Perception and innovativeness level of farmers on the integration system of rice and cattle farming

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Abstract. Farmers’ perceptions of the disseminated technology influence the speed and rate of its adoption. The integration system of rice and cattle farming, named SITT, was developed to increase rice and beef production based on a zero-waste concept. Information on farmers’ perceptions of the SITT technology’s characteristics is needed to improve the technology. This study analyzed farmers’ perceptions of the SITT technology’s characteristics, social characteristics, economic capabilities, and innovativeness level. This research was carried out in October 2018 in Serdang Bedagai District, North Sumatra. Data were collected through interviews using a structured questionnaire to 40 farmers who applied the SITT technology and selected purposively. Data were analyzed using qualitative and quantitative descriptive methods. The result proved that, in general, the farmers’ perceptions of the SITT technology have a greater relative advantage, compatibility, trialability, observability, and less complexity. Most of the farmers are not involved in the farmer group’s management (94.9%). Farmers stated that the financing source for farming activities was their capital (55.0%). The level of farmers’ innovativeness concluded that 43.6% of farmers were in the late majority group. The acceleration of SITT technology needs to be carried out continuously with methods following the specifics of the location and the farmers’ level of innovation. This dissemination activity will provide assurance and trust to farmers in SITT technology to be applied in their farming activities to increase production, productivity, and profits.

1. Introduction

Innovation is an idea or practice perceived as new by an individual or adopter, and the innovation adoption rate depends on the adopter’s perception of the attributes of the innovation [1]. In agriculture, the technology innovations adoption by farmers could indicate logical decision-making determined from farmers’ perceptions of the suitability of the technology’s characteristics and value in the future years. Perception is the view that farmers have about innovation based on their needs and experiences, which will affect farmers’ attitudes towards innovation [2]. Farmers’ perceptions are not permanent, and they will change with new information or knowledge. As claimed by Iskandar and Nurtilawati [3], the level of perception of farmers has a significant and direct effect on applying integrated crop management (ICM) in Bogor, West Java. Farmers do not directly apply technological innovations; instead, it takes time and is influenced by farmers’ perceptions of the technology [4].

The government, through research institutions, has developed various technology innovations in agriculture to increase farming productivity to elevate the welfare of the farmer. The Integration System of Rice and Cattle Farming named SITT is one of the Indonesian government innovations for increasing
the production and productivity of rice and beef. SITT is a farming system that intends to increase production and productivity by minimizing external inputs and zero waste. In the opinion of [5], the principle of integration system of rice and livestock farming is a system that applies zero waste that utilizes local resources and is environmentally friendly. In agreement with [6], the integration of rice and cattle farming system merges multiple agriculture sectors build upon the principle of organic recycling and input-output connection between products with a low external input approach by the usage of crop waste and cattle manure to raise production and productivity in a green farming process to increase farmers’ income. The dissemination of SITT is carried out with the Rural Agriculture Development Model through Innovation program called MP3MI. Serdang Bedagai District, North Sumatra, is one of the locations for disseminating the SITT technology in the MP3MI program. Serdang Bedagai is a rice production center and supplies beef production in North Sumatra Province, Indonesia; therefore, it was chosen as the location of the dissemination activity. This district provides lowland rice production approximately 10.3%, while beef production attain 6.2% [7]. Nevertheless, not all farmers implement SITT technology because of the variety of their perceptions of the innovation attributes.

It is suspected that the adoption of SITT technology tends to be low at the field level due to the perception of farmers about this technology. Farmers may perceive that the application of technology might increase inputs, such as production tools (i.e., fertilizer amount), labor, and working time. In the meantime, with those extra inputs, the technology application may not necessarily increase productivity and profits. Refers to Rogers’ concept that an individual’s perception of the innovation attributes affects a person’s level of adoption [1]; then, it is necessary to collect information regarding farmers’ perceptions of SITT technology. Rogers also stated that the attribute or characteristics of these technological innovations include relative advantage, compatibility, complexity, trialability, and observability. In addition, technology receiver, technology attribute or characteristics, the prevailing social system, and communication channels affect technology adoption [1]. Similarly, Sirnawati E and Sumedi [8] concluded that the characteristics of technological innovation had a positive and significant effect on the adoption of Jarwo Super technology on rice production.

