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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

Suharyon Suharyon[1*)], Busyra B Saidi[1]

[1]Assessment Institute of Agricultural Technology (AIAT) of Jambi, Jambi 36128, Indonesia
[*)]Corresponding author: suharyonhariyon@gmail.com

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ABSTRAK

Wilayah Kabupaten Tanjung Jabung Barat didominasi agroekosistem lahan pasang surut sehingga pola usahatani yang berkembang berbasis lahan pasang surut. Penelitian ini bertujuan mempelajari karakteristik petani di agroekosistem lahan pasang surut dan implikasinya terhadap penerapan teknologi usahatani. Penelitian dilakukan di Desa Bunga Tanjung Kecamatan Betara, Kabupaten Tanjung Jabung Barat, tahun 2019, melibatkan 40 orang petani yang terpilih sebagai responden secara acak. Melalui analisis data secara deskriptif diperoleh gambaran sebagai berikut: Pertama, usahatani di lahan pasang surut dicirikan oleh penguasaan lahan usahatani yang relatif belum diolah dan ditanami, intensitas tanam (*crop intensity*) komoditas pangan rendah, tingkat produktivitasnya rendah, sehingga hasil usahatani belum bisa terpenuhi secara maksimal kedua, kondisi biofisik lahan usahatani yang kurang kondusif mempengaruhi keputusan petani dalam menerapkan teknologi usahatani. Ketiga, peluang untuk meningkatkan produktivitas usahatani di lahan pasang surut masih terbuka luas melalui optimalisasi pemanfaatan potensi sumberdaya lahan usahatani didasarkan atas kekuatan dan kelemahan petani. Keempat, untuk meningkatkan produktivitas di wilayah agroekosistem lahan pasang surut, strateginya adalah melakukan diversifikasi usaha (*multi enterprises*); menerapkan pola integrasi antar komoditas; melakukan percepatan diseminasi teknologi dan mendorong tumbuhnya jaringan kerjasama kemitraan. Agar strategi tersebut terlaksana, diperlukan adanya kebijakan skim kredit lunak yang dalam implementasinya diikuti pendampingan oleh penyuluh dan peneliti.

Kata kunci: agroekosistem lahan pasang surut, karakteristik petani, penerapan teknologi

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

on tidal land was characterized by the control of relatively unprocessed and cultivated farm land, low crop intensity of food commodities, and low levels of productivity resulting in unfulfillable farming results properly. The second, the biophysical conditions of farming land wereless conducive to influence the decisions of farmers to Apply farming technology. The third, the opportunity to increase farming productivity in tidal lands was still wide open by optimizing the potential utilization of farmland resources based on the strengths and weaknesses of farmers. The fourth, the strategies to increase productivity in tidal land agroecosystem areas were conducted by diversifying into multi- enterprises, implementing integration patterns between commodities, accelerating technology dissemination, and encouraging the growth of partnership networks. In order for these strategies to be implemented, it is necessary to have a soft credit scheme policy which in its implementation it is followed by assistance of extension agents and researchers.

Keywords: tidal land ecosystem agro, farmer characteristics, application of farm technology

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 Subaktilah 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 Straitand 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 $^{\circ}$C with a minimum

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 plantations 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 km^2, 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 urprising 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 isa typical farming condition at the subdistrict level.

Unlike the irrigated land, the land agroclimatic condition was less conducive and depended particularly on the rain falland 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 satthe study site were:a) rice+citrus+*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 estcitrus 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	
	Average	Range
Age (Years Old)	44.51	
Education (Years Old)	7.54	
Farming Experience (Years Old)	19.57	26−65
Productive Workforce (Person/Family Head)		
Male	1.71	1−4
Female	1.49	1−3
Owned Land Area (ha)	2.69	0.5−6
Arable Land Area (ha)	2.41	1.5−6

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	Citrus Production (ton)				
	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.

Citrus Cultivation Technology Innovation on Tidal Land Lime and Fertilization Application

Adding ameliorative substance to improve acidic soil properties known as amelioration (Dariah et al., 2013). The lime application was a method of land amelioration to increase soil fertility. The application of lime in addition to increasing soil pH also increases soil fertility by increasing the availability of nutrients for plants. Research results (Septiyana et al., 2017) show that besides increasing the pH and alkaline saturation, the lime application increases the Ca and Mg content in peat lands. The result of the study Ubi et al. (2017), the effect of liming on the availability of plant nutrients and the attendant effect on soil nutrient status and nutrient availability in the plant.

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 lime application on peatlands was effective in increasing soil pH, as shown by the results of research by Aryanti et al. (2016) in Riau. 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 sowingin 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.

