *Contemp. Educ. Psychol.*, 61(May). DOI: 10.1016/j.cedpsych.2020.101865.
- Ho, J C; Wu, C G; Lee, C S and Pham, T T T (2020). Factors affecting the behavioral intention to adopt mobile banking: An international comparison. *Technology in Society*, 63(December 2019). DOI: 10.1016/j.techsoc.2020.101360.
- Hong, A; Nam, C and Kim, S (2020). What will be the possible barriers to consumers' adoption of smart home services? *Telecomm. Policy*, 44(2):101867. DOI: 10.1016/j.telpol.2019.101867.
- Huang, B; Chen, F; Shen, Y; Qian, K; Wang, Y; Sun, C; Zhao, X; Cui, B; Gao, F; Zeng, Z and Cui, H (2018). Advances in targeted pesticides with environmentally responsive controlled release by nanotechnology. *Nanomaterials* 8(2): 102. DOI:10.3390/nano8020102.
- Imani, B; Allahyari, M S; Bondori, A; Emami, N and El Bilali, H (2020). Adoption of organic potato production in Ardabil Plain, Iran: An application of the extended theory of planned behaviour. *Potato Res.* DOI:10.1007/s11540-020-09471-z.
- Jain, S K and Kaur, G (2004). Green marketing: An attitudinal and behavioural analysis of Indian consumers. *Glob. Bus. Rev.*, 5(2): 187-205. DOI:10.1177/097215090400500203.
- Joshi, Y and Rahman, Z (2015). Factors affecting green purchase behaviour and future research directions. *Int. Strategic Manag. Rev.*, 3(1-2): 128-143. DOI: 10.1016/j.ism.2015.04.001.
- Kalafatis, S P; Pollard, M; East, R and Tsogas, M H (1999). Green marketing and Ajzen's theory of planned behaviour: A cross-market examination. *J. Consum. Mark.* 16(5): 441-460. DOI:10.1108/07363769910289550.
- Kamarudin, N H; Wahid, M B; Moslim, R and Ali, S R A (2007). The effects of mortality and influence of pheromone trapping on the infestation of *Oryctes rhinoceros* in an oil palm plantation. *J. Asia-Pacific Entomol.*, 10(3): 239-250. DOI:10.1016/S1226-8615(08)60358-1.
- Kamarudin, N; Seman, I A and Masri, M M M (2019). Prospects in sustainable control of oil palm pests and diseases through the enhancement of ecosystem

services - The way forward. *J. Oil Palm Research*, 31(3): 381-393. DOI:10.21894/jopr.2019.0030.

Kamaruzaman, N A, Leong, Y H, Jaafar, M H, Khan, H R M, Rani, N A A, Razali, M F, and Majid, M I A (2020). Epidemiology and risk factors of pesticide poisoning in Malaysia: A retrospective analysis by the National Poison Centre (NPC) from 2006 to 2015. *BMJ Open*, 10(6): e036048.

Karatekin, K (2014). Social studies pre-service teachers' awareness of solid waste and recycling. *Procedia Soc. Behav. Sci.*, 116:1797-1801.

Karimi Takalo, S; Sayyadi Tooranloo, H and Shahabaldini Parizi, Z (2021). Green innovation: A systematic literature review. *J. Clean. Prod.*, 279. DOI: 10.1016/j.jclepro.2020.122474.

Karunamoorthi, K (2012). Medicinal and aromatic plants: A major source of green pesticides/risk-reduced pesticides. *Med. Aromat. Plants*, 01(8): 8-10. DOI:10.4172/2167-0412.1000e137.

Kaur, A and Kaur, P (2017). Green pesticides for clean environment. *Int. J. Engin. Dev. Res.*, 5(4):1347-1349.

Klöckner, C A (2013). A comprehensive model of the psychology of environmental behaviour: A meta-analysis. *Glob. Environ. Change*, 23(5): 1028-1038. DOI: 10.1016/j.gloenvcha.2013.05.014.

