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Comparison of Smart Agriculture Literacy of Farmers in Thailand

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Abstract—Smart agriculture is a concept of management of modern farming using smart/digital techniques to monitor, to optimize, and to control processes of agricultural production. To manage farm presently, the literacy in smart agricultural technologies is significant so that farmers need to improve themselves to adopt smart technologies for farming. However, each farmer has the difference skills and experience into adoption of smart agriculture technologies. Therefore, the aims of this paper is to survey smart agriculture literacy of farmers' skills and experience, specific in Chiang Mai and Khon Kaen province, Thailand. The questionnaire was constructed based on smart farmer's properties. The results of this paper reveal the comparison of smart agriculture literacy of farmers in Chiang Mai and Khon Kaen province, Thailand, by analyzing the survey results. According to the survey analysis results, farmers in Chiang Mai and Khon Kaen province are totally different of smart agriculture literacy due to their farming experiences, training experiences, age, background, etc.

Keywords—Survey, Smart Farming, Smart Farmers, Smart Agriculture

I. INTRODUCTION

Precision agriculture known as smart farming is a crucial issue in Thailand for the last 5 years because the farming sector is one of the most importance for Thai economy. As the farming is approximately 40% to the country's total land area and 30% of total labor force in Thai economy. However, this sector is significantly low in the term of value and growth compare to other economic sectors. This issue getting more attention to Thai society includes government and private sector, as a results they try to help the farmer to improve a farming technique and develop a new business model for the farmer who want to do a smart farming business. Changing a tradition farming to smart farming is a great challenge, for those farmer, government or any institutions who involve with this business to adapt this new technique to Thai farmers. To adopt or implement this farming technique our farmers have to has a digital literacy as this is a basic knowledge for smart farming.

This innovative approach of farm business need a great deal of effort, however According to [1] the traditional farming normally there are less connectivity as a result the farmer sometime has a lack of digital literacy. Moreover, a basic knowledge of digital literacy for smart agriculture technique is how to use Information and Communication Technology (ICT) in the agricultural farming which basically include how to use smart devices, the knowledge level of digital literacy and particle training in a new farming technique.

Furthermore, the knowledge of how to operate farming business such as business model and marketing for farming business are also importance. Five main skills requirements for smart agriculture production include technology usage, digital literacy, agricultural standard, marketing skill, and smart agriculture practice [2][3] according to smart farmers' qualification that will be explained in section 2. As describe above, before adopting a smart agriculture technique we have to understand a current situation of our farmers. So, this work we try to evaluate our farmers in Thailand to understand the characteristic of farmers before adopting smart agricultural technique to their farm.

The aim of this work is to survey a current situation and a levels of digital knowledge for Thai farmer and identify a differentiate of smart agriculture literacy of farmers in Chiang Mai and Khon Kaen province, Thailand. The rest of this work is structured as follows: Section 2 the description of our questionnaire which we use in this work. Section 3 analysis and results. Finally, section 4 draws the conclusions.

II. QUESTIONNAIRE

The questionnaire was constructed based on the smart farmers' qualification, as mentioned previously, which is the skills and experience that are necessary for smallholder farmers to be smart farmers. The purposes of this questionnaire are to understand the farming activities of farmers, and their ability and experience. Respondents, which are farmers in Chiang Mai and Khon Kaen province (Thailand), need to answer all questions relevant to themselves, farm area, their actual farming activities and their behaviors during farming practices. Furthermore, the researcher also report that technology device become import material for mobile learning that suitable for adult learner like smart farmer. Therefore, understanding the pattern of technology usage will encourage the designer to provide the appropriate devices to smart farmer. These information helps to understand and defines the knowledge level of farmers in each aspect comprising seven parts of the questionnaire [5][13-22]:

A. Part 1: General information

The purpose of this part is to understand the basic information relevant to farmers. The questions in this part include name, country, age, gender, qualification, subsidies(s) received, family income per year, source(s) of family income, professional background. Based on the question in this part, farmers' general background and farming experiences will be elucidated.

B. Part 2: Farm Description

The purpose of this part is to understand the details of farm area and farming activity of farmers. The questions in this part include topography of their farm area, their total area (they are owner or rent that area for farming), agriculture produce, nature and technique used of farming, and experience to be learning and demonstration site.

