ATTITUDE OF SMALL-SCALE FARMERS TOWARDS THE USE OF DIGITAL APPLICATIONS FOR PARTICIPATORY MONITORING

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Abstract

Digital applications for participatory monitoring in management are increasingly used for knowledge sharing and collective actions in agriculture. Therefore, this study aims to assess the attitude of small-scale farmers towards the use of digital applications for participatory monitoring. The theory of planned behavior has been utilized as theoretical framework. A qualitative case study research of the project of System of Rice Intensification Farmer Field School in West Malaysia was carried out. The research was conducted in relation to the digital applications of WhatsApp, Google Forms and online interview. In this study, the sampling was purposive and included small-scale farmers and farmer trainers in three locations. After the collection of data from October 2020 to March 2021, the interviews and the project's milestone reports were analyzed through thematic and content analyses. The findings showed that the indicators of commitment, trust, resources, time and recognition have positive influence towards the use of digital applications for participatory monitoring. The study concluded that these indicators must be included in the design of digital applications protocols, particularly the integration of traditional practices and cultural values were found determinants for the small-scale farmers and farmer trainers attitude towards the use of digital applications for participatory monitoring. This study recommends further research on the relationship of small-scale farmers place attachment and participatory monitoring.

Keywords: Attitude, Monitoring, Digital applications, Small-scale farmers

Introduction

Recently, the growing use of information and communication technology (ICT) based platforms in agriculture created the space for the emergence of decentralized monitoring systems (Munthali et al., 2018) that encouraged the problem-solving of

arising issues within the local farming communities in a timely manner (Cieslik et al., 2018). As small-scale farmers "live in close communities with strong social bonds in villages scattered throughout remote areas" (Landmann et al., 2020, 1446), it is relevant to study small-scale farmers' attitude to use digital applications (DAs) for participatory monitoring (PM) of agricultural practices.

Farmers' attitude towards the participation (Dias et al., 2020) and use of ICT-based tools (Ali et al., 2020; Bucci et al., 2019; Luqman et al., 2019; Nwafor et al., 2020) has recently gained attention. In fact, the opportunities for ICT-based platforms like social media in agriculture had been largely assessed (Aguilar-Gallegos et al., 2021; Barau & Afrad, 2017; Kanjina, 2021; Klerkx, 2021; Larochelle et al., 2017; Mills et al., 2020; Ofori & El, 2020; Phillips et al., 2018; Thakur & Chander, 2018; World Bank, 2017). Social media such as Twitter, Facebook and WhatsApp have been evaluated as DAs for long term engagement in farmer-to-farmer distance learning (Mills et al., 2019; Phillips et al., 2018; Thakur & Chander, 2018). Indeed, an ICT-based initiative is effective if it influences the learning among farmers (Karubanga et al., 2017). In this regard, the understanding of farmers' attitude towards the use of DAs resulted as having a positive relationships with the effectiveness of ICTs (Hasan et al., 2019). However, fewer studies had focused on the factors that influence the specific community of small-scale farmers (SSFs) (Awan et al., 2019; Beza et al., 2018; Moonsammy et al., 2020; Ofori & El, 2020).

This study draws from the farmer decision-making literature that has encouraged further attention towards internal decision-making processes (Landmann et al., 2020; Meijer et al., 2015; Natalia et al., 2021). In this sense, this study aims to understand the intrinsic factor of attitude of SSFs towards the use of DAs for PM.

Participatory Monitoring among Small-scale Farmers

The mobile phones are the newest technologies for ICT in agriculture (World Bank, 2017). The assessment of their use by small-scale farmers revealed that the use is related to the fact that they are affordable (World Bank, 2017) and easy to use (Beza et al., 2018), if simplified protocols are applied (Bimonte et al., 2021). Moreover, they allow for real time information exchange (Moonsammy et al., 2020). Indeed, ICT-based applications have demonstrated to be a good tool for monitoring agricultural practices (Zipper, 2018) by facilitating two-way information dissemination (Steinke et al., 2020) and strengthening relationships through encouraging participatory linkages (Morrone, 2017).