Koul, O; Walia, S and Dhaliwal, G (2008). Essential oils as green pesticides: Potential and constraints. *Biopestic. Int.*, 4(1): 63-84.

Komorowicz, I; Gramowska, H and Barańkiewicz, D (2010). Estimation of the lake water pollution by determination of 18 elements using ICP-MS method and their statistical analysis. *J. Environ. Sci. Health A*, 45(3), 348-354.

Kumaran, S (2019). The Dynamics for Mandatory MSPO Certification Scheme to be Successfully Implemented. *JOPEH*, 10(148): 1-7. DOI:10.5366/jope.2019.01.

Kumaran, S (2021). Moving forward with mandatory MSPO certification standards. *Oil Palm Industry Economic J.*, 21(1): 1-12. DOI:10.21894/opiej.2021.01.

Kushairi, A; Singh, R and Ong-Abdullah, M (2017). The oil palm industry in Malaysia: Thriving with transformative technologies. *J. Oil Palm Research*, 29(4): 431-439. DOI:10.21894/jopr.2017.00017.

Kushwah, S; Dhir, A and Sagar, M (2019). Ethical consumption intentions and choice behavior

towards organic food. Moderation role of buying and environmental concerns. *J. Clean. Prod.*, 236: 117519. DOI: 10.1016/j.jclepro.2019.06.350.

La Barbera, F and Ajzen, I (2021). Moderating role of perceived behavioral control in the theory of planned behavior: A preregistered study. *J. Theoret. Soc. Psychol.*, 5(1): 35-45. DOI:10.1002/jts5.83.

Lee, Y Y; Chisholm, D; Scd, P M E; Dsc, P D G; Fleischmann, A; Konradsen, P F; Bertram, M Y; Mihalopoulos, P C; Brown, R; Santomauro, D F; Ba, J S and Ommeren, M Van (2021). The cost-effectiveness of banning highly hazardous pesticides to prevent suicides due to pesticide self-ingestion across 14 countries: An economic modelling study. *Lancet Glob. Health*, 9(3): 291-300. DOI:10.1016/S2214-109X(20)30493-9.

Leong, K H; Benjamin Tan, L L and Mustafa, A M (2007). Contamination levels of selected organochlorine and organophosphate pesticides in the Selangor River, Malaysia between 2002 and 2003. *Chemosphere*, 66(6): 1153-1159. DOI: 10.1016/j.chemosphere.2006.06.009.

Liu, X; Wang, C; Shishime, T and Fujitsuka, T (2012). Sustainable consumption: Green purchasing behaviours of urban residents in China. *Sustain. Dev.*, 20(4): 293-308. DOI:10.1002/sd.484.

Lou, X and Li, L M W (2021). The relationship between identity and environmental concern: A meta-analysis. *J. Environ. Psychol.*, 76(June): 101653. DOI: 10.1016/j.jenvp.2021.101653.

Ma, Y J; Littrell, M A and Niehm, L (2012). Young female consumers' intentions toward fair trade consumption. *Int. J. Retail Dist. Manag.*, 40(1): 41-63. DOI:10.1108/09590551211193595.

Mahmood, I; Imadi, S R; Shazadi, K; Gul, A and Hakeem, K R (2016). Effects of pesticides on environment. *Plant, Soil and Microbes: Implications in Crop Science* (Hakeem, K R; Akhtar, M S and Abdullah, S N A eds.). Springer International, Switzerland. p. 253-271.

Maizatul-Suriza, M; Seman, I A; Madihah, A Z and Hefni Rusli, M (2017). Detached leaf assay for in vitro screening of potential biocontrol agents to control goosegrass weed (*Eleusine indica*). *J. Oil Palm Res.*, 29(4): 562-569. DOI:10.21894/jopr.2017.0003.