Based on questions in this part, the topography of each farm area will be elucidated including advantages and limitations of each farm area. Additional, the nature and technique used for their farming practice will be interpreted including farmers' skills and limitations. Furthermore, we will know their training skills that farmers, who have training skills, can be the trainer.

C. Part 3: Technology Usage

Technology usage is the skills and experiences of using smart devices in daily life of farmers like smartphone. Due to the smart agriculture technology, it is essential to be useable the smart devices for farming practices [2][4].

The purpose of this part is to understand farmers' experience of using technology. The questions in this part include three main aspects comprising the ICT device(s) farmers used and the reason of usage, experiences of using smart farming technique, and method to get any information relevant to agriculture production. Based on the question in this part, most type of ICT device(s) usage and the purposes of using including their experience relevant to smart farming will be elucidated.

D. Part 4: Digital Literacy

The digital literacy is a technical support combination together with cognitive, social skills, and emotional. Digital literacy refers to the use of technology to assist users and provides significant roles in users' daily life that is including the interaction of social [5][6].

The purpose of this part is to understand the level of farmers' understanding and ability relevant to information and communication technology. There are five aspects of digital competence as described in Table I. These five aspects of digital competence were developed into a self-assessment grid based on three proficiency levels: basic, intermediate and advanced [5].

TABLE I. THE DEVELOPMENT OF DIGITAL COMPETENCE FRAMWOEK [5]

Aspect	Description
Information processing	Measures users ability to 'identify, locate, retrieve, store, organise and analyse digital information, judging its relevance and purpose'.
Communication	Measures users' potential to 'communicate in digital environments, share resources through online tools, link with others and collaborate through digital tools, interact with and participate in communities and networks, cross-cultural awareness'.
Content-creation	Measures users' talent to 'create and edit new content (from word processing to images and video); integrate and re-elaborate previous knowledge and content; produce creative expressions, media outputs and programming; and deal with and apply intellectual property rights and licenses'.
Safety	Measures learners' skills regarding 'personal protection, data protection, digital identity protection, security measures, safe and sustainable use'.
Problem-solving	Measures users' ability to identify digital needs and resources, make informed decisions as to which are the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital means, their creative use of technologies, solve technical problems, and update one's own and others' competences.

E. Part 5: Farming practice and agricultural standards

Numerous agricultural standards are used for smart agriculture practice to control the quality of their production and yields, such as IFOAM, GAP, Thai organic standard, etc., due to the increasing of food safety demand especially organic food and low chemical residue food products [7-9].

Consequently, the skills and experiences of low chemical residue and organic farming practices are significant to farmers.

The purposes of this part are to understand the level of farmers' knowledge and practices on farming and their understanding of agricultural standards. There are three areas of this part including agriculture norms and/or standards, cultivation practice, and livestock farming practice. Farmers' skills and experience regarding agriculture norms and/or standards, crop cultivation and animal raising practice will be elucidated.

F. Part 6: Marketing Skills

Marketing involves the services of an agricultural product transferring from farm to consumer comprising planning, organizing, directing and handling of agricultural produce to satisfy farmers, middlemen and consumers. Marketing have to encompass the whole range of operations of supply chain for agricultural products, whether proceeded through one involving contract farming or ad hoc sale. [2][3].

The purpose of this part is to understand the methods that farmers used for selling their productivities. In this part, farmers' experience about the method and/or media that they use for selling their products and their business will be elucidated.

G. Part 7: Smart Farming practices/training experience

Smart agriculture practice is an experiences of adoption smart technologies for crops production. The smart technologies adopted have a robust potential for economic performance enhancement of farming production and will encourage to sustainability of agricultural industry since farmers may enhance inputs precision to crops and soils based on specific requirements of farms, and these aspects will be linked to farm management systems [10-12]. This practice relates to skills and experiences of adoption smart technology for farming.

The purpose of this part is to understand farmers' experiences relevant to smart farming practices and/or training. There are two main areas of this part comprising an experiencing of training and trainer, and smart farming understanding. Therefore, farmers' training skills based on their experiences of farming practice and smart farming practices will be elucidated.

III. ANALYSIS METHODOLOGY AND RESULTS

A. Analysis Methodology

Based on questions of the survey, there are both multiple choices and answer the questions in the blank. Therefore, two methods for data collection were constructed.

- Multiple choices: number 0 represents to 'do not select this answer' and number 1 represents to 'select this answer', see Fig.1(a). All data was collected into excel file, see Fig 1(B). After that, The spss tool was used to analyse collected data and calculate into percentage.