Technology characteristics, social characteristics and financial capabilities, and innovativeness level may affect Serdang Bedagai farmers’ perception and adoption of technology, so this research needs to be carried out. Therefore, the purpose of this study was to analyze farmers’ perceptions of the characteristics of SITT technology, social characteristics and economic capabilities, and innovativeness level in the Serdang Bedagai District. We hope that knowing farmers’ perceptions of the attributes of SITT technology innovations would give feedback to develop improved technology innovations so that the adoption rate of farmers will be higher and eventually improve agricultural productivity.

2. Materials and methods

2.1. Materials

The study was conducted through a survey method at Lubuk Bayas Village, Perbaungan Sub-District, Serdang Bedagai District, North Sumatra Province, in October 2018. This study uses primary and secondary data. Primary data collection was conducted through structured questionnaire interviews to farmers as respondents, totaling 40 farmers. In this study, we used purposive sampling to get the respondent. The selected farmers lived and performed rice and cattle farming at the location of the SITT dissemination in the MP3MI program conducted by the North Sumatra Assessment Institute for Agricultural Technology (AIAT), Indonesian Agency for Agricultural Research and Development (IAARD). Secondary data was gathered through desk studies from research journals, reports, and other scientific publications. The data collected includes the farmers’ characteristics, perceptions of the attribute of SITT technology, social characteristics, economic capabilities, and the level of innovation.

2.2. Methods

The SITT innovation integrates rice cultivation and cattle farming. In rice cultivation, the technology introduced is the use of new High Yielding Varieties (HYV), balanced fertilization, young seedlings,
organic fertilizers, *Jarwo* planting system, and Integrated Pest Management (IPM). While in cattle farming, the innovations are the production of bio urine dan compost.

Farmers’ perceptions of the characteristics of SITT technology are discussed based on five attributes [1], that is (1) relative advantage: an innovation is reviewed enhanced than the idea it generates, (2) compatibility: an innovation is perceived as in line with the values, experiences, and needs, (3) complexity: an innovation is considered as hard to understand and use, (4) trialability: an innovation may be tried with on a partial basis, and (5) observability: the outcomes of an innovation are visible to others. The social characteristics of farmers are explained from the leadership aspect regarding the involvement of farmers in the farmers’ organization management. Furthermore, they were described from the cosmopolitan aspect of farmers regarding the communication, interaction, and participation in farmer group meetings, counseling, training, and mentoring. Finally, the financial ability of farmers is described from the source of financing in farming.

The level of farmers’ innovativeness is categorized into five categories, namely Innovators (Venturesome), Early Adopters (Deliberate), Early Majority (Respectable), Late Majority (Sceptical), and Laggards (Traditional) [1]. To answer the research objectives regarding farmers’ perceptions of the characteristics of SITT technology, social characteristics and economic capabilities, and the level of innovativeness of farmers, the data and information obtained were analyzed using qualitative and quantitative descriptive approaches.

### 3. Results and discussion

#### 3.1. Farmers’ perceptions of the characteristics of SITT technology

Based on the technology characteristics, in general, farmers’ perceptions of SITT technology are economically profitable, matched with the existing values and needs, not difficult to understand and use, easy to be experimented with on a limited basis, and the results are visible to farmers. The analysis results show that the percentage of farmers’ perceptions of SITT technology that increases profits the most is compost technology, 88.9%. The percentage of farmers’ perceptions of SITT technology that best suits farmers’ needs is organic fertilizer technology (96.6%). The percentage of farmers’ perceptions of the least complicated SITT technology carried out by farmers is HYV technology and organic fertilizer (100%). In line with [9] in Poso District, Central Sulawesi, farmers’ interest in HYV was because the technology was needed and easy to apply.

