Characteristics of Farmers in Suboptimal Land Agroecosystems and the Implications of the Application of Farm Technology

Karakteristik Petani di Agroekosistem Lahan Suboptimal dan Implikasinya terhadap Penerapan Teknologi Usahatani

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(Received: 5 February 2021, Accepted: 20 September 2021)

Citation: Suharyon S, Saidi BB. 2021. Characteristics of farmers in suboptimal land agroecosystems and the implications of the application of farm technology. Jurnal Lahan Suboptimal : Journal of Suboptimal Lands. 10 (2): 150–159. DOI: 10.36706/JLSO.10.2.2021.528.

ABSTRACT

The area of West Tanjung Jabung District is dominated by tidal land agroecosystems so that the farming pattern that develops is based on tidal land. This research aimed to study the characteristics of farmers in tidal land agroecosystems and their implications for the application of farming technology. The research was conducted in Bunga Tanjung Village, Betara Subdistrict, West Tanjung Jabung District in 2019, involving 40 farmers who were randomly selected as respondents. The descriptive data analysis showed the first, farming
INTRODUCTION

West Tanjung Jabung District is commonly dominated by tidal land agroecosystems that the most farming business relies on it (CBS 2018a). One of the salient characteristics of the farming business on tidal lands is the low crop intensity and relatively slow technological developments compared to irrigated rice fields. The low planting intensity is related to cropping patterns that depend on rainfall with the result that the farmers can only cultivate food crops (seasonal) once a year, namely during the rainy season, except for annual crops.

The slow agricultural development on tidal land constitutes a negative impact on agricultural development policy which so far has been biased towards the irrigated agriculture and does not consider the tidal land potential. The agricultural development programs in irrigated wetland agroecosystems are relatively more numerous than those on the tidal areas. Infact, the tidal are a potential in Indonesia is quite extensive, including in West Tanjung Jabung District, Jambi Province, which, if managed properly, will be a potential source of growth as a producer of agricultural production. Nevertheless, the Indonesian Agency for Agricultural Research and Development (IAARD, 2016) has produced many agricultural innovations (location-specific technology and institutional models) proven to be suitable for development on suboptimal tidal lands. The application of agricultural technology can help farmers increase the productivity and quality of agricultural products according to consumer needs, the competitiveness of agricultural commodities and the income and welfare of agribusiness actors/farmers through technological innovation activity.

Farmers as the spearhead of agricultural development play a very important role in increasing the productivity of agricultural products, given that farmers are the main actors in agriculture. Agricultural technology innovation will not be of any benefit, if farmers do not use it. Therefore, the adoption of this technological innovation by farmers is important in order to increase farm productivity (Fatchiya et al., 2016). The problems are: a) to what extent are farmers in tidal land agroecosystems willing and able to apply the introduction of farming technology, b) what factors influence farmers to apply the introduction of farming technology in tidal land, and c) what is the strategy to increase productivity in the tidal land?

This problem arises because empirically, the availability of farming technology does not necessarily guarantee that it can increase productivity. There are still other factors to consider, namely the adoption of technology by farmers. Udimal et al. (2017) The adoption of rice technology is influence
by demographic characteristics, economic factors, and technical factors. Factors such as; age, farm size, on-farm demonstration, credit access. Mills et al. (2013) point out that the attitude of farmers in adopting technological change is influenced by (a) the relative advantage when the technology is adopted, (b) the suitability of technology with local socio-culture, (c) the results of farmers' observations one other farmers trying or having tried the technology as a basis for laying trust, (d) trying for themselves the success of new technology and (e) existing economic conditions.

In connection with the above problems, in general this research aimed to discuss the characteristics of tidal land farmers and the implications of farming technology application, and in particular to reveal the factors influencing the farmers to apply the technology and formulate alternative efforts to increase the productivity on tidal lands.

**MATERIALS AND METHODS**

**Data Sources**

The data sources were primary and secondary data. The primary data were collected using an exploratory diagnostic approach, as part of the Participatory Rural Appraisal (PRA) method and complementary to the base line survey. The survey was conducted in June to July 2019, involving 40 respondents who were randomly selected from a number of farmers in Makmur Jaya Village, Betara Subdistrict, West Tanjung Jabung District. The collected primary data were a) respondent characteristics, including age, levels of formal education, family dependents, control of assets and others and b) the variety of crop farming activities, including commodity types, cropping patterns, time spent working, land tenure status, inputs and outputs of farming, plant maintenance, and product marketing activities. The discussion was enriched with the identification of conditions of production facilities (input markets) and output markets, farmer institutions, transportation, agricultural product processing activities, and support from the local government institutions. The secondary data were collected from various relevant agencies, including the developments in cropping areas and production, the local government policies, and developments in the price of production facilities.