Participatory monitoring (PM) originally developed from different participatory research traditions (to emphasise on the importance of locally significant methods for collecting, analysing and using information (Abbot & Guijt, 1998). The PM includes the major stakeholders to actively participate in the monitoring process that eventually promotes corrective actions to address local conditions. PM is grounded in five broad principles: participation, learning, negotiation, flexibility and diversityBased on these principles, the participation of the most affected by a program is expected to contribute with on-going capacity building that leads to learning and improvement at the local level. The complex structure that involving all the major stakeholders may result in does not affect the principle of negotiation where all voices are heard (Rossman, 2015). Lastly, the PM is flexible in adapting to circumstances as they arise, and methodologically eclectic in providing a wide range of methods to generate information.

As key factor for the participation in monitoring is the perception and knowledge of the impacts of on the farmers' livelihood. A study on farmers' intention towards climate change showed that although farmers perceived that climate change was happening, they still maintained negative attitudes towards the adoption of climate change adaptation techniques (Zamasiya et al., 2017). Therefore, the promotion of knowledge is a fundamental step to explain farmers' attitude (Bagheri et al., 2019).

This study will consider the SSFs' basic knowledge of PM in the assessment of the use of DAs for PM.

Farmers' Attitude in Digital Applications

The intrinsic factor of attitude has been mainly studied in relation to the decision-making theory of Theory of Planned Behaviour (TPB). The TPB has been increasingly applied to understand people's behavioral intentions and the actual behavioral control in environmental-related activities (Borges & Lansink, 2016; Dawson et al., 2016; Fielding et al., 2008; Maleksaeidi & Keshavarz, 2019). According to the TPB, the human behavior is predicted and explained through the interplay of extrinsic and intrinsic factors, with the former shaping the latter.

Studies that focused on the external decision-making processes (extrinsic factors) showed that the farmers' personal characteristics, such as age and education (Aldosari et al., 2017; Kabir, 2015; Moonsammy et al., 2020); socioeconomic characteristics, such as farm size (Kassem et al., 2020) and access to infrastructure (Aldosari et al., 2017); and familiarity with technology (Mwalupaso et al., 2019; Rahman et al., 2019) are determinants for farmers' knowledge and attitude towards the use of ICT-based tools. However, a comprehensive study including intrinsic factors leads to a better understanding of what influences farmers' decision-making processes (Meijer et al., 2015).

The intrinsic factor of attitude has been originally formulated in three constructs: attitude towards behaviour (ATB), subjective norms (SN), and perceived behavioural control (PBC) (Ajzen, 1991). Firstly, the ATB refers to the advantages or disadvantages of the perceived outcome of the individual towards the technology (Meijer et al., 2015). The ATB has been found related with farmers' knowledge of the action (Bagheri et al., 2019), the higher the knowledge and the better the predictions towards the farmers' intentions. Secondly, the SN involves the social pressure over the performance of such behaviour. A negative opinion from others was found to affect farmers' attitude towards the action (Bagheri et al., 2019), although the two constructs are theoretically independent, but often are formed simultaneously (Natalia et al., 2021). A study on farmers' intention towards the adoption of integrated pest management (IPM) found that the interiorization of the social pressure, known as personal norm, was the most important determinant of farmers' attitude (Rezaei et al., 2019). Lastly, the PBC refers to the perceived capacity to perform the behaviour. Daxini et al. (2019) found that the perceived ease or difficulty was the primary drive in farmers' attitude towards the use of nutritional management plan. A recent study on the cognitive drivers that affect farmers' adoption of smartphones for agricultural purposes was conducted with particular focus on small-scale farmers in developing countries and concluded that "the respondents are not used to modern ICT yet and live in close communities with strong social bonds in villages scattered throughout remote areas" (Landmann et al., 2020, 1446). The understanding of small-scale farmers' internal decision-making process may contribute to the farmer decision-making literature that has widely assessed that the three constructs of ATB, SN and PBC have positive impacts on farmers' intentions (Savari & Gharechaee, 2020).

