Socio-economic characteristics of farmers on the existence of floating-rice cultivation demonstration plots in flood prone area in Bojonegoro, East Java

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Abstract. Some parts of Bojonegoro Regency along the Bengawan Solo River experience flooding every year due to its downstream area. This leads to a drowning in the rice field areas for several months in the rainy season. As the consequence, the rice fields cannot function well in the agricultural cultivation process. One of the ways to adapt to this condition is cultivating floating rice. However, the further research on the social economic characteristics of the farmers in their accordance to the technological advancement needs to be conducted. This article aims to study the social economic characteristics of the farmers on the existence of the demonstration plots of floating rice cultivation. The method used in this research includes the demonstration plots and farmers survey. The surveyed respondents were 200 farmers living 3 km away from the demonstration plots. The findings show that the characteristics in which respondent farmers are dominated by unproductive ages, low education, low income, limited land tenure, and the lack of information shall be the obstacles in developing floating rice cultivation. This is due to the relatively high operational cost for making floating medium and caring plants different from others. The farmers’ mindset tendency to give up to the natural condition is difficult to change when adapting to flood conditions.

1. Introduction
The world’s climate is changing and will continue to change in the coming century at rates projected to be unprecedented in recent human history. The risks associated with these changes are real but highly uncertain. Adequate attention must be given to respond to the impacts of climate change that are already occurring, while at the same time preparing for future impacts. It is important to understand the nature of those risks, where natural and human systems are likely to be most vulnerable and what may be achieved by adaptive responses. It is most urgent to ensure adequate and rapid support to the most vulnerable countries and communities. Adaptation is one significant measure that reduces vulnerability to actual or expected climate change effects. There is an urgent need for adaptation assessment in the short-term, as witnessed by the increasingly high costs of extreme
weather events, compounded by rising population densities, eroding natural protection systems and aging infrastructure [1].

Agriculture plays a main role in ensuring food security and contributing to economic growth. Currently, this sector is strongly impacted by natural disasters (drought, flood and increasing insect pests and diseases) caused by climate change influencing farmer livelihoods [2]. Rainfed production systems are hypothesized to be most vulnerable to direct effects of climate change (e.g. changes in rainfall patterns) [3]. Bojonegoro regency occupies the largest flood-prone rice fields of about 14,198 hectares, in East Java province. Floods commonly occur due to Bengawan Solo River overburst, particularly in rainy season. The fields are potential for cultivating rice, but floods lasting for months cause these areas to be unproductive for about four months. For farmer households living in flood prone areas, flood will cause a loss of agricultural production [4]. According Ramakrishna and Harwood [5,6], floods undermine farm yields and the national harvest, reducing household and national food availability, and agricultural income derived from crop sales.

Managing the flood prone ecosystem for rice production needs to evaluate the reasons and a comprehensive appropriate technology through research efforts for better rice production under such harsh ecology [7]. Empowering farmers with all kinds of activities can reach sustainable food security in flood prone areas for farmer households. There are activities such as introducing deep-water rice technology, optimizing food consumption, increasing the number of villages, which can produce their own food, building food barns on farmer households, living harmony with flood and providing early warning system [8]. In addition, technology of floating rice cultivation is developed. This is a rice cultivation technique that uses rafts as cultivating media as an effort of adaptation to flood [4].

Floating rice cultivation is an innovation introduced in the flood prone area in Bojonegoro. Potentialities of this locally innovated 'floating rice agriculture' practice need to be assessed for adaptation as a profitable farming with changing climate [9,10,11]. The practice of floating agriculture also helps supplement the income of local communities and contributes to the alleviation of poverty [12]. It, moreover, provides greater food security by increasing the land output and supporting capacity for poor and landless people [13].

The introduction of floating-rice technology requires training, demonstration plots and socialization to farmers. Demonstration plot (demplot) is a method of agricultural extension services to farmers, by making a pilot area, so farmers can see and prove to the object demonstrated. Pilot group should carry out demonstration plots. If pilot project is done successfully, it will drive force to public who are interested in doing similar thing [8]. Before becoming government policy, the floating-rice cultivation needs to be studied regarding the farmers social economic characteristics to prevent failure of cultivation process. This is crucial, given that the cost of floating-rice is relatively high and there is a different treatment procedure in the cultivation. This article aims to study the social and economic characteristics of the farmers on the presence of floating-rice cultivation demonstration plot.

