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## “The skill priorities and requirements of smart farm”

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## 1. Survey (questions and guideline)

The purposes of the survey is to understand the farmers, their farming activity, and their ability and experience, to define their skills for construction an appropriate learning sets to improve farmer's skills on agricultural production enhancement.

The survey consists of seven parts to understand farmers' behaviours, their cultivation skills, and including their requirements for their future farming practices.

- **Part 1 –**
  - *General information:* 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, and the reason to join this project.
  - Based on the question in this part, we will understand farmer's general information and their background and their experiences relevant to farming.
- **Part 2 –**
  - *Farm description:* 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 the question in this part, we will understand the topography of each farm area that we will know the advantage and limitation of each farm area. Additional, we will know the nature and technique used for their farming practice so that we can understand their skills and limitations. Furthermore, we will know their training skills that farmers who have training skills can be the trainers of this project.
- **Part 3 –**
  - *Technology usage:* 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, we will know most type of ICT device(s) used and the purposes of using including their experience relevant to smart farming technology.
- **Part 4 –**
  - *Digital literacy:* to understand the level of farmers' understanding and ability relevant to information and communication technology. There are five areas of digital competence including Information processing, Communication, Content-creation, Safety, and Problem-solving as described in Table 2.

Table 1:: Framework for the development of digital competence

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 potentiality 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.

These five areas of digital competence have been developed into a self-assessment grid according to three proficiency levels: basic, intermediate and advanced.

- **Part 5 –**

- *Farming practice and agricultural standards:* 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. Agriculture norms and/or standards aspect helps to know farmers' skills and experience regarding agriculture norms and/or standards. Cultivation practice aspect helps to know farmers' skill and experience relevant to crops cultivation including their limitations. Livestock farming practice aspect, helps to know farmers' skill and experience relevant to animal raising including their limitations.

- **Part 6 –**
  - *Marketing skill:* to understand the methods that farmers used for selling their productivities. In this part we will know farmers’ experience about the method and/or media that they use for selling their products including their technique to plan their business.
- **Part 7-**
  - *Smart Farming practices/training experience:* 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. In experiencing of training and trainer aspect, we will know trainer skills of farmers who are used to train other people relevant to farming practices based on their experiences. In smart farming understanding aspect, we will know farmers’ understanding and skills relevant to smart farming practices and technologies.

Respondents, which are farmers, need to answer all questions relevant to themselves, farm area, their actual farming activities and their behaviours during farming practices. This information helps us to understand and define the knowledge level of farmers in each aspects including we can understand their requirements for improving their farm production process.

Analysis Model and results

To analyse the survey results, we need to create the model to make an analysis for each part of the survey. Based on questions of the survey, there are both multiple choices and answer the questions in the blank. Therefore, we need to create two ways for collecting data.

- *Multiple choices:* For the multiple choices, we will assume number 0 to represent ‘do not select this answer’ and number 1 to represent ‘select this answer’, see Figure 2(a). Therefore, we will know which choice is selected in each question. Then we do for all questions and all respondents. These data collection is put in an excel file. After that, we analyse each question in each part that how many respondents select each choice and calculate in percentage, see Figure 2(b).

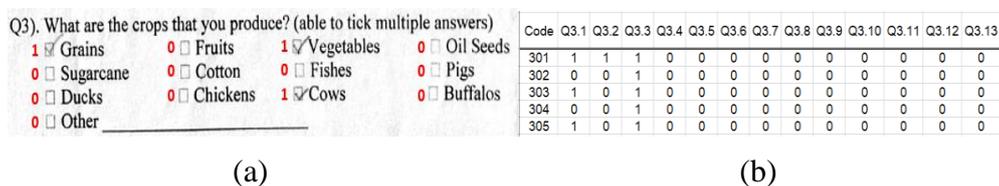


Figure 1: Data collection for multiple choices

- *Answer the questions in the blank:* For this type of answer, we will put the answer as a note of each question (see Figure 3). After that, we will summary all answer of each part to analyse their answers.