Materials and Methods

Case Study

A Farmer Field School (FFS) program applying the agrobiodiversity-based System of Rice Intensification (SRI) rice farming method was selected as case study. The SRI-FFS program was conducted in three locations in West Malaysia: Sri Lovely farm at Kampung Lintang in Sik, State of Kedah (SRI-FFS1); SRI Learning Center at Sawah Sempadan, State of Selangor (SRI-FFS2); and Seligi at Kampung Seligi, State of Kelantan (SRI-FFS3). The SRI-FFS program was implemented under the project *"Upscaling Agrobiodiversity-Based Rice Farming Systems through the System of Rice*

Intensification (SRI) in Malaysia" conducted by the Malaysian Agroecology Society for Sustainable Resource Intensification (SRI-Mas) through the United Nations Development Programme (UNDP) Small Grant Programme funded by the Global Environment Facility (GEF). The SRI-FFS program aimed to promote agrobiodiversity-based rice farming among Malaysian rice farming communities adopting participatory-based approaches to enhance farmers' decision making.

Farmers were encouraged to learn from each other and transfer their knowledge to other farmers after graduating from the first phase of Training of Trainers (ToT). At the graduation, the roles assigned were of junior and master trainers based on the length of experience in agrobiodiversity-based rice farming. The ToT participants were 14, among which six (6) graduated as junior trainers and four (4) as master trainers. In addition, the participatory-approach was addressed by involving the major stakeholders among local authorities throughout the program. Activities like stakeholder introductory meetings and round table dialogues were organized to capture local capacity needs, build working framework, and delivery outputs and outcomes on monitoring baselines.

The SRI-FFS ToT program covered a period of two (2) months from October to November 2018, and included the follow up over graduates' application of the knowledge acquired in their own communities over the next rice season. Over the course of the SRI-FFS ToT program, ICT-based platforms were employed for continuous engagement and participatory monitoring. The ICT-based platforms included WhatsApp and Google Forms.

Data Collection and Analysis

This study adopted a qualitative case study approach. The data for this study were primarily obtained from interviews and SRI-FFS project milestone reports. The interviews involved farmers and trainers graduated from the SRI-FFS ToT program and were selected through purposive sampling. A total number of eleven (11) respondents was selected for the interviews. A number of nine (9) small-scale farmers (SSFs) and farmer trainers (FTs) were selected based on (a) their completion of the ToT and (b) the conduction of at least one Training of Trainers course. Other two (2) key informants (KIs) were chosen in relation to (a) their involvement in the stakeholder introductory meeting and (b) participation in round table dialogues. The interview questions were semi-structured and designed to focus on the understanding of the factors that influenced farmers and trainers' attitudes towards the use of DAs for monitoring agrobiodiversity-based rice farming. The interview protocol and questions were validated by two (2) experts from the research field and two (2) experts from the research design. The interviews were conducted face-to-face and through phone calls from October 2020 to March 2021. The interviews were eventually transcribed and analysed through the inductive method of thematic analysis. Lastly, materials and data from secondary sources were sought to validate the findings from the interviews. Particularly, the study included the SRI-FFS project's Midterm Review Reports and the Project Final Report.

Findings

The findings revealed five (5) indicators connected to the intrinsic factor of attitude, namely commitment, trust, resources, time and recognition. These indicators are presented individually and eventually summarized in Table 1.

Attitude towards the Use of Digital Monitoring

The attitude of small-scale farmers towards the use of digital applications had a positive relationship with the indicators of commitment, trust, resources, time and recognition.

Commitment

The SSFs and FTs showed an interest for monitoring outputs that are tangible and functional to use in the daily farming activities. The commitment towards monitoring had a positive relationship with the impact that the monitoring indicators may have on the SSFs' livelihood.

The soil degradation, the monoculture practices that increase the risk of pest and disease outbreak, the use of harmful chemicals and the resulting danger to human health were meaningful issues for all SSFs and FTs. The "concerns for the rampant use of chemicals" (FT3) and the sense of togetherness (SFF4, FT1) united the participants in the efforts to monitor and apply agrobiodiversity-based farming practices. Thus, the connection over the same "place", intended as geographical linkage with the land and traditional bonds with no-harmful farming practices, was both professional and personal. There was an emphasis over the nature of the relationships between and among SSFs and FTs. A relationship that "that does not have border" thus is not confined within the training program (FT2) was fostered by mutual understanding and interest over the monitoring outcomes. One of the SSFs explained that if a farmer from a rural village does not have support around him/her, he/she will not pursue the application of new practices (SSF5). The commitment weakens as the sense of collectivity derived from the SRI-FFS experiential, group learning experience vanishes. It was highlighted the idea that if FTs "stay strong, [the SSFs] also are strong (…) and will follow" (SSF1) because the SSFs feel that they are "in it together" (SSF4).