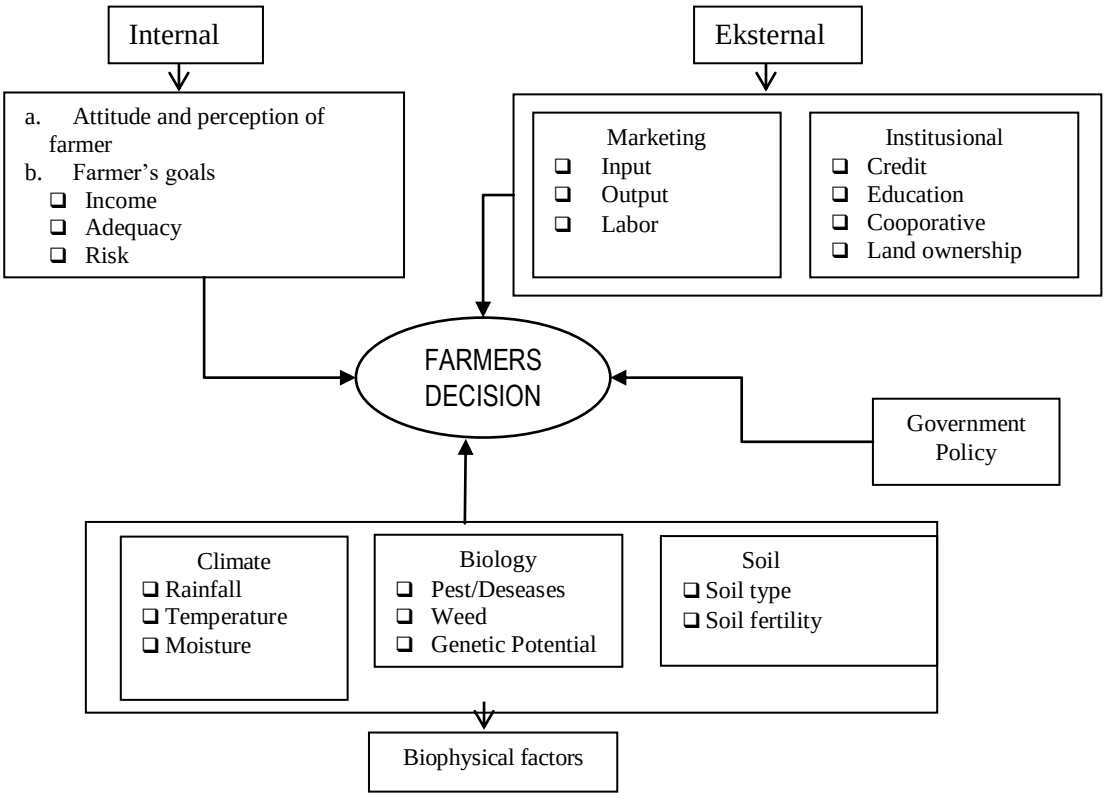

Figure 1. Factors that influence farmers′decisions on technology adoption (Source: Adyana, 1990 with modifications as necessary)

Other considerations beyond the farmers them selves 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 onthis 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

carrying out farming activities, including during soil cultivation, planting and time to control plant pests (OPT).

Another strength that farmers have in tidal land is the high access of farmers to markets that are quite good, and others. The role of these elements of strength can be optimized in encouraging efforts to increase productivity and income of farmers on dry land, so that they are able to seize opportunities and face challenges that may arise. The challenges faced by farmers in carrying out farming in tidal land agroecosystem areas are the relatively low ability of farmers to absorb technology so that a wise approach is needed to overcome it. Another challenge is the weak control of farming capital due to the relatively limited number of financial institutions willing to participate in providing loans with soft bank interest.

Meanwhile, what is a threat to farmers in tidal land, among others, is the agroclimatic conditions that are less conducive, especially the land has not been properly organized 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 plants. 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 as trategy in order to beable toaccommo date the seconditions. The following description is a business development alternative that can be used as an option for farmers to increase their productivity and income in dry land agroecosystem areas:

a. Having diversify business (multi-enterprises). The justification underlying this approach is to provide opportunities for farmers to increase the added value of their farming. In other words, if farmers fail to harvest due to drought or pest attacks, they will still survive because they still have income sources from other businesses.
b. Accelerating technology dissemination. Aspreviously stated, the availability and relatively a large number of technologies from the IAARD (2019) are suitable to be developed in tidal fields. Consequently, what is needed now is to accelerate the dissemination of these technologies. The dissemination can be accelerated through, among others, having a technology exhibition, field laboratories or 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.
c. Touch of farming capital. This proposal is classic but it is still necessary because empirically the capacity of farmers' capital is relatively weak. Therefore, we need atouchof soft credit schemes for farmers so that they can encourage the application of technology as recommended. An alternative to providing capital for farmers can also be pursued through increasing the institutional role of Joint Venture Groups (*KUB*).

CONCLUSSION

The salient characteristic of farming on tidal lands in the study location was,in addition to beingless 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 existence of input/output markets and institutional support and government policies, but also the unconducive bio physical conditions of farming land contributing a lot inthe farmers' decisions. Opportunities to increase farming productivity on tidal land are still wide open through optimizing the potential use

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 providea 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.

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