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	Q3.13.1
309	1	0	1	0	0	0	0	0	0	0	1	0	0	
310	1	0	0	0	0	0	0	0	0	0	0	1	1	maize
311	1	0	1	0	0	0	0	0	0	0	1	0	0	goats
314	0	1	1	0	0	0	0	0	0	0	0	1	0	
315	1	0	1	0	0	0	0	0	0	0	1	0	1	goats
326	0	0	0	0	0	0	0	0	0	0	0	0	1	paddy
327	0	0	1	1	0	0	1	0	0	1	1	1	0	
328	0	0	0	0	0	0	0	0	0	1	0	0	0	

Figure 2: Data collection for answer the questions in the blank

After data collection, we will analyse these data to understand knowledge and skills of farmers (respondents). The analysis model of each part comprises;

- Part 1 General information:

Criteria:

- 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

Analysis method:

- Q1) – Q4) and Q6) - Q7): To see the average of age, gender, qualification, and income of farmers by plotting graph.
- Q5: Plotting graph to see the trend of each source of income. Therefore, we can see trend of farmers' sources of income.

- Part 2 Farm description:

Criteria:

- The farm area, type of farm area, and total farm area of farmers
- The productivities are produced
- The farming techniques of farmers

Analysis method:

- Plot a graph to see the most answer in each question

- Part 3 Technology usage:

Criteria:

- 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

Analysis method:

- Plot a graph to see the most answer in each question
- You can see the skills of farmers in terms of technology usage

- Part 4 Digital literacy:

Criteria:

- The level of ICT literacy of farmer in Asian countries
- The difference in level of ICT literacy among farmer in Asian countries?

Analysis method:

- In this part, we use the analysis method from *Al Khateeb et al., 2017*.
- 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.
- Part 5 Farming practice:

Criteria:

- 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

Analysis:

- Plot a graph to see the most answer in each question
- You can see farmers' skills relevant to farming practice
- Part 6 Marketing skill:

Criteria:

- The method of selling
- The market/target group of farmers for selling
- The business plan

Analysis method:

- Plot a graph to see the most answer in each question
- You can see the market of farmers and their business plan to increase income
- Part 7 Smart Farming practices/training experience:

Criteria:

- Trainer and trainee experience of farmers
- The understanding, skills, and experience on smart farm technology
- The preference of farmers on training channel

Analysis method:

- Plot a graph to see the most answer in each question

- You can see farmers experience, skills, and understanding on smart farming practice and technology.
- You can get the preference of farmers on training channel, which one they prefer most.

## 2. Group of farmers' classification

### 2.1 Context and global profiles

After analysing the survey, we are classified group of farmers to define farmer's profiles because training methodologies need to fit with farmers' profiles. It depends on various criteria, from local context and accessibility to farmers' profiles and current knowledge in the use of technologies.

To define the most relevant training approach, a first step was therefore to include in the survey a part on farming practices and training experiences. The objective is to know farmers' experiences relevant to smart farming and/or training. Three criteria have been used:

- Trainer and trainee experience of farmers
- Understanding, skills and experience on smart farming technologies
- Farmers' preferences on training channel

This survey has been filled by a total of 349 respondents (110 in Chiang Mai, 140 in Khon Kaen, 50 in Butan, 49 in Nepal).

### 2.2 Definition of farmer's groups

Farmer's groups were classified based on five aspects including Technology usage, Digital literacy, Farming practices and standards, Marketing skills, and Smart farming practices and training experiences. Based on the survey results, farmer's groups were defined into three groups comprising Group 0, Group 1, and Group 2 as shown in Figure 37.

Technology Usage	Digital Literacy	Farming Standard	Marketing	SF Practice /Training	Total	
X	X	X	X	X	68	<b>G0 = 122</b>
X	X	X	X	✓	14	
X	X	X	✓	X	26	
X	X	X	✓	✓	14	
X	X	✓	X	X	0	
X	X	✓	X	✓	1	
X	X	✓	✓	X	0	
X	X	✓	✓	✓	0	
X	✓	X	X	X	9	<b>G1B = 20</b>
X	✓	X	X	✓	2	
X	✓	X	✓	X	3	
X	✓	X	✓	✓	6	
X	✓	✓	X	X	0	
X	✓	✓	X	✓	0	
X	✓	✓	✓	X	0	
X	✓	✓	✓	✓	0	
✓	X	X	X	X	46	<b>G1A = 80</b>
✓	X	X	X	✓	6	
✓	X	X	✓	X	11	
✓	X	X	✓	✓	17	
✓	X	✓	X	X	0	
✓	X	✓	X	✓	0	
✓	X	✓	✓	X	0	
✓	X	✓	✓	✓	2	
✓	✓	X	X	X	20	<b>G2 = 121</b>
✓	✓	X	X	✓	10	
✓	✓	X	✓	X	20	
✓	✓	X	✓	✓	71	
✓	✓	✓	X	X	0	
✓	✓	✓	X	✓	0	
✓	✓	✓	✓	X	0	
✓	✓	✓	✓	✓	3	
*SF = Smart Farming					<b>349</b>	

Figure 3: Farmer's group classification

However, in this project, we defined one more group to be the trainers, which are made from government representatives and researchers called Group 3.