2. Methods
The research location, which was selected through purposive technique, includes Bojonegoro Regency which is a flood prone area experiencing flood every year [4,8]. The locations of floating-rice demonstration plot (demplot) are rice fields near by the residential roads, for instance, in Balungdowo Hamlet, Karangdayu Village, Baureno Subdistrict (Figure 1 and 2). The floating-rice demplot uses floating medium made from bamboo and planting media from the rice field soil and husk charcoal in a ratio of 1:1. The range of the plantation is 20 x 20 cm with Ciherang varieties as the selected planting seeds. This floating-rice cultivation demplot is the development of the previous research finding in determining the highest and the lowest production costs. The rice production resulted in the research scale reaches 13.78 ton/ha. This area was selected as demplot location due to its proneness to flooding for about 4 months during the rainy season. Meanwhile, the survey was carried out to the farmers living 3 km away from the demplot. Based on the mapping using purposive sampling technique, the farmers chosen were from Karangdayu and Pomahan Villages in Baureno Sub-district.
The population in this research include the farmers living or owning rice fields near by the floating-rice cultivation demplot, with the maximum radius of 3 km far from the location. The research samples taken were 200 farmers selected in purposive way.

The design of this study is exploratory research, in which a research aims to obtain description or study on the condition of local food barns in Central Java. Explanatory research seeks explanations to the observed phenomena, problems, or behaviours [14]. The data were collected through in-depth interview, observation, and recording. The data were analysed using analytical descriptive method.

3. **Result and Discussion**

The respondent farmers were members of farmer groups in both villages, Pomahan and Karangdayu. The farmer group usually consists of 20 – 25 members from one stretch group. This institution has a fundamental role in deciding the plantation time, irrigation schedule, pest control, agricultural insurance, and the regulation of input subsidies from the government.

Demplot needs to be disseminated to public so the results provide more benefits to them. Demonstration plot can be applied/replicated to other areas that have the identical condition.
Socialization of demonstration plot aims to improve public knowledge about the results from farmers group. Socialization can be done through demonstration plots and promotion through various media both print and electronic media. If public response about the demonstration plot is negative, they will not adopt the results. They do not support the results of the introduction. Therefore, we need to change their response through other agricultural extension activities [8].

Understanding the social economic characteristics of the farmers is significant in order to gain the depiction of the farmers’ capacity as the main subject in the agricultural activity. The success of a technology adoption in agriculture cannot be separated from the farmers’ social economic condition. Thus, the social economic condition needs to be explored as the input material for the policy makers in applying the technology introduced. Farmers in the surrounding area of floating-rice cultivation demplot are from Pomahan and Karangdayu Villages. The characteristics of social economic condition of the farmers lie in the age, education, number of family members, income, land tenure, type of work, and mastery of information sources.

a. Farmers’ age represents their ability in adopting new technology and information in their agricultural business. According Davis [15] proposes that 35 year is the maximum age of young farmer category. In the research location, the age of farmer is described as follows:

| Age groups | Number (person) | Percentage (%) |
|------------|-----------------|----------------|
| 35         | 30              | 15             |
| 36 – 59    | 40              | 20             |
| >59        | 130             | 65             |
| Total      | 200             | 100            |

Data source: Primary data analysis (2018)

Table 1 shows that the farmers are mainly in unproductive ages. This phenomenon happens not only in the research location but also in other regions in Indonesia [16]. Young farmers with the maximum age of 35 are very small in number percentage in the research location. This is due to the youth’s tendency to work outside the agricultural sector. The dominant number of old farmers and the decreasing number of youths interested in working in the agricultural sector are also experienced by other countries outside Asia, such as European countries and Canada [17,18,19]. This shows that the characteristics of farmer’s household are considered less supportive to agricultural cultivation management. In the older age category, farmers tend to be closed to accept innovation such as the application of new technology. The dominating number of the old farmers will lead to the scarcity of farmers in the following years, thus later contributes to the scarcity of labors.