Malik, M I; Nawaz Mir, F; Hussain, S; Hyder, S; Anwar, A; Khan, Z U; Nawab, N; Shah, S F A and Waseem, M (2019). Contradictory results on environmental concern while re-visiting green

- purchase awareness and behavior. *APJIE*, 13(1): 17-28. DOI:10.1108/apjie-11-2018-0061.
- Marshall, S D G; Moore, A; Vaqalo, M; Noble, A and Jackson, T A (2017). A new haplotype of the coconut rhinoceros beetle, *Oryctes rhinoceros*, has escaped biological control by *Oryctes rhinoceros* nudivirus and is invading Pacific Islands. *J. Invertebr. Pathol.*, 149: 127-134. DOI: 10.1016/j.jip.2017.07.006.
- Mei, N S; Wai, C W and Ahamad, R (2016). Environmental awareness and behaviour index for Malaysia. *Procedia Soc. Behav. Sci.*, 222(07): 668-675. DOI: 10.1016/j.sbspro.2016.05.223.
- Meijaard, E; Brooks, T M; Carlson, K M; Slade, E M; Garcia-Ulloa, J; Gaveau, D L A; Lee, J S H; Santika, T; Juffe-Bignoli, D; Struebig, M J; Wich, S A; Ancrenaz, M; Koh, L P; Zamira, N; Abrams, J F; Prins, H H T; Sendashonga, C N; Murdiyarso, D; Furumo, P R and Sheil, D (2020). The environmental impacts of palm oil in context. *Nat. Plants*, 6(12): 1418-1426. DOI:10.1038/s41477-020-00813-w.
- Meijaard, E and Sheil, D (2019). The moral minefield of ethical oil palm and sustainable development. *Front. For. Glob. Change*, 2(5). DOI:10.3389/ffgc.2019.00022.
- Mobki, M; Safavi, S A; Safaralizadeh, M H and Panahi, O (2014). Toxicity and repellency of garlic (*Allium sativum* L.) extract grown in Iran against *Tribolium castaneum* (Herbst) larvae and adults. *Arc. Phytopathol. Plant Prot.*, 47(1): 59-68. DOI:10.1080/03235408.2013.802896.
- Mohd Noor, F M; Gassner, A; Terheggen, A and Dobie, P (2017). Beyond sustainability criteria and principles in palm oil production: Addressing consumer concerns through inseting. *Ecol. Soc.*, 22. 10.5751/ES-09172-220205.
- Mossa, A T H (2016). Green pesticides: Essential oils as biopesticides in insect-pest management. *J. Environ. Sci. Technol.*, 9(5): 354.
- Nambiappan, B; Ismail, A; Hashim, N; Ismail, N; Shahari, D N; Idris, N A N; Omar, N; Salleh, K M; Hassan, N A M and Kushairi, A (2018). Malaysia: 100 years of resilient palm oil economic performance. *J. Oil Palm Res.*, 30(1): 13-25. DOI:10.21894/jopr.2018.0014.
- Nan, L; Yang, Z; Xin, H; and Lijuan, L (2019). Agricultural subsidies, production certification and green pesticide use rate: Evidence from experiments. *Preprints*, 2019: 2019020259. DOI:10.20944/preprints201902.0259.v1.
- Nevin, J. A. (1992). An integrative model for the study of behavioral momentum. *JEAB*, 57(3): 301-316. DOI:10.1901/jeab.1992.57-301.
- Nevin, J A and Grace, R C (2000). Behavioral momentum and the law of effect. *Behav. Brain Sci.*, 23(1): 73-130. DOI:10.1017/S0140525X00002405.
- Nicolopoulou-Stamati, P; Maipas, S; Kotampasi, C; Stamatis, P and Hens, L (2016). Chemical pesticides and human health: The urgent need for a new concept in agriculture. *Front. Public Health*, 4(7): 1-8. DOI:10.3389/fpubh.2016.00148.
- Nnamonu, L A and Onekutu, A (2015). Green pesticides in Nigeria: An overview. *J. Biol.*, 5(9): 48-63.
- Oreg, S (2006). Personality, context, and resistance to organizational change. *Eur. J. Work Org. Psychol.*, 15(1): 73-101. DOI:10.1080/13594320500451247.
- Özdemir-Güngör, D and Camgöz-Akdağ, H (2018). Examining the effects of technology anxiety and resistance to change on the acceptance of breast tumor registry system: Evidence from Turkey. *Technol. Soc.*, 54(1): 66-73. DOI: 10.1016/j.techsoc.2018.03.006.
- Paul, J; Modi, A and Patel, J (2016). Predicting green product consumption using theory of planned behavior and reasoned action. *J. Retail. Consum. Serv.*, 29: 123-134. DOI: 10.1016/j.jretconser.2015.11.006.
- Pavela, R and Benelli, G (2016). Essential oils as ecofriendly biopesticides? Challenges and constraints. *Trends Plant Sci.*, 21(12): 1000-1007.
- Rajmohan, K S; Chandrasekaran, R and Varjani, S (2020). A review on occurrence of pesticides in environment and current technologies for their remediation and management. *Indian J. Microbiol.*, 60(2): 125-138. DOI:10.1007/s12088-019-00841-x.
- Ramayah, T; Lee, J W C and Mohamad, O (2010). Green product purchase intention: Some insights from a developing country. *Resour. Conserv. Recycl.*, 54(12): 1419-1427. DOI: 10.1016/j.resconrec.2010.06.007.
- Ramle, M; Wahid, M B; Norman, K; Glare, T R and Jackson, T A (2005). The incidence and use of *Oryctes* virus for control of rhinoceros beetle in oil palm plantations in Malaysia. *J. Invertebr. Pathol.*, 89(1): 85-90. DOI: 10.1016/j.jip.2005.02.009.
- Salazar, H A; Oerlemans, L and Van Stroe-Biezen, S (2013). Social influence on sustainable consumption: Evidence from a behavioural experiment. *Int. J. Consum. Stud.*, 37(2): 172-180. DOI:10.1111/j.1470-6431.2012.01110.x.