Three target groups are foreseen, with an additional "group 0" composed of farmers that cannot be included in our project:

*Group 0* – digitally illiterate farmers, who do not want to change their practice,

*Group 1* – mostly digitally illiterate farmers, but they are willing and able to learn

*Group 2*– having some expertise in agricultural and/or ICT and/or business management domain (academics also are part of this group)

*Group 3* – experts in agricultural and/or ICT and/or business management domain

Figure 4 provides an overview of these target groups.

**Group 0** is traditional farmers (see Figure 39). They do not use any ICT devices, and do not have internet access in their farm, but they have a basic level of digital literacy. They cultivate their crops based on their experience and do it as a routine for a long time. They reject to adopt any technology for farming because it is very difficult and complicated for them and they do not want to learn new things. Consequently, this group is not included, as farmers' profiles make the training of these farmers irrelevant for our program.

**Group 1** is the less advanced farmers. They do not have Internet access in their farm, and sometimes have difficulties to write and read. As long as they are willing to learn, farmers can be included in this group (100 farmers). Due to the diversity of profiles, two sub groups are foreseen. Group 1B (Trained farmers) with the intermediate level in terms of digital literacy, Group 1A (Practitioner farmers) with those who have some basic understanding in it detailed in Figure 40 and Figure 41.

**Group 2** is non-standard farmers. Farmers do the modern farming practices. They are more advanced, may already have some technology. They also are entrepreneurs, which means that they are able to change their practices. (121 farmers, see Figure 42 Details of group 2).

**Group 3** is made from government representatives, junior technical assistant, and academic staff or administrative. (36 academics and technical assistants + 16 admin).