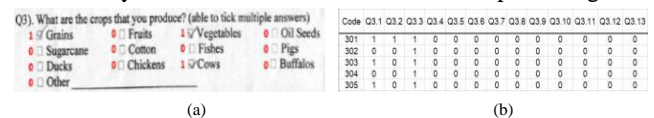


Fig. 1. Data collection for multiple choices

- Answer the questions in the blank: the answer was put as a note of each question (see Figure 2). After that, we will summary all answer of each part to analyse their

answers. Then, data was analyzed to understand knowledge and skills of farm methodology as illustrated in Table II.

Code	Q3.1	Q3.2	Q3.3	Q3.4	Q3.5	Q3.6	Q3.7	Q3.8	Q3.9	Q3.10	Q3.11	Q3.12	Q3.13	Q3.14
309	1	0	1	0	0	0	0	0	0	1	0	0	0	0
310	1	0	0	0	0	0	0	0	0	0	0	1	0	0
311	1	0	1	0	0	0	0	0	0	1	0	0	0	0
312	1	0	1	0	0	0	0	0	0	0	0	1	0	0
313	1	0	1	0	0	0	0	0	0	0	0	0	1	0
314	0	0	0	0	0	0	0	0	0	0	0	0	0	1
315	1	0	1	0	0	0	0	0	0	0	0	0	0	1
316	0	0	0	0	0	0	0	0	0	0	0	0	0	1
317	0	0	0	0	0	0	0	0	0	0	0	0	0	1
318	0	0	0	0	0	0	0	0	0	0	0	0	0	1
319	0	0	0	0	0	0	0	0	0	0	0	0	0	1
320	0	0	0	0	0	0	0	0	0	0	0	0	0	1
321	0	0	0	0	0	0	0	0	0	0	0	0	0	1
322	0	0	0	0	0	0	0	0	0	0	0	0	0	1
323	0	0	0	0	0	0	0	0	0	0	0	0	0	1
324	0	0	0	0	0	0	0	0	0	0	0	0	0	1
325	0	0	0	0	0	0	0	0	0	0	0	0	0	1
326	0	0	0	0	0	0	0	0	0	0	0	0	0	1
327	0	0	0	0	0	0	0	0	0	0	0	0	0	1
328	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Fig. 2. Data collection for answer the questions in the blank

TABLE II. ANALYSIS METHODOLOGY OF QUESTIONNAIRE

Part/Aspect	Criteria	Analysis Method
General information	- The trend of age gender, and qualification of farmers - The main source of farmers' family income and the subsidies for farming - Income per year and farming experiences of farmers	- Plotting a graph to see the most answer in each question
Farm description	- The farm area, type of farm area, and total farm area of farmers - The productivities are produced - The farming techniques of farmers	- Plotting a graph to see the most answer in each question
Technology usage	- The smart devices used by farmers and the purpose of using them in agricultural field - The experience and ability of farmers of using internet - The experience of farmers relevant to using smart farming technologies for farming	- Plotting a graph to see the most answer in each question
Digital literacy	- The level of ICT literacy of farmer in Asian countries - The difference in level of ICT literacy among farmer in Asian countries	- The analysis method from Al Khateeb et al., 2017. was used in this part. - Those five areas of digital competence have been developed into a self-assessment grid according to three proficiency levels: • Choice 1 is a basic level, • Choice 2 is an intermediate level, and • Choice 3 is an advanced level.
Farming practice and Standard	- The farming knowledge/skills relevant to farming used and farming standard of farmers - The farming types used - The plan of farming practice in the future - Knowledge of farming practice relevant to agricultural farming and livestock farming	- Plotting a graph to see the most answer in each question
Marketing skill	- The method of selling - The market/target group of farmers for selling - The business plan	- Plotting a graph to see the most answer in each question
Smart Farming practices/training experience	- Trainer and trainee experience of farmers - The understanding, skills, and experience on smart farm technology - The preference of farmers on training channel	- Plotting a graph to see the most answer in each question

B. Analysis Results

According to the smart farmer's qualification, five aspects will be focused comprising: technology usage, digital literacy, farming practice and standard, marketing skills, and smart farming practice of farmers.