Saragih [20] proposes that age affects the working productivity of any activity requiring physical energy. On the other side, young farmers are considered to be more open minded and bold in trying to apply new technology for the sake of increasing the agricultural productivity [21].

b. In the development of any business, human power is the fundamental factor affecting the success. Although the other factors determining the success have been met, without the support of the adequate quality and quantity of human power, the business will experience various obstacles, even failure. The formal education required for the farmers is the education they have taken since the elementary school until the higher education, as depicted in the following table:

| Education Groups                        | Number (person) | Percentage (%) |
|-----------------------------------------|-----------------|----------------|
| Not graduated from elementary school    | 28              | 14.0           |
| Graduated from elementary school        | 83              | 41.5           |
| Graduated from junior high school       | 52              | 26.0           |
Graduated from senior high school / vocational high school & 33 & 16.5 \\
Graduated from College (D3, S1, S2) & 4 & 2.0 \\
**Total** & **200** & **100** \\

Data source: Primary data analysis (2018)

The level of formal education of the farmers is important because it determines their capacity in counting, assessing, and analysing a business. The better level of education will result in the better ability to analyse a business [22]. The table above shows that the education level of the farmers is relatively low. This proves that their ability in mastering and applying technology is also limited. Thus, it will later lead to the quality and the quantity of the production result. The old age and the low level of education will affect the farmers’ manner and mindset about their interest on the floating-rice cultivation technology.

The high level of education supports the nationalism and insight of the farmers towards the advancement and the adoption of new technology in managing their business. For this reason, farmers with the relatively higher education will be more rational in running their agribusiness by comparing the results gained from the use of new technology to the flooded rice fields. The education has a positive impact to farmers’ skills in managing their agribusiness [23,24,25].

Learning from the experience and the knowledge can improve the farmers’ skill in making decision wisely [26]. To support the skills and capability of the farmers in mastering and applying the floating-rice cultivation technology, the trainings on cultivation is required.

c. Working as a farmer or any other profession as the source of livelihood can be categorized as the basic and side jobs. As the basic job, the source of family earnings is mostly from farming, as depicted by the table below:

**Table 3. Type of Jobs**

| Type of Jobs   | Number (person) | Percentage (%) |
|---------------|-----------------|----------------|
| Basic jobs    | 127             | 63.5           |
| Side jobs     | 73              | 36.5           |
| **Total**     | **200**         | **100**        |

Data source: Primary data analysis (2018)

Some people with farming as the basic job do not own agricultural land, but only as farm laborers (24.5% of the total samples) and as cultivators. For some people in the research location, farmer is also as the side job of civil servants, village apparatus, traders, and entrepreneurs.

In the flood prone area, adapting to the work outside the agricultural sector is very possible, given that the rice fields cannot be used for 4 months. Farmers’ adaptation activity is mainly by fishing in the inundation areas to get fish for food and for sale. Besides, they can work as daily laborers in the construction work. The adaptation in the agricultural sector has not been common because they regard the risk of cultivating the rice while flooding is relatively high.

d. The number of family members acts as two sides of a coin. In one side, it acts as one of the sources of income when the family members are in the productive age, so that they can help the family finance. Thus, it will give a positive impact in the food security of the farmer household. On the other side, the number of the family members can be the burden of the family itself when they are not in productive age [22]. The number of family members who still become the family burden is as follows:

**Table 4. The Total Family Members**

| Number of dependents | Number (person) | Percentage (%) |
|----------------------|-----------------|----------------|
| 1 – 4                | 120             | 65             |
The more complex the family burden indicates the more increasing the family expenses. To gain great family income, various efforts are done, such as getting income from outside the agricultural sector. This family burden is indeed source of potential workforce, which can be empowered in adopting the floating-rice cultivation. However, if the family burden is under or over the productive age, it is no longer potential workforce to reduce the cost of adopting the cultivation.

e. The family income of the respondent comes from both inside and outside the agricultural sectors. The income from farming is considered to have a high risk of loss when the rice planted and ready to be harvested fails due to the flood. In the conversion to month, the average income of farmer families can be elaborated as follows:

Table 5. Amount of Family Income

| Amount of income (IDR/ month) | Number (person) | Percentage (%) |
|-----------------------------|-----------------|----------------|
| < 1.000.000                 | 118             | 59             |
| 1.000.000 – 3.000.000       | 74              | 37             |
| >3.000.000                  | 8               | 4              |
| Total                       | 200             | 100            |

Data Source: Primary data analysis (2018)

The highest household income group is in the income less than IDR 1.000.000/month. This comes from the job as farm laborers who do not work every day. At certain times they are unemployed, for instance when the rice plants are under preservation. Meanwhile, the farmers whose main source of livelihood is not from farming, such as civil servants, village apparatus, drivers, and entrepreneurs, gain the income above IDR 3.000.000/month. Compared to the regional minimum wage, which is between IDR 1.350.000 – IDR 1.400.000, most of the farmers are under the minimum wage. The farmers’ income can increase through land expansion, farm productivity increases through optimal utilization of land potential, and the application of agribusiness concept in farming [27].