**Data Analysis**

The collected data were analyzed using simple statistics and discussed descriptively based on the statistical parameters including, inter alia percentage, average, maximum value, minimum value, etc. As for the qualitative data, particularly the non-technical aspects, they were analyzed descriptively and intensely with the SWOT analysis (strengths, weaknesses, opportunities, threats) by adopting the method of Subaktiilah et al. (2018).

**RESULTS**

**Regional Characteristics of West Tanjung Jabung District Geographical location**

West Tanjung Jabung was one of the districts in Jambi Province with the capital city of Kuala Tungkal with an area of 500,982 ha (CBS 2015). Mean while, the district area mapped by the CRDALR-Center for Research and Development of Agricultural Land Resources (2011) covers an area of 493,089 ha. West Tanjung Jabung District was located at the coordinates between 0°53’–01°41’ South Latitude and between 103°23’–104°21’ East Longitude, and administratively the northern part was bordered by Riau Province, the eastern part by the Berhala Strait and East Tanjung Jabung District, the southern part by Batanghari District and the western part by Batanghari and Tebo Districts.

West Tanjung Jabung District was a lowland with an altitude of 0–500 m above sea level. The average annual rainfall was 2,125.6 mm with the highest daily rainfall of 337.2 mm. The average air temperature was 27.5 °C with a minimum
The air temperature of 23.6 °C and a maximum air temperature reaching 32 °C (CRDALR 2017). The number of population of West Tanjung Jabung District is 322,527 people. During the period of 2010–2017, there was an average population growth per year of 2.27%. In 2017 the total workforce was 161,822 people consisting of 156,851 employed people (96.92%) and 4,971 unemployed ones (3.07%).

The largest work force in agriculture was 91,896 people, in industry 11,487 people, and in service 53,468 people. West Tanjung Jabung District consists of 13 districts, 134 villages. Batang Asam was the largest subdistrict, followed by Betara, Renah Mendaluh, and Pengabuan Subdistricts, while Seberang Kota was the smallest subdistrict or 2.42% of the whole district area (CBS 2018a). In 2017, the production of lowland rice in West Tanjung Jabung District was 46,635 ton with a productivity of 4.51 ton/ha, while the production of upland rice was 494 ton with a productivity of 2.09 ton/ha.

The production of secondary crops such as maize, cassava and sweet potato was 2,024 ton, 3,147 ton and 245 ton accordingly with respective productivity of 5.11 ton/ha, 20.84 ton/ha and 7.4 ton/ha (CBS 2018a). The productions in West Tanjung Jabung District were generally small holder plantations. The largest production of small holder plantations was oil palm and coconut (Cocos nucifera L.). The oil palm production in 2018 was 131,235 ton and the Cocos nucifera production was 54,569 ton. Administratively, Makmur Jaya Village was located in Betara Subdistrict, Tanjung Jabung Barat District, Jambi Province with an area of 17.63 km², with the number of population of 30,663 people, while Makmur Jaya Village has 2,047 people. The population in the age group of 25–44 years old was 9,694 people (CBS 2018b). Makmur Jaya Village belongs to a lowland area with an altitude of 3–7 meters above sea level. It was not surprising that most of the area of Makmur Jaya Village was watered and consists.

Characteristics of Location and Village Population

Trenches irrigated productive areas of community land. The river crossing the border of Makmur Jaya Village was the Betara River.

Characteristics of Farmers of Makmur Jaya Village, Betara Subdistrict

Characteristics of farmers of Makmur Jaya Village, Betara Subdistrict, West Tanjung Jabung District were presented in Table 1. Table 1 showed that the age of farmers varies between 26 to 75 years old, with an average age of 47.37 years and categorized as a productive age. The younger farmers usually have curiosity that they try to adopt innovations of Inpara and Margasari varieties although they were still in experienced in Inpara variety cultivation. The average completed education level was 7.6 years, ranging from elementary to senior high schools. Sutariah (2015) states that farmers with higher education generally adopt innovation more quickly than those with low education that they generally find it rather difficult to adopt innovation (new high yielding varieties).

Application of Farming Technology

According to the harvested area, the dominant type of crop was tidal land rice. Almost all villagers were attempted to substitute rice as a staple food. The second order after corn was Cocos nucifera, and citrus. The dominance of these commodities at the village level is a typical farming condition at the subdistrict level.

