Understanding the relationship among the determinants of rice cropping index in Deli Serdang Regency

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Abstract. The cropping index of rice is one of determining factors to increase rice production. In certain areas of Deli Serdang Regency, the rice crop has high possibility of being sowed three times annually. Unfortunately, some parts of this regency still have a low cropping index, then affecting the stagnant production. Hence, this study was conducted to identify the determinant variables and explain their relationship with rice cropping index and also to construct the strategic actions to increase the rice cropping index. This study was conducted in six districts with 180 total respondents, using household-based survey method. The descriptive statistics analysis and Pearson correlation analysis were performed using the SPSS tool to achieve the objectives. The result shows that frequency of flood occurrence on riceland, productivity, total income from agricultural sector, number of household member, age, education level, distance of irrigation channel to the riceland and the irrigation status are the significant determinants of rice cropping index. In addition, some strategic actions that have to introduced to the local government and the farmers are sowing the adaptive varieties which is tolerant on flooding condition; using the precise planting calendar to find the exact schedule for planting time; planting the certified variety that gives high productivity; increasing the capacity building, especially the cultivation skill, through following the technical guidance; constructing the irrigation system and repairing/maintaining the irrigation infrastructures; and harvesting the water to support the sustainable water for riceland.

1. Introduction
As one of important food crops for Indonesian people, including for Deli Serdang Regency, it is very important to maintain the sustainable production of rice. In line with the growing number of populations over the years, the continuous increase of riceland is critically needed. By considering the rice consumption rate of Indonesian people, 130.57 kg per capita [1], Deli Serdang Regency needs 281,378 ton of rice to fulfill 2.155 million people in 2019 [2]. This is becoming a big deal in the next few years because the stagnant production for the last ten years was experiencing in Deli Serdang Regency.

The issue of the stagnant production in Deli Serdang Regency is affected by many factors, such as: the variety, land fertility, cropping index, flood and drought, riceland conversion [3], farmers capacity/skill, farmers income, supporting infrastructures, etc. Especially for the rice cropping index, it gives a significant contribution especially for the rice production. The cropping index itself, is the number of planting time of rice by farmers within a year in the similar area [4]. Thus, while increase the number of cropping index of rice, it will give double for rice production.

It is surely important to identify the determinant variables of rice cropping index. Knowing the determinant and their relationship with the cropping index, gives an advantage to understand more about
the environment of the riceland specifically. In addition, it will be easy to arrange the strategic measures [5] to increase the rice production related to the cropping index.

Considering the important of cropping index of rice, this study was conducted to increase the stagnant production in Deli Serdang Regency. There are two main objectives of this study, to identify the significant determinants of rice cropping index and investigate the relationship of the identified-determinants. The descriptive statistics and Pearson correlation analysis were performed to find the exact result. All information from this study can be adopted by policy makers to generate the appropriate strategic actions to achieve the sustainable rice production.

2. Materials and Methods
The study was conducted at six districts of Deli Serdang Regency, namely: Beringin, Hamparan Perak, Percut Sei Tuan, STM Hilir, Sunggal and Tanjung Morawa, which is located at 2° 57’ – 3° 16’ N and 98° 33’ – 99° 27’ E geographically. This regency has bordered with Karo, Serdang Bedagai, Simalungun, Langkat, Binjai and Medan City administratively; and has elevation ranges from 0 to 500 meters above sea level [6] (Figure 1).

The study was carried out by implementing the household-based survey method. A set of questionnaire sheet was prepared and copied up to 180 sets, which is similar with number of respondents. The respondents were elected from the six districts which is representing the total riceland area starting from the largest (Percut Sei Tuan and Hamparan Perak, by 13,637 and 10,955 ha, respectively) up to smallest (Tanjung Morawa and STM Hilir, by 5,113 and 1,815 ha, respectively). Besides, the variables of age, education and prosperity level are also used as considering variables to choose the proper respondents.

All information from the household-based survey were gathered based on respondents’ perception and continuing by entering into SPSS tool. The two kinds of analysis, descriptive statistics analysis and Pearson correlation analysis, were performed for this study. The descriptive statistics analysis is a simple analysis that has a function to provide basic information about all dataset gathered from the survey [7]. While, the Pearson correlation analysis has a function to identify the relationship between the
3. Results and Discussion

3.1. Determinants of Rice Cropping Index

Previously, there were eleven of determinant variables of rice cropping index recorded during the household-based survey, namely: frequency of inadequate of water for supporting rice growth, frequency of drought occurrence on riceland, frequency of flood occurrence on riceland, productivity, total income from agricultural sector, total income from non-agricultural sector, number of household member, age, education level, distance of irrigation channel to the riceland and the irrigation status. All these variables were gathered based on farmers perception, as respondents.