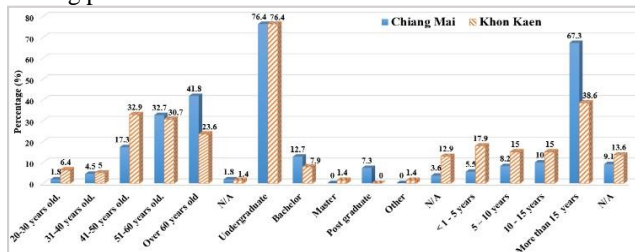


Fig. 3. Comparison of farmers' background

Fig. 3 illustrates the farmers' background that 74.5% (Chiang Mai) and 54.3% (Khon Kaen) of respondents are aging people. Therefore, building young farmers is significant for future farming industry in both provinces. Most of respondents (farmers) in Chiang Mai has farming experience more than five years (67.3%), on the other hand, respondents in Khon Kaen has farmers experience more than fifteen years (52.2%). However, most of respondents (76.4%) in both provinces has the same education level which is undergraduate level (over 70%).

Fig. 4 illustrates comparison of technology usage of farmers in Chiang Mai and Khon Kaen province. Based on the result, smartphone is mostly used with 61.8% and 55% of respondents (Chiang Mai and Khon Kaen respectively). The respondents in Chiang Mai province mostly use it for taking photos (57.3%) and surfing the internet (39.1percent). Some of farmers uses it for agricultural and weather forecast applications (13.6%, 10% respectively). While, respondents in Khon Kaen province use for communication with other people and weather application (57.9%, 38.6% respectively). Based on these result, they can learn new things relevant to smart

technology. And Table III illustrates a comparison of digital

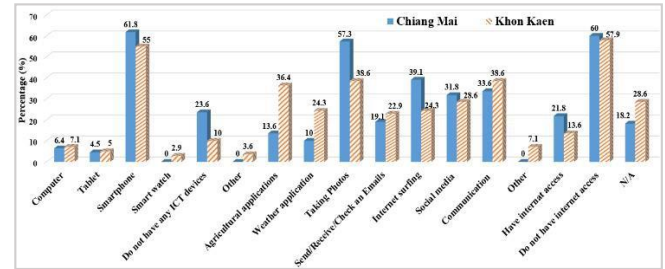


Fig. 4. Comparison of technology usage

TABLE III. COMPARISON OF DIGITAL LITERACY

Aspect	Chiang Mai	Khon Kaen
Information processing	<ul style="list-style-type: none"> Basic level (47.93%) Farmers only look at the content without any interactions Farmers are able to select the content without search ability. 	<ul style="list-style-type: none"> Below Basic level (51.20%) Farmers are unable to use search engine to find information. Farmers are unable to save the content or information found on the internet.
Communication	<ul style="list-style-type: none"> Basic level (39.00%) Farmers can communicate by using LINE, Facebook, WhatsApp. Farmers are able to use basic communication feature in applications. Farmers are able to share content in applications. 	<ul style="list-style-type: none"> Below Basic level (34.95%) Farmers can use a wide range communication tools (e-mail, chat, SMS) Farmers are unable to use basic communication feature in applications. Farmers are unable to share content in applications.
Content-creation	<ul style="list-style-type: none"> Basic level (55.71%) Farmers are able to create simple content. Farmers are able to modify simple functions of software and applications as changing default setting. Farmers do not have any programming skills. 	<ul style="list-style-type: none"> Below Basic level (50.53%) Farmers are able to create simple content. Farmers are unable to modify simple functions of software and applications as changing default setting. Farmers do not have any programming skills.
Safety	<ul style="list-style-type: none"> Below Basic level (30.09%) Farmers are able to manage basic security in devices. Farmers are awareness of personal protection. Farmers do not know how to use security program. 	<ul style="list-style-type: none"> Below Basic level (41.10%) Farmers are unable to manage basic security in devices. Farmers are awareness of personal protection. Farmers do not know how to use security program.
Problem-solving	<ul style="list-style-type: none"> Basic level (49.48%) Farmers are able to solve problem from setting guideline. Farmers are able to follow the instruction manual. Farmers are unable to configure the program. 	<ul style="list-style-type: none"> Below Basic level (47.25%) Farmers are unable to solve problem from setting guideline. Farmers are unable to follow the instruction manual. Farmers are unable to configure the program.

