Analysis of income and expenditure of farmers’ household in the rain-fed area of Boyolali district

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Abstract. Farmers usually work in various activities to obtain income and fulfill household demands. The objectives of this study are to determine and investigate the structures and factors influencing farmer households' income and expenses in the rain-fed areas. This research was conducted in Tegalgiri Village, Nogosari Sub-district, Boyolali District from January to March 2020. The study used survey technique. Data were analyzed descriptively and quantitatively using multiple linear regression analysis. The results showed that the average household income of IDR 5,262,387/month with the largest proportion (65.31%) came from on-farm activities and 34.70% came from non-agricultural activities. Factors influencing household income were rice production and farmers' education. The average household expenditure was IDR 3,869,634/month consisted of food expenditure 30.17%, 23.94% for non-food expenditure, and 19.42% for farming cost. Factors influencing household expenditure are income and land area. To increase household income and welfare, farmers need to optimize the management of rain-fed lowland and upland fields.

1. Introduction
The agricultural sector has an important role in economic development in Indonesia since it is a source of income and employment opportunities for rural communities. In addition, most Indonesians live in rural areas and earn a living as farmers. Therefore, the agricultural sector has become their main source of income.

One of the agricultural commodities cultivated by farmers is rice. Rice is the main staple food for most Indonesian people. Central Java is one of the third largest national rice producers after East Java and West Java with a contribution of 16.82% of national rice production [1]. Rice plantation has been widespread throughout the regions in Central Java, including in Boyolali Regency. Boyolali Regency has a potential land area of 44,443 ha with a productivity of 5.41 tons/ha [2].

In Boyolali, rice has been planted in the area of wet rice fields, rain-fed rice fields and dry land. Farmers, in general, use their rice production for two objectives. They use their rice production to meet the household demand for food and sell the remaining rice production to gain cash income. Therefore, increasing rice production could greatly contribute to increasing their income as well as household food security [3].

Farmers nowadays not only depend on rice farming as their source of income but also work in various activities to obtain income from other sources. Khunthongjan and Loison [4,5] suggested that to obtain high income, farmers carried out various activities either on-farm, off-farm, or non-farm. Those activities could increase household income and fulfill demand of the households.
Household income is closely related to household expenditure. The higher household income, the higher household expenditure would be. Higher household income could increase the ability of a household to buy food and non-food needs [6]. Therefore, the increase in household income will substantially increase non-food consumption expenditure since food consumption has been fulfilled [7]. The objectives of this study are to: 1) determine the Structure and factors affecting the income of farm households; and 2) investigate the Structure and factors affecting rice farmers' household expenditure in the rain-fed areas.

2. Research methods

2.1. Time and location of study
The study was conducted in Tegalgiri Village, Nogosari Sub-District, Boyolali Regency from January to March 2020. The research location was selected based on the consideration that Tegalgiri Village has the second-largest rain-fed rice field in Boyolali, and the main livelihood of the population comes from different off-farm activities in the rain-fed lowland.

2.2. The collection data method
Data used in this study included primary and secondary data. The primary data were obtained from observation and interviews using structured questionnaires. Farmer respondents were selected purposively specifically for farmers who own paddy fields and have rice farming as their source of income. The primary data consisted of farmer characteristics (age, education, farming experience, number of family members and side jobs) and farmer’s household data (sources of income and household expenses). Secondary data were obtained from several agencies and a literature review was used to support the results obtained.

2.3. Data analysis method
The obtained data were analyzed to identify the income and expenditure structure on farmer’s households as well as factors influencing household income and expenditure.