- Sapbamrer, R and Thammachai, A (2020). Factors affecting use of personal protective equipment and pesticide safety practices: A systematic review. *Environ. Res.*, 185(January). DOI: 10.1016/j.envres.2020.109444.
- Schreinemachers, P; Chen, H Pu, Nguyen, T T L; Buntong, B; Bouapao, L; Gautam, S; Le, N T; Pinn, T; Vilaysone, P and Srinivasan, R (2017). Too much to handle? Pesticide dependence of smallholder vegetable farmers in Southeast Asia. *Sci. Total Environ.*, 593-594: 470-477. DOI: 10.1016/j.scitotenv.2017.03.181
- Sharma, M and Chatterjee, S (2021). Cognitive functioning: An underlying mechanism of age and gender differences in self-assessed risk tolerance among an aging population. *Sustainability*, 13(4): 1-9. DOI:10.3390/su13042361.
- Sharma, M M; Haider, S Z; Andola, H and Purohit, V K. (2011). Essential oils as green pesticides for sustainable agriculture. *Res. J. Pharm. Bio. Chem. Sci.*, 2: 100-106.
- Sinha, B. (2012). Global biopesticide research trends: A bibliometric assessment. *Indian J. Agric. Sci.*, 82(2): 95-101.
- Singh, R and Singh, M (2016). Botanicals: The green pesticides. *Recent Trends in PGPR Research for Sustainable Crop Productivity* (Sayyed, R Z; Reddy, M S and Al-Turki, A I eds.). Scientific Publisher, India. p: 137-148. DOI:10.13140/RG.2.1.2863.7047
- Singh, H and Kumaran, S (2016). Malaysian Palm Oil Certification Council's role in the implementation of the MSPO certification scheme. Paper presented at the European Palm Oil Conference. Warsaw, Poland. 5-6 October 2016.
- Singh, N and Gupta, K (2013). Environmental attitude and ecological behaviour of Indian consumers. *Soc. Responsib. J.*, 9(1): 4-18. DOI:10.1108/17471111311307787.
- Smith, H H; Idris, O A and Maboeta, M S (2021). Global trends of green pesticide research from 1994 to 2019: A bibliometric analysis. *J. Toxicol.*, 2021. DOI:10.1155/2021/6637516.
- Snyder, H (2019). Literature review as a research methodology: An overview and guidelines. *J. Bus. Res.* 104 (2019): 333-339.
- Standard MSPO Part 2 (Encrypted).pdf. (2013). SIRIM Berhad.
- Standard MSPO Part 3 (Encrypted).pdf. (2013). SIRIM Berhad.
- Stenberg, J A (2017). A conceptual framework for integrated pest management. *Trends Plant Sci.*, 22(9): 759769. DOI: 10.1016/j.tplants.2017.06.010.
- Sulaiman, S K Bin, Ibrahim, Y and Jeffree, M S (2019). Evaluating the perception of farmers towards pesticides and the health effect of pesticides: A cross-sectional study in the oil palm plantations of Papar, Malaysia. *Interdiscip. Toxicol.*, 12(1): 15-25. DOI: /10.2478/intox-2019-0003.