Unlike the irrigated land, the land agroclimatic condition was less conducive and depended particularly on the rain fall and optimal land arrangement that the farmers wereen courage to optimize it by app lying a rice and citrus cropping pattern arranged like a transect. The identified cropping pattern sat the study site were:a) rice+Cocos nucifera.
This cropping pattern has been running until now to be the characteristic of the farmers of Makmur Jaya Village, Betara Sub district. Tidal land on the citrus horticultural area contains very acidic pH with low to moderate macro nutrient contents (Table 2). The land suitability analysis needed to be carried out to determine the potential for citrus development and cultivation technology to be applied to improve suboptimal conditions (Chyntia & Soemarno 2018). The land suitability indicators for citrus crops were physical and chemical properties of soil which included soil texture, water level, drainage, pH, CEC (Cation Exchange Capacity), and soil organic matter (Das & Sudhakar 2014). Land suitability for agriculture was a very important piece of information in agriculture development and future planning. Based on that, a land suitability assessment for Agriculture purpose has been conducted in order to help decision makers, agriculture development planners and determine how proper or appropriate it was for a particular use of the land in a particular location which were more suitable for certain agriculture use (Singha & Swan 2016). Land use for agriculture in West Tanjung Jabung District consists of land for food crops, plantations and horticulture. The citrus horticultural area was located in an area of 25 hectares, in several subdistricts, namely Merlung, Tebing Tinggi, Senyerang, Tungkal Ilir, Bram Itam and Betara (CBS 2018). The high citrus production in the past 5 years was produced from Betara, Bram Itam and Tungkal Ilir Subdistricts (Table 3). The citrus cultivation implemented by the farmers of West Tanjung Jabung District was generally not in accordance with the technology recommendations for agroclimatic conditions in the region. The increased productivity of citrus was achievable through the application of innovative technology of fertilization and amelioration to improve soil physical and chemical properties, use of certified superior seeds, branch pruning for plant maintenance and farm sanitation.

Table 1. Characteristics of farmers of Makmur Jaya village, Betara subdistrict

| Description                                | Makmur Jaya Village, Betara Subdistrict |
|--------------------------------------------|----------------------------------------|
| Age (Years Old)                            | 44.51                                   |
| Education (Years Old)                      | 7.54                                    |
| Farming Experience (Years Old)             | 19.57                                   |
| Productive Workforce (Person/Family Head)  | 1–4                                     |
| Male                                       | 1.71                                    |
| Female                                     | 1.49                                    |
| Owned Land Area (ha)                       | 2.69                                    |
| Arable Land Area (ha)                      | 2.41                                    |

Source: Primary data, Makmur Jaya village, 2019.

Table 2. Chemical property of tidal soil in Betara subdistrict of Tanjung Jabung Barat

| Soil Chemical Property | Value     | Criteria      |
|------------------------|-----------|---------------|
| pH                     | 3.88      | Very Acid     |
| N                      | 0.32%     | Moderate      |
| P                      | 9.52 ppm  | Moderate      |
| K                      | 0.289 me/100 g | Low  |
| C Organics             | 9.74%     | Very High     |
| Salinity               | 1.0351    | Low           |
| Ratio C/N              | 28.48     | Very High     |

Source: Purnama et al., 2018.
Table 3. Citrus production of West Tanjung Jabung district 2012–2017

| Subdistrict       | 2012 | 2014 | 2015 | 2016 | 2017 |
|-------------------|------|------|------|------|------|
| Tungkal Ulu       | 0    | 0    | 0    | 16   | 0    |
| Merlung           | 7    | 14   | 22   | 0    | 44   |
| Batang Asam       | 20   | 0    | 0    | 0    | 0    |
| Tebing Tinggi     | 2    | 24   | 30   | 1    | 35   |
| Renah Mendaluh    | 14   | 6    | 0    | 5    | 4    |
| Muara Papalik     | 15   | 187  | 170  | 1    | 0    |
| Pangabuan         | 1    | 38   | 27   | 0    | 27   |
| Senyerang         | 1    | 38   | 27   | 0    | 27   |
| Tungkal Ilir      | 68   | 32   | 78   | 0    | 110  |
| Bram Itam         | 241  | 1125 | 494  | 0    | 643  |
| Seberang Kota     | 0    | 0    | 28   | 0    | 28   |
| Betara            | 21   | 198  | 599  | 0    | 909  |
| Kuala Betara      | 0    | 0    | 0    | 2    | 0    |

Source: The Central Bureau of Statistics (CBS) of Jambi Province of 2013, 2015, 2016, 2017.