Table 1 presents the basic information of all determinant variables which is resulting from descriptive statistics analysis. All level of determinant variables used the scale format, except inadequate water occurrence, drought occurrence, flood occurrence, education and irrigation status which are presented in nominal format. Based on the result, it can be observed that rice crop was sowed once until three time a year. The issues of inadequate of water, drought and flood, as resulting impact of climate change, was maximally occurred once a year in the study area. For the rate of income, the respondents have $ 3,470 annually from agricultural sector, while $ 815 from the non-agricultural sector. In term of respondents personal, they are grouped in the working-age classification because their age average are 45 years old with 3 children. Especially for the education level, the minimum level of education is illiterate level and the maximum is graduate level. Furthermore, in terms of distance of irrigation channel and status, the closest and the furthest distance are ten meters and eight kilometres; meanwhile for the status, the best is very good condition and the worst is unirrigated status.

| Table 1. Descriptive statistics of the determinant of rice cropping index. |
|-------------------------------------------------|----------|----------|
| Min | Max | Mean |
|-----------------|--------|--------|
| Cropping index (times/yr) | 1 | 3 | 1.67 |
| Inadequate water occurrence (times) | 0 | 1 | 0.50 |
| Drought occurrence (times) | 0 | 1 | 0.84 |
| Flood occurrence (times) | 0 | 1 | 0.48 |
| Productivity (t/ha) | 1.67 | 8.62 | 5.02 |
| Agricultural income ($) | 215 | 20,250 | 3,470 |
| Non-agricultural income ($) | 85 | 8,571 | 815 |
| Household member (number) | 1 | 7 | 3.36 |
| Age (year) | 25 | 71 | 45.6 |
| Education | 1 | 6 | 3.58 |
| Distance from irrigation channel (m) | 10 | 8,000 | 625.57 |
| Irrigation status | 1 | 4 | 2.57 |

3.2. Relationship among the determinants and strategies to increase rice cropping index

Identification of the relationship among the determinants of rice cropping index was quantified by Pearson correlation analysis using SPSS tool. The result which is presented in Table 2 shows that among eleven of determinant variables, there are eight variables give significant relationship to the cropping index level, namely: frequency of flood occurrence on riceland, productivity, total income from agricultural sector, number of household member, age, education level, distance of irrigation channel to the riceland and the irrigation status.

The frequency of flood occurrence which is taking place on respondents’ riceland area has significant relationship with the cropping index level. The negative value relationship of these two variables, means
higher the flood frequency occurred lower the number of cropping index. Undoubtedly, the flooding as the negative impact from climate change caused the farmers postpone their planting season. Furthermore, flooded-area on riceland can decrease the quality of environment [9]. Thus, information about the weather is important to set the exact schedule planting time [10]. It can be observed from Table 2 as well that this particular variable give significant negative relationship with the productivity, means higher the flood frequency occurred lower the productivity gained by farmers.

The correlation analysis shows that the productivity, the total income from agricultural sector and the cropping index have the positive significant relationship. Through this relationship, it can be interpreted that more rice productivity produced by farmers higher the frequency of farmers sowing their riceland. In line with the productivity, higher income received from agricultural sector higher the frequency of farmers sowing their riceland as well [11]. Definitely, when farmers have higher productivity, they will get more income from their agricultural land. They will be able use their money to buy some input to support their agricultural land and have much chance to increase their cropping index. Conversely, while farmers have low productivity, they do not have much money to sowing their riceland for the next season.

The two variables, the number of household member and age, have the negative relationship with the cropping index of rice. Higher number of household member, lower the rice cropping index. Especially for this relationship, it is linked with the farmers income. The farmer who has high number of children will spend more much money to fulfil their needs rather than the small number. Surely, they do not have much money to use for their agricultural land. While, for the age variable, older the farmers lower number of cropping index of rice. It is related to the energy they use to sow their rice crop.

For the education level, higher education level of farmers will higher the rice cropping index. For this case, educated-farmers agree that they will get more money when they cultivated more their riceland. It is also related to their knowledge, that the educated-farmers use their skill to manage their land [12], so it can be planted continuously.

Lastly, for the distance of irrigation channel to the riceland and the irrigation status, they have significant positive relationship with the rice cropping index. Closer the irrigation channel and better the condition of irrigation infrastructure, higher the cropping index of rice. It is related to the sustainable water irrigation because rice crop will grow well when there is supporting from water [13]. Undoubtedly, the irrigated riceland will give more productivity compared with unirrigated riceland.

Table 2. Pearson correlation analysis between rice cropping index and some determinants.
As rice cropping index is one of responsible actor for the total rice production, it is highly important to increase the cropping index level. Some of the following strategic measures can easily implemented by farmers:

a. Sowing the adaptive varieties which is tolerant on flooding condition
b. Using the precise planting calendar to find the exact schedule for planting time
c. Sowing the certified variety that give high productivity
d. Following the government policy related to the number of children (two children for maximum)
e. Increasing the capacity building, especially the cultivation skill, through following the technical guidance
f. Constructing the irrigation system and repairing / maintaining the irrigation infrastructures
g. Harvesting the water to support the sustainable water for riceland

4. Conclusion
To increase rice production, it is very important to identify which determinant variables give the significant contribution to the cropping index. The rice cropping index of rice in Deli Serdang Regency, especially in the study area, is still low. Although some farmers have high potency to sow rice crop within 3 times annually, but the average rate of cropping index is 1.67 only. Some of dependants influencing the rice cropping index based on farmers perception in the study area are frequency of flood occurrence on riceland, productivity, total income from agricultural sector, number of household member, age, education level, distance of irrigation channel to the riceland and the irrigation status. Hence, the strategic measures is highly important to be implemented to increase the rice cropping index, such as: (i) sowing the adaptive varieties which is tolerant on flooding condition; (ii) using the precise planting calendar to find the exact schedule for planting time; (iii) sowing the certified variety that give high productivity; (iv) increasing the capacity building, especially the cultivation skill, through following the technical guidance; (v) Constructing the irrigation system and repairing / maintaining the irrigation infrastructures; (vi) Harvesting the water to support the sustainable water for riceland.

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