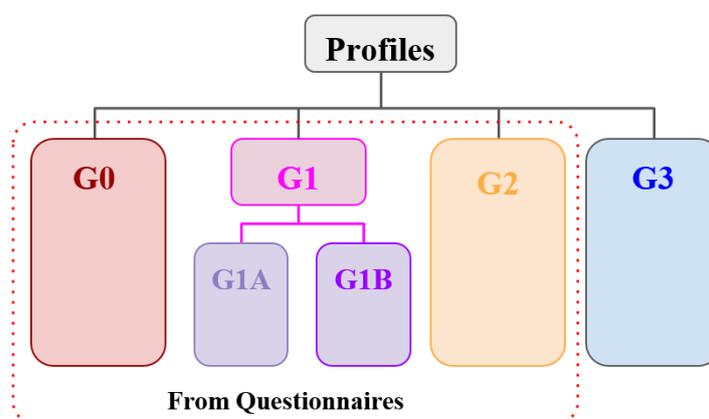


Figure 4: Overview of target groups

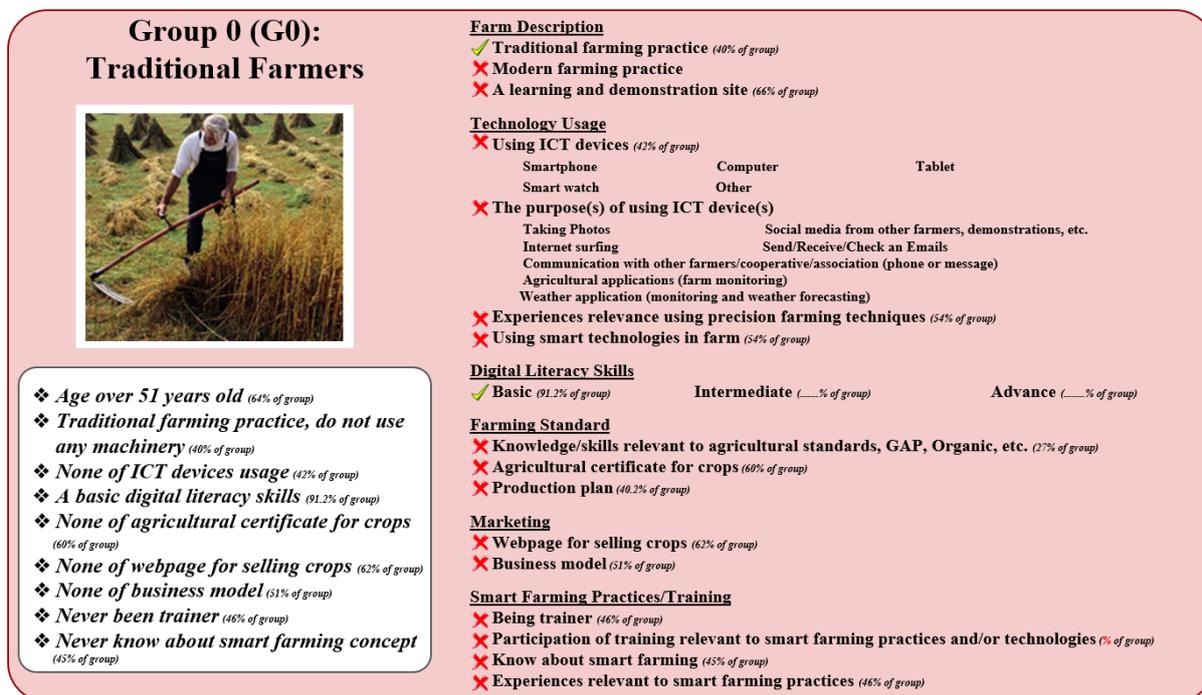


Figure 5: Details of Group 0

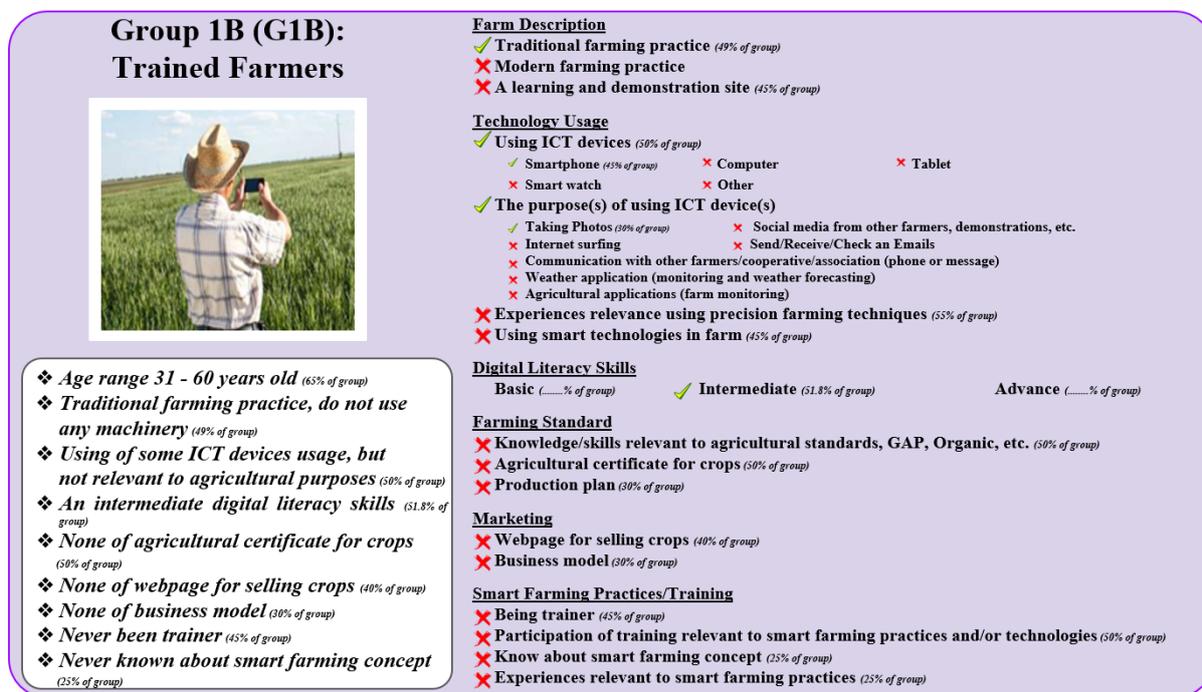


Figure 6: Details of Group 1B

### Group 1A (G1A): Practitioner Farmers



- ❖ Age range 31 - 60 years old (64% of group)
- ❖ Traditional farming practice, do not use any machinery (49% of group)
- ❖ Using of some ICT devices usage, but not relevant to agricultural purposes (91.3% of group)
- ❖ A basic digital literacy skills (33.2% of group)
- ❖ None of agricultural certificate for crops (62.8% of group)
- ❖ Using of webpage for selling crops (4% of group)
- ❖ Using of business model (1.4% of group)
- ❖ Never been trainer (59% of group)
- ❖ Knowing about smart farming concept (1.7.5% of group)