The land amelioration through lime application was an important technological element which did not become a priority for citrus farmers in West Tanjung Jabung District, therefore the introduction of technology was required. The purpose of lime application was to increase soil pH making it more suitable for plant growth and production. The study results of Purnama (2018) in the citrus cropping area of Betara Subdistrict, West Tanjung Jabung District show that the application of lime of 6 kg per tree and balanced fertilizer increases plant production from 40.63 kg per tree to 49.13 kg per tree. The lime application could be done before planting and flowering period of the citrus plants. The lime that could be applied was Agricultural Lime and dolomite by means of sowing in the grooves following the circle of citrus plant canopy. The grooves were made to a depth of approximately 20 cm, then covered with soil after the lime was sown in the hole.

DISCUSSION

Factors Affecting the Application of Farming Technology

The low application of farming technology in tidal land agroecosystems is a reflection of individual farmer decisions. Theoretically and empirically, the farmers’ decisions are influenced by not only the encouragement of internal factors, but also the existence of large external factors. The attitudes and perceptions of farmers on the farming and the farmers’ goals are the internal factors that underlie their decisions. In this case, the farmer’s goals of the farming were to get income, or just to fulfill daily needs, or even just to avoid risks.
Other considerations beyond the farmers themselves characterizing the decision of technology adoption are the existence of marketing support for inputs (production facility), outputs (results), and the institutional elements, among others, credit, extension, cooperatives and land ownership (Figure 1). The role of biophysical factors which include climatic conditions (rainfall, temperature and humidity), biology (pests, weeds and genetic potential) and soil conditions (types and fertility) were determinant factors in making decisions about technology adoption, besides the government alignment, it could otherwise be encouragement or obstacle playing a role as an opportunity or even become a threat in the farming development on this tidal land.

**Alternative Strategy Approach for Increasing Productivity Tidal Land**

In responding to the many determinant factors for farmers to make a decision before applying the technology, the wisdom of all parties is needed to act proportionally in fostering farmers by not judging them if agricultural production is not in accordance with the development expectations. A strategy that might be considered to increase the productivity of tidal land is by optimizing the potential that becomes the strength of farmers to get opportunities and face existing challenges and minimize elements of weaknesses so as to reduce the emergence of threats that carry the risk of farming failure.

An element that becomes the strength of farmers in tidal fields is their tenacity in running their farming. He is still actively doing business even though he knows that his land conditions are not optimal and his agroclimate support is not conducive. Collaboration between farmer members who are united because they have the same feeling of suffering is an element of strength that can become capital for agricultural development in tidal fields. The form of cooperation that has been seen so far is in the form of mutual cooperation in
The salient characteristic of farming on tidal lands in the study location was in addition to being less optimal tenure of farming land, characterized by low crop intensity of food so that farming products derived from food commodities were not reliable to be the main source of family income. The decision of farmers to run farming on tidal land was influenced not only by external factors such as the door to drain water in their fields, considering the land or tidal conditions, the rainy season period is shorter than drought, as well as environmental stress, especially the poison of pyrite, a bird pest that often destroys crops. Regarding the existence of elements as the strengths and weaknesses of the farmers on the one hand and the opportunities and threats on the other, it is necessary to have a strategy to accommodate the conditions. The following description is an alternative to increasing the productivity of farmers on tidal land, so that they are able to seize opportunities and income of farmers on dry land. A wise approach is needed to overcome the challenges faced by farmers in tidal land, to accelerate the dissemination of these technologies. The dissemination can be accelerated through, among others, technology extension workers and technology clinics. In addition, there need to have mentoring assistance from researchers and extension workers so that the delivery of technology to farmers goes well. The decision of farmers to run farming on tidal land was influenced not only by external factors such as the door to drain water in their fields, considering the land or tidal conditions, the rainy season period is shorter than drought, as well as environmental stress, especially the poison of pyrite, a bird pest that often destroys crops. 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of farmland resources based on the strengths and weaknesses of farmers and minimizing the impact of adverse biophysical environmental stresses. A strategy alternative to increase productivity in tidal land agroecosystem areas is to diversify business (multi-enterprises), apply the integration pattern of livestock and plants; accelerate technology dissemination and encourage the growth of partnership networks. To support the implementation of this strategy, it is necessary to provide a touch of capital in the form of a farm credit scheme with soft interest without collateral and assistance in the intensive application of technology by extension agents and researchers.

ACKNOWLEDGEMENTS

Special gratitude goes to the Regional Government of West Tanjung Jabung District, especially the Head of the Agriculture Service, the Head of the Food Crop Production Division, the Head of the Tanjung Bunga Village, Betara Subdistrict, the Field Officer (PPL) who already helped and collaborated a lot in this activity until the completion of this research activity. Thank you very much to comrades in refining this paper to be presented at the Suboptimal Land seminar on October 20, 2020. Suggestions and constructive input are expected from all seminar participants. The authors hope that the results of this study can be useful and become a policy for the local governments.

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