Seen from the low income, the farmers are likely to find difficulty in funding the floating-rice cultivation due to the relatively high operational cost in making the floating medium. Generally, farmers with low income have no savings to invest because their income can only meet their daily needs, even less than expected.

f. Land tenure. One of the approaches in promoting the farmers’ welfare and free them from poverty is by increasing the access of land tenure by the farmers [28]. The main factor of the poverty of villagers who are mainly working as farmers is that most of the farmers belong to small-scale farmers with the average number of land tenure less than 0.5 hectare. In Indonesia, the definition of small farmer commonly refers to the land tenure. According Sayogyo [29] classifies the farmers in East Java into three categories, namely: small-scale farmers with land tenure <0.5 ha, middle-scale farmers with land tenure 0.5-1.0 ha, and big-scale farmers with land tenure >1.0 ha. The land tenure, which comes from the self-owned and rented land as much as 10 percent from the total number of farmers renting lands from other farmers, is depicted as follows:

Table 6. Land Tenure

| Land area (m²) | Number (person) | Percentage (%) |
|----------------|-----------------|----------------|
| 0              | 49              | 24.5           |
| 1 – 2.500      | 130             | 65.0           |
The biggest number of farmers’ land tenure is between 1 – 2.500 m$^2$, while the smallest number is more than 0.5 ha. The system of inheritance division results in narrower land owned by farmers so that the individual management is considered inefficient. Rich farmers who have not yet inherit the land to the heirs own the land tenure above 0.5 ha. With the assumption that the total income of the farmers is only from rice field farming in two seasons in a year, in order to promote the welfare or to free them from the poverty, or in other words, to gain income as much or more than the poverty line by BPS, the land tenure needed by each rice farmer household has to be at least 0.65 ha/capita/year [30].

From the of rice field area cultivated by the farmers, it can be said the farmers living near by the demplot are not categorized as prosperous farmers because their land tenures are under 0.65 ha/capita/years. Moreover, almost 25 percent of the respondents are only farm labours. This comes out as an obstacle in the adoption of the floating rice. They tend not to have the initiative to adopt a technology, except on the orders of the land owner. Because of it, land owners are most potential target to adopt the floating rice technology.

g. The mastery over the information source is reached using several sources to gain the information about the floating rice cultivation technology. The accurate and actual information will pique the farmers’ interest in the process of adopting the technology. Furthermore, when the information is delivered by the reliable figures, the channel and the stream of the information will spread out faster to the farmers as the consideration for taking action. The information mastery by the respondent farmers can be elaborated as follows:

| Information source mastery        | Number (person) | Percentage (%) |
|----------------------------------|-----------------|----------------|
| Self-observation                 | 128             | 64.00          |
| Information from peer friends    | 68              | 34.00          |
| Mass media                       | 4               | 2.00           |
| **Total**                        | **200**         | **100**        |

Data source: Primary data analysis (2018)

Most of the farmers get the appropriate information about the floating-rice technology by directly observing the floating rice demplot in the research location. The farmers passing by the demplot location are enthusiastic about the floating rice cultivation. Meanwhile, only some of the respondents know the floating rice cultivation technology from the mass media (online media) because most of the farmers are not conscious about the multimedia technology. The role of extension officers and community leaders also can increase farmers' awareness by inviting them to utilize multimedia technology and thus the floating rice technology can be implemented successfully.

The more complete the information gained from the floating rice cultivation is, the more it will give positive impact on the increase of motivation and enthusiasm of the farmers in adopting the technology. This is so for by cultivating the floating-rice, farmers can still gain production results when the rice fields are drowned by flood. Meanwhile, inadequate information will give a negative impact in the motivation of the farmers due to the relatively high operational cost. Moreover, old-aged farmers are reluctant to make an innovation in running their agricultural business because they tend to surrender to the natural condition.

4. Conclusion
One of the ways to adapt to the floating-rice cultivation in the flooded area is by developing the floating rice cultivation technology. Before applying this technology in the wider scale, it is very crucial to know the social economic condition of the farmers who directly experience the flood impacts. The characteristics such as the dominating unproductive age, the low level of education, the low income, and inadequate information, become the obstacles in developing the floating-rice cultivation. The floating-rice cultivation technology is something newly introduced in Bojonegoro Regency so that the strong effort is required to attain the success in the application.

Acknowledgements
We would like to express our sincere gratitude to Universitas Sebelas Maret for funding this research. Our sincere appreciation is also extended to all parties who have provided information to complete this article.

Conflicts of Interest. The authors declare there is no conflict of interest

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