Percentage of farmers’ perceptions of SITT technology that is easiest for farmers to experiment is HYV, balanced fertilization, organic fertilizer, *Jarwo* planting system, and compost (100%). The percentages of farmers’ perceptions of SITT technology that are easiest for farmers to observe are HYV technology, fertilization, young seedlings, organic fertilizers, *Jarwo* planting system, and compost (100%).

Of the five characteristics of the technology, farmers’ perception of SITT technology is quite good. It is directly related to the farmers’ characteristics, such as age, formal and non-formal education, farming experience, number of family members, primary occupation, primary income, and land tenure. The majority of Serdang Bedagai farmers are in productive age, experienced in farming, have low formal education, and attend informal training a few times. Farming is their primary occupation and income, with small land tenure (less than one hectare) and several cattle.

The farmers’ characteristics are factors that influence the knowledge, attitudes, and perceptions of farmers, so that it will affect the decision to adopt technology, in addition to other factors such as the economy and social interaction of farmers [2,3,10]. Therefore, farmers’ competence depends on each farmer’s characteristics [11] and is directly related to farming activities [12].

Farmer age does not affect farmers’ perception of innovation [10] and farmer’s level of innovation [1]. Education significantly affects technology adoption [13,14], while [15] argues otherwise. In contrast to [1,2], the level of literacy, education, and social status of farmers affect the introduction of technology because it is in line with the level of innovation of farmers. As claimed by Indraningsih [16], in Cianjur and Garut District, income level, land area, attitude towards change, competence, and
extension agents’ role, are the factors that influence farmer cooperator perceptions of the characteristics of innovation. In non-cooperator farmers, factors that influence farmers’ perceptions of the characteristics of innovation are intelligence, risk-taking, cosmopolitanism, availability of inputs, and availability of marketing facilities.

**Table 1.** Percentage of farmers’ perceptions of the characteristics of SITT technology in Serdang Bedagai District, 2018

| SITT technology component | Relative advantage | Compatibility | Complexity | Trialability | Observability |
|---------------------------|-------------------|---------------|------------|--------------|---------------|
| HYV                       | 66.67             | 94.45         | 100.00     | 100.00       | 100.00        |
| Fertilization             | 79.16             | 75.00         | 95.83      | 100.00       | 100.00        |
| Young seedlings           | 75.00             | 94.44         | 97.22      | 91.67        | 100.00        |
| Organic fertilizer        | 82.76             | 96.55         | 100.00     | 100.00       | 100.00        |
| Jarwo                     | 87.50             | 91.67         | 91.67      | 100.00       | 100.00        |
| IPM                       | 72.73             | 81.82         | 78.78      | 87.88        | 87.88         |
| Bio urine                 | 81.25             | 89.65         | 81.25      | 96.56        | 96.56         |
| Compost                   | 88.89             | 92.30         | 96.30      | 100.00       | 100.00        |

3.2. **Social characteristics and economic capability of farmers**

One of the farmers’ social characteristics is explained from the farmer leadership aspect, namely the involvement of farmers in managing organizations such as farmer groups or others. Farmers must become members of farmer groups or Gapoktan because farmer groups have a role as agents in applying new technologies [17]. From the analysis results, most farmers were not involved in managing farmer groups, Gapoktan, or other organizations (94.9%), farmers only as organization members. Farmers who were involved in organization management as much as 5.1%. The head of the farmers’ group has a reasonably high role in shallot cultivation technology adoption in Bantul: as a motivator, communicator, facilitator, and organizer [18].

The activeness of farmers in expressing opinions and ideas is another indicator of social characteristics from the leadership aspect. The findings of this study indicate that 64.1% of farmers never express opinions; they only listen, accept, and implement joint decisions, while 35.9% of farmers are actively involved in expressing opinions. Other social characteristics are described from the farmers’ cosmopolitan aspect, namely from farmers’ level of communication and interaction. The analysis results illustrate that farmers routinely communicate and interact with extension workers, farmers outside the village, community leaders, and village officials. The average interaction between farmers and outsiders is 1-3 times/month. Another cosmopolitan aspect of farmers is the participation of farmers in group meetings, counseling, training, and mentoring. The analysis shows that the average participation of farmers in meetings, counseling, training, and mentoring is 1-3 times/season.