It seemed that the prevalent concern for the growing use of agricultural chemical-based inputs and the connection over the same "place" created a sense of belonging and community that strengthened the commitment towards monitoring through DAs.

Trust

The indicator of trust appeared to build upon pre-existing relationships among the participants. The selection of SSFs was based on their previous experience in SRI and agrobiodiversity-based farming practices, thus on the likeliness that SSFs will continue to manage and replicate the training learnings. On the other hand, the selection of FTs considered their belonging to the farming community within which they already have the respect of their peers and know the local conditions and needs. The fact that the FTs were located at each SRI-FFS contributed to a longer-term engagement and developed a sense of reliability (FT3). The reliability was particularly expressed by the physical presence of FTs at each SRI-FFS activity during which they *turun sawah* (literally, go down the paddy fields) with the SSFs. The practice of *turun sawah* all together is embedded in the local cultural practice of *gotong royong* (literally, mutual-cooperation). Traditionally, Malaysian farmers stepped down (*turun sawah*) the paddy fields to perform the farming activities as a group. This indigenous concept of community helping of one another deeply characterized the society's cultural values. In this case study, the participation to the activity of *turun sawah* seemed to foster the trust between SSFs and FTs. In this regard, the short appearances of the local authorities during the SRI-FFS field activities were signs of disinterest and disengagement (FT2, FT3). On the same note, both FT1 and SSF3 expressed their preference for conducting in-person monitoring through field visits. They did not exclude the use of DAs per se, but commented on the greater advantages that in-person monitoring brings to the relationship between SSFs and FTs. This finding suggests that a limitation in the use of DA may be the absence of performing local traditional practices that strengthen in-person relationships and trust among participants.In conclusion, the pre-existing relationships within and among farmer groups fostered the initial trust that determined a long-term bond between SSFs and FTs. However, in-person monitoring visits may still be needed to complement the efforts of monitoring through DAs as it may include local traditional practices and cultural values.

Resources

The resources were intended as human resources and material resources. The human resources included the competency and knowledge to conduct the monitoring through DAs. The competency was determined by the access or ownership of mobile phone types or ICT infrastructure availability. The findings suggested that SSFs and FTs possessed a smartphone and were able to participate to the monitoring through DAs. On the other hand, the knowledge regarding monitoring though DAs appeared to be limited. During the review of the interview protocol and questions, the field experts suggested a number of different options to translate "participatory monitoring" in the local language (Malay) in absence of a shared terminology. In support of this finding, some of the participants (SSF1, SSF5, FT3, KI1) requested further clarification on the meaning of PM. As a consequence, the SSFs, FTs and KIs' interviews focused on the description of data collection through DAs, and did not comment on the process of analysis and use of data. Indeed, the monitoring through DAs in this case study appeared to be jointly-led: the SSFs and FTs collected and shared data through DAs, and the SRI-FFS program implementers analysed them and occasionally sharing them back. It is to be noticed that the process of data collections through DAs seemed suitable for farmers with limited formal education (FT1). The DAs provided a range of methods to generate information that included visual and audial options. Regarding the material resources, there was no particular mention of material incentives. With the exception of the SSF1 who stated that could have done more with an allowance, financial allowance was used in one occasion by FT2 to reward monitoring efforts in one of activities carried out at the SRI-FFS3.

In conclusion, the SSFs and FTs were competent in the use of DAs that additionally provided different methods to generate data thus facilitating the participation of those with limited formal education. Nevertheless, the indicator of human resources showed some limitations in the basic knowledge of monitoring through DAs by SSFs. This limitation seemed to affect the perceived use of DAs that resulted limited to the data collection. However, a jointly-led approach was used to address this limitation and complement the monitoring progress.