- Farm Description**
- ✓ Traditional farming practice (49% of group)
  - ✗ Modern farming practice
  - ✗ A learning and demonstration site (65% of group)
- Technology Usage**
- ✓ Using ICT devices (91.3% of group)
    - ✓ Smartphone (79% of group)
    - ✗ Smart watch
    - ✓ Computer (5% of group)
    - ✗ Other
    - ✓ Tablet (2.5% of group)
  - ✓ The purpose(s) of using ICT device(s)
    - ✓ Taking Photos (61.3% of group)
    - ✓ Internet surfing (13.8% of group)
    - ✓ Communication with other farmers/cooperative/association (phone or message) (48.8% of group)
    - ✗ Agricultural applications (farm monitoring)
    - ✗ Weather application (monitoring and weather forecasting)
  - ✗ Experiences relevance using precision farming techniques (80% of group)
  - ✗ Using smart technologies in farm (7.6.3% of group)
- Digital Literacy Skills**
- ✓ Basic (23.2% of group)
  - Intermediate (.....% of group)
  - Advance (.....% of group)
- Farming Standard**
- ✗ Knowledge/skills relevant to agricultural standards, GAP, Organic, etc. (34% of group)
  - ✗ Agricultural certificate for crops (64% of group)
  - ✗ Production plan (41% of group)
- Marketing**
- ✓ Webpage for selling crops (4% of group)
  - ✓ Business model (1.4% of group)
- Smart Farming Practices/Training**
- ✗ Being trainer (59% of group)
  - ✓ Participation of training relevant to smart farming practices and/or technologies (37.5% of group)
  - ✓ Know about smart farming concept (1.7.5% of group)
  - ✓ Experiences relevant to smart farming practices: Existing but limited use of technologies (7.5% of group)

Figure 7: Details of Group 1A

### Group 2 (G2): Non-Standard Smart Farmers



- ❖ Age range 20 - 50 years old (47.1% of group)
- ❖ Modern farming practice (56% of group)
- ❖ Using of ICT devices (94.2% of group)
- ❖ An intermediate digital literacy skills (42.5% of group)
- ❖ None of agricultural certificate for crops (58% of group)
- ❖ Using of webpage for selling crops (12.4% of group)
- ❖ Using of business model (35.5% of group)
- ❖ Being trainer (32.2% of group)
- ❖ Knowing about smart farming concept (60% of group)

- Farm Description**
- ✗ Traditional farming practice
  - ✓ Modern farming practice (56.2% of group)
  - ✓ A learning and demonstration site (36.4% of group)
- Technology Usage**
- ✓ Using ICT devices (94.2% of group)
    - ✓ Smartphone (93.4% of group)
    - ✓ Smart watch (4.1% of group)
    - ✓ Computer (20% of group)
    - ✓ Other (1.7% of group)
    - ✓ Tablet (0.3% of group)
  - ✓ The purpose(s) of using ICT device(s)
    - ✓ Taking Photos (76% of group)
    - ✓ Internet surfing (61.2% of group)
    - ✓ Communication with other farmers/cooperative/association (phone or message) (59% of group)
    - ✓ Weather application (monitoring and weather forecasting) (54% of group)
    - ✓ Agricultural applications (farm monitoring) (37.2% of group)
  - ✓ Experiences relevance using precision farming techniques (30% of group)
  - ✓ Using smart technologies in farm (16% of group)
- Digital Literacy Skills**
- Basic (.....% of group)
  - ✓ Intermediate (42.5% of group)
  - Advance (.....% of group)
- Farming Standard**
- ✗ Knowledge/skills relevant to agricultural standards, GAP, Organic, etc. (43% of group)
  - ✗ Agricultural certificate for crops (58% of group)
  - ✓ Production plan (31.4% of group)
- Marketing**
- ✓ Webpage for selling crops (12.4% of group)
  - ✓ Business model (35.5% of group)
- Smart Farming Practices/Training**
- ✓ Being trainer (32.2% of group)
  - ✓ Participation of training relevant to smart farming practices and/or technologies (70% of group)
  - ✓ Knowing about smart farming concept (60% of group)
  - ✓ Experiences relevant to smart farming practices: both Existing but limited use of technologies and already using smart farming technologies (27.3% of group)

Figure 8: Details of Group 2

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