- Sundaraja, C S; Hine, D W and Lykins, A (2020). Confronting the palm oil crisis: Identifying behaviours for targeted interventions. *Environ. Sci. Policy*, 103(3): 99-106. DOI: 10.1016/j.envsci.2019.08.004.
- Terano, R; Mohamed, Z; Shamsudin, M N and Latif, I A (2015). Farmers sustainability index: The case of paddy farmers in state of Kelantan, Malaysia. *J. Int. Soc. Southeast Asian Agric. Sci.*, 21(1): 55-67.
- Trujillo-Barrera, A; Pennings, J M E and Hofenk, D (2016). Understanding producers' motives for adopting sustainable practices: The role of expected rewards, risk perception and risk tolerance. *Eur. Rev. Agric. Econ.*, 43(3): 359-382. DOI:10.1093/erae/jbv038.
- Turan, A. and Karaosmanoğlu, H (2019). Effect of drying methods on long term storage of hazelnut. *Food Sci. Technol.*, 39: 406-412.
- Van Dijk, W F A; Lokhorst, A M; Berendse, F and de Snoo, G R (2016). Factors underlying farmers' intentions to perform unsubsidised agri-environmental measures. *Land Use Policy*, 59: 207-216. <https://doi.org/10.1016/j.landusepol.2016.09.003>.
- Walia, S; Saha, S; Tripathi, Vand Sharma, K K (2017). Phytochemical biopesticides: Some recent developments. *Phytochem. Rev.*, 16(5): 989-1007. DOI:10.1007/s11101-017-9512-6.
- Wang, J; Chu, M; Deng, Y; Yuan, L H and Tang, J (2018). Determinants of pesticide application: An empirical analysis with theory of planned behaviour. *China Agric. Econ. Rev.*, 10(4): 608-625. DOI:10.1108/CAER-02-2017-0030.
- Wang, P; Liu, Q and Qi, Y (2014). Factors influencing sustainable consumption behaviors: A survey of the rural residents in China. *J. Cleaner Prod.*, 63:152-165. DOI: 10.1016/j.jclepro.2013.05.007.
- Weisstein, F L; Asgari, M and Siew, S W (2014). Price presentation effects on green purchase

intentions. *J. Product Brand Manag.*, 23(3): 230-239. DOI:10.1108/JPBM-06-2013-0324.

Xu, R; Wu, Y and Luan, J (2020). Consumer-perceived risks of genetically modified food in China. *Appetite*, 147(2): 104520. DOI: 10.1016/j.appet.2019.104520.

Ye, M; Beach, J; Martin, J W and Senthilselvan, A (2013). Occupational pesticide exposures

and respiratory health. *Int. J. Environ. Res. Public Health*, 10(12): 6442-6471. DOI:10.3390/ijerph10126442.

Zaidon, S Z, Ho, Y B, Hashim, Z, Saari, N and Praveena, S M (2018). Pesticides contamination and analytical methods of determination in environmental matrices in Malaysia and their potential human health effects–A review. *Malays. J. Med. Health Sci.*, 14: 81-88.

ARTICLE IN PRESS