Time

The SSFs and FTs explicitly mentioned the benefit of direct interactions and timely feedback in the use of DAs (SSF1, SSF4). The opportunity to gather and process the data collectively and extemporaneously was relevant to the participants as it facilitated a timely analysis and prompt use of the information. The DAs favoured the field level sharing over SRI techniques, biodiversity (plant diversity, aquatic animals, insects, water management, soil health), and organic inputs (azolla, fish amino acid, manure, biochar, wood vinegar, etc.) that helped the prompt adoption of the agrobiodiversity-based farming practices. The convenience of using social media for direct communication and exchange of information well adapted to the notoriously constant engagement of SSFs in their fields. In this sense, the SSF1 expressed the benefit of using DAS at any convenient time. However, the project final report stated that monitoring season-long farming activities appeared to be challenging, and there was a need for constant reminders and follow-ups (Isahak et al., 2021). It seemed that on one side, the use of DAS facilitated a more farmer-led process in which SSFs and FTs took initiatives and ownership of the information exchanged; on the other side, it was not sufficiently organized to suit the working framework. Additionally, it was pointed out

that the use of DAs facilitated the inclusion of new farmers who were initially not participating in the SRI-FFS program (SSF3). Because the process was primarily farmer-led, it also well adapted to the frequency of rice farming activities that change according to the rice growth stage and seasons. In fact, the use of DAS appeared to establish an adaptive process that stayed relevant to the participants over time by adapting to circumstances and demands as they arise.

In conclusion, the indicator of time influenced the use of DAs that were found timely appropriate and useful. The DAs was also found flexible in adapting to arising changes like the addition of new members and the dynamics of the rice farming activities.

Recognition

The FTs witnessed a process of interiorization that graduate SSFs experienced in practicing their roles as junior trainers. The virtual relationship that emerged from the interactions through digital applications seemed to not impact on the closeness that developed among SSFs and FTs, instead it gave space for SSFs to interiorize their new role and be recognized by other members of the SRI-FFS program (FT3). The interiorization contributed to an increase in confidence and the recognition of peers within their own network. As the FT3 stated, “the more they engage in such (…) activities, the more confident they become, you know, of acting as leaders (…) in their villages in the future”. However, the findings showed that SSFs also sought the recognition from the larger community. In fact, it appeared that some of the SSFs and FTs expected a more remarked acknowledgment from the local authorities. The FTs described the participation of these stakeholders at any stage of the training program as limited to mere appearances. However, the local authorities were regularly informed by the FTs and project implementers about monitoring results as there is a strong interest from local authorities to identify local farmers that could perform as “role models” (KI1) and teach other farmers.

In conclusion, the indicator of recognition emerged from the observations of an ‘internal recognition’ that SSFs experienced in interiorizing their role of junior trainers within their own community; and from the accounts of SSFs and FTs that a more ‘external recognition’ from the larger community was expected in support of the local SSFs’ efforts towards the adoption of agrobiodiversity-based rice farming practices.

Table 1: Intrinsic factor of attitude

Attitude Indicators Towards the Use of Digital Applications for Monitoring		
Attitude	Commitment	- Relationships beyond the training program - Place social bonding in local groups that are technically and emotionally connected to that land and the traditional practices
	Trust	-Pre-existing groups -FTs’ knowledge of local conditions and needs -Local cultural practice of *turun sawah*
	Resources	-Human resources, competency: access to ICT-based tools -Human resources, knowledge: jointly-led monitoring -Material resources: moderate determinants

	Time	-Timely feedback and prompt use of data -Flexibility to circumstances (farmer-led) -Diverse methods to generate information
	Recognition	-Space for interiorization within own community (internal recognition) - Space for recognition from the larger community (external recognition)

Discussion

The main aim of this study was to understand the intrinsic factor of attitude of small-scale farmers towards the use of DAs for monitoring agrobiodiversity-based rice farming. Using the case study of SRI-FFS program in West Malaysia, this study identified five (5) indicators. The findings suggested that the indicators of commitment, trust, resources, time and recognition mainly influenced the attitude of SSFs and FTs towards the use of DAs for PM.