The economic capability of farmers reflects the farmers’ ability to finance their farms, which affects the adoption of technology. Capital is one of the crucial factors in farming, where limited capital affects the application of technology. According to Wati et al. [19], motivation and capital are the main obstacles in applying off-season mango farming technology in Cirebon District. In other studies [20], economic support has a positive and significant relationship to farmers’ decisions in planting Ciherang rice varieties in Semarang District. In line with Sumarno and Hiola [21], financial capability tends to affect technology application. From the results of the analysis, the source of financing for farmers’
farming comes from their own capital (55.0%), their own capital and loans, both individuals and financial institutions (42.5%), and loans (2.5%).

The large percentage of farming financing from own capital is due to the significant farmers’ income for rural areas. The average income of farmers is 2.6 million IDR/month, which is obtained from rice farming and cattle farming as the main occupation of farmers. This income is not only utilized to meet the necessities of life but also to finance his farming activities, such as purchasing seeds, fertilizers, pesticides, and paying labor wages while applying technology.

| Tabel 2. Percentage of financing sources for farmers’ farming in Serdang Bedagai District, 2018* |
|---|---|
| No | Source of farming costs | Farmers (%) |
|---|---|---|
| 1 | Owner’s capital | 55.0 |
| 2 | Own capital and loan | 42.5 |
| 3 | Loan | 2.5 |

*Source: primary data (processed), 2018

3.3. Farmer’s level of innovation

Based on the analysis, most farmers are in the late majority category, which is 43.6%. Farmers in this category find it challenging to adopt new technology and skeptical of new technology. They wait for other farmers to adopt the technology first and will adopt it if it is proven. Farmers in this category need time to adopt new technologies, which can be an obstacle in technology diffusion. This behavior is an effort to reduce the risk of failure due to limited capital. According to [22], a late majority group is a group that is very careful in accepting innovation and will accept the innovation if most other groups use it first.

Farmers in the early majority category (28.2%) desire to adopt new technology even with various considerations. Farmers in the early adopter category are 17.9%, in the laggards category are 7.7%, and in the innovator category are 2.6%. Innovators are open, brave farmers, like to do new things, always looking for information, have their own capital capabilities, and dare to risk failure. Farmers in the category of early adopters and innovators can be optimized in the technology dissemination and diffusion process so that technology adoption becomes massive.

| Tabel 3. Level of farmers innovativeness in Serdang Bedagai District, 2018 |
|---|---|
| No | Farmer’s level of innovation | Farmers (%) |
|---|---|---|
| 1 | Innovators | 2.56 |
| 2 | Early adopters | 17.95 |
| 3 | Early majority | 28.21 |
| 4 | Late majority | 43.59 |
| 5 | Laggards | 7.69 |

4. Conclusions

In general, farmers’ perceptions of SITT technology were economically profitable, consistent with the existing values and needs, not difficult to understand and use, easy to be experimented with on a limited basis, and the results are visible to farmers. From the social characteristics aspect, most farmers were not involved in managing organizations such as farmer groups, Gapoktan, or other organizations (94.9%); farmers were active in communicating and interacting with stakeholders, regularly attending meetings, training, and mentoring to support their farming. From the aspect of economic capacity, 55.0%
of farmers’ sources of financing come from their own capital. In the level of innovativeness of farmers, they were mainly included in the category of late majority (43.6%).

Although, in general, farmers’ perception of SITT is as desired, farmers are still skeptical of new technology; therefore, it is still difficult for farmers to adopt new technology innovations. Consequently, the government needs to accelerate SITT technology and continuously assist farmers with methods following the specifics of the location and the level of innovation of farmers. This dissemination and assistance will provide assurance and trust to farmers for SITT technology to be applied in their farming activities to increase production, productivity, and profits.

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