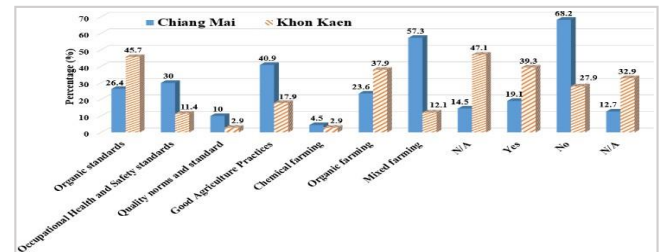


Fig. 5. Comparison of agricultural standard

Fig. 5 illustrates the comparison of respondents' agriculture skills and experience, and agricultural standards. Most of respondents knows some of agricultural standards which are Good Agricultural Practices (GAP) and Organic standards, 67.3% and 63.6% (Chiang Mai and Khon Kaen respectively). However, few of them received an agricultural standard certificate which is 19.1% and 39.3%, Chiang Mai and Khon Kaen respectively. Nevertheless, they require getting agricultural standard certificate to enhance their production and to improve productivity.

Fig. 6 illustrates the comparison of respondents' marketing skills and experience. Respondents in Chiang Mai sell their crops directly to consumers more than respondents in Khon Kaen around 34.5%. Additional, respondents in Chiang Mai sell their crops through cooperative group (29.1%) so that they can get higher income because they do not get under price by middle man. On the other hand, 27.8% of respondents in Khon Kaen sell their products through middle man and cooperative group. However, most of respondents in both provinces not have a web page so that they are unable to expand their consumer base, but they prefer to have their own web page.

Fig. 7 illustrates the comparison of respondents' experience of smart agriculture practice. From the result, over

smart farming technology because of the difficulty and lack of financial support. However, some of them (lower 25%) has an experience of adoption some technologies for monitoring and automatic irrigation control. However, some of respondents in Chiang Mai province (7.3%) do not know how to use data collected. Moreover, over 50% of respondents in both provinces are not adopted any smart technology device(s) in farm due to lack of technology knowledge and financial limitation.

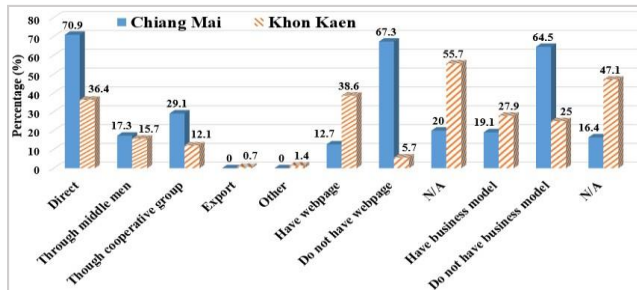


Fig. 6. Comparison of marketing

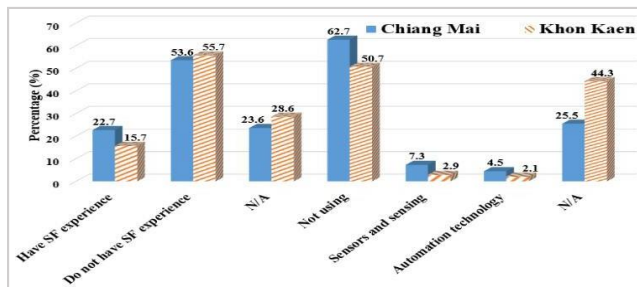


Fig. 7. Comparison of smart farming experience

IV. CONCLUSION AND DISCUSSION

A. Conclusion

This paper reveals the comparison of smart agriculture literacy of farmers in Chiang Mai and Khon Kaen province, Thailand, by using a questionnaire. The questionnaire was created according to smart farmer's properties. In this paper, we focus on the comparison of five aspects comprising technology usage, digital literacy, agricultural standard, marketing skills, and smart farming practice according to the properties of smart farmers. Based on the results, smart agriculture literacy background of farmers in Chiang Mai and Khon Kaen province are totally different due to their farming experiences, training experiences, age, background, etc.

B. Discussion

The results in this paper just display the knowledge and experience of farmers in Chiang Mai and Khon Kaen province in terms of smart agriculture literacy. However, the profiles of farmers are still required. These profile will help to understand and classify the farmer's groups. The farmer's groups will be useable to create an appropriate set of learning content for farmers in the future to enhance farmer's skills to adopt smart agriculture technology for farming. Therefore, our future work is the classification of farmer's groups to categorize their skills and construct an appropriate knowledge content to farmers.

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