The ecological damage and socio-economic vulnerabilities that conventional farming practices caused in the recent past are prevalent concerns among SSFs and FTs currently adopting agrobiodiversity-based farming techniques. The strong connection of SSFs and FTs with traditional practices and cultural values were found determinants in the attitude towards the use of DAs for monitoring. On one hand, the collective concern and connection over the land created a sense of belonging and community that fostered commitment. The local agrobiodiversity-based rice farming system draws from traditional agricultural practices that build upon indigenous knowledge and culture. The emotional bond between SSFs and FTs and the land strengthens the commitment and affects their attitudes towards the use of DAs for monitoring. This is in line with studies on the place attachment of farmers that revealed that the attachment is multi-dimensional, and that the farmers' knowledge of the land can be technical and emotional (Cheshire et al., 2013). The common motivation and interests towards the farmer-to-farmer exchange is important in virtual communities (Lee & Suzuki, 2020) and may affect farmers' participation more than the prospect of being recompensed (Dias et al., 2020). On the other hand, the local cultural values were found connected with the indicator of trust. In the context of ICT-based applications, the factor of trust was related to the source of information (Misaki et al., 2018), either technical sources of information (Beza et al., 2018; Verbrugge et al., 2016) or social information sources (Daxini et al., 2019) and in the economic relationships (Duncombe, 2015). Moreover, in many of these cases it was still dependent on face-to-face interactions (Munthali et al., 2018). This study further highlighted the determinant of the limited integration of local cultural practices in building trust. The familiar social contexts of collective field activities (*gotong royong*) and the cultural values embedded in this context (*turun sawah*) were found determinants to building trust within and among SSFs and FTs. The factor of harmony between language and cultural contexts and the importance of mutual collaboration (Misaki et al., 2018; Subashini & Fernando, 2018) were found to affect the attitude towards the use of DAs. Furthermore, the importance of local knowledge encouraged the selection of local FTs to carry out SRI-FFS experimental plots in their own communities. This finding was related to the indicator of material resources, as the existence of local FTs eliminated the need for external extension agents or facilitators thus reduced the costs. Alongside, the use of lower-cost tools like DAs further reduced the financial burden that monitoring farmer training programs usually bring (Quizon et al., 2001; Waddington et al., 2014). Rather than incentives, it emerged that the indicator of recognition would influence the use of DAS for monitoring. Besides the material resources, the element of human resources that challenged the attitude

towards DAs was the knowledge. The limited understanding of the monitoring process itself influenced the attitude towards the use of DAs. SSFs and FTs' perceptions of the monitoring influenced their perceived use for data collection. The SSFs, FTS and project implementers seemed to conduct the monitoring using a jointly-led approach in which competences were distributed based on time availability and capacity. SSFs and FTs collected and shared data, while implementers and researchers elaborated the results. The jointly-led monitoring addressed the limited basic knowledge of SSFs and FTs. Additionally, the diversity of methods to generate information that DAs provided the SSFs was found having a positive influence over the attitude towards its use. In light of the monitoring principle of PM as a methodologically eclectic approach[1] (Rossman, 2015), the DAs provided the possibility to generate data through not only textual, but also visual and audial formats. This facilitated the participation of those SSFs with limited formal education and encouraged the inclusiveness of the SSFs most directly affected by the SRI-FFS monitoring program. Lastly, considering the monitoring principle of flexibility (Rossman, 2015), the DAs provided timely interactions that encouraged prompt interventions in the farming practices in the fields. The use of DAs appeared to be adapting to new circumstances thus maintain their efficiency over time.

Conclusion

The conclusion from this study is that the intrinsic factor of attitude influences the use of digital applications for monitoring agrobiodiversity-based rice farming. The indicators of commitment, trust, resources, time and recognition had a positive relationship with the attitude of small-scale farmers towards the use of digital applications for monitoring. Particularly, the bonding over the land and connection over traditional practices and cultural values are key elements that influence the small-scale farmers and farmer trainers' attitude towards the use of DAs. The integration of these element may complement the efforts to use DAs for monitoring local farming practices by strengthening commitment and trust. The monitoring principles of diversity and flexibility are reflected in the use of DAs and facilitated the participation of the SSFs most affected by the SRI-FFS program.

This study has important practical implications for the selection of appropriate protocols for the use of digital applications in the case of small-scale farmers' monitoring, in line with previous suggestions that simplified protocols and indicators that are more accessible to farmers (Bimonte et al., 2021). Furthermore, theoretical implications can be drawn from the small-scale farmer decision-making literature in the study of place attachment and social bonding as factors that influence the attitude towards the use of digital applications for monitoring agrobiodiversity-based rice farming practices. In this regard, it can be suggested that further research is conducted on the relationship between place attachment and participation in PM to enhance the understanding of attitudes and behaviours of SSFs and FTs.

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