2.3.1. Household incomes. Farmer's household income came from rice farming (on-farm) and non-farm activities. Therefore, the total household income formulated as follows:

\[ I_{HT} = I_{HF}^{on-farm} + I_{HF}^{off-farm} + I_{HF}^{non-farm} \]

IHT was total household income (IDR/month), IH\textsubscript{HF}\textsuperscript{on-farm} was household income from on-farm activities (IDR/month), IH\textsubscript{HF}\textsuperscript{off-farm} was household income from off-farm activities (IDR/month), and IH\textsubscript{HF}\textsuperscript{non-farm} was household income from non-farm activities (IDR/month). On-farm income was defined as an income obtained from rice farming. Off-farm activities were categorized as farming activities that cultivate other plants than rice. Examples of off-farm activities were vegetable farming or cassava farming. Non-farm incomes were incomes that come from other jobs than farming, namely as employees, village officials, retirees, or traders [8]. Factors affecting household income were influenced by rice production, number of working family members, age and education of farmers, and non-farm activities. The factors that affect household income were developed from the model used by [9] as follows:

\[ I_{HT} = a_0 + a_1 PR + a_2 FM + a_3 AF + a_4 EF + a_5 DFH + e \]

IHT = total household income (IDR/month), PR = rice production (kg), FM = number of working family members (people), AF = age of farmer (year), EF = education of farmer (year), DFH = dummy for farmers who work in other activities than farming (1 if farmer works in non-farm activities, 0 others), a0 = constant, a1 - a5 = estimated parameter, and e = error term
2.3.2 Household expenses. Farmers used their income to buy food, non-food (service and other secondary needs), farming costs, and savings. Therefore, the household expenditure or monthly average expenditure formulated as:

\[ EHT = EF + ENF + PC + S \]

EHT defined as total farmer's household expenditure (IDR/month); EF was food expenditure (IDR/month); ENF = non-food expenditure (IDR/month); PC was production costs (IDR/month), and S was savings (IDR/month). To identify factors influencing household, this study used the expenditure model of Achmad B and Asrol [10; 11] as follows:

\[ EHT = a_0 + a_1 IHT + a_2 LA + a_3 FM + a_4 LW + a_5 PR + e \]

IHT, as already defined previously, was defined as total household income (IDR/month); LL = land area (m2); FM = number of family members (people); LW = labor wage (IDR/HOK); PR = price of rice (IDR/kg); \( a_0 \) = constant; \( a_1 \) - \( a_5 \) = estimated parameter; \( e \) = error term.

3. Results and discussion

3.1. The characteristics of farmer respondents
The identified characteristics of farmer respondents are age, education level, number of family members, farming experiences, and farming scale. The characteristics of farmers could influence farmers' decisions in farming activities. The decision indirectly affect the household production and income [12]. The characteristics of farmer respondents are presented in Table 1.

| No | Characteristics                              | Minimum | Maximum | Average |
|----|---------------------------------------------|---------|---------|---------|
| 1  | Age (years)                                 | 43      | 80      | 61.83   |
| 2  | Education of the Head of Family (years)     | 6       | 17      | 8.80    |
| 3  | Number of family members (people)           | 1       | 5       | 2.43    |
| 4  | Farming experience (years)                  | 8       | 63      | 33.00   |
| 5  | Paddy land ownership (m2)                   | 500     | 5,000   | 2,297.50|

Source: Primary data, 2018 (processed)

The age of farmer respondents in the research location was ranged between 43 and 80 years with an average of 61.83 years. There were 50% of farmers in the productive age range (40-64 years) and the remaining were in the unproductive age range (＞64 years). This indicates that farmers in the research location still had the physical ability to do farming activities. However, it is also important to aware that the age of the farmer is approaching the unproductive age. As the age is rising, productivity will also increase, and the productivity will shortly fell after passing through the productive age [12,13].

The education level of farmers varied from elementary school to undergraduate level (S1) with an average formal education around 8.80 years or equivalent to the level of junior high school. The level of education shows the level of knowledge that farmers have to apply to social and economic activities [14]. The proportion of farmers who completed formal education at elementary school level was 43.33%, junior high school 30.00%, senior high school 16.67% and S1 10.00%. According to the data, it is clear that most farmer respondents had finished elementary and junior high school education. The lack of formal education level of farmers indicates the necessary efforts to improve farmers’ knowledge through additional informal education such as training, demfarm, and others.

The number of family members in the respondent's farm household were ranged between 1 and 5 people with an average of 2.43 people. Most farmer households (56.67%) had family members around 1-2 people, 30% of households have 3 members, and only 13.33% of households have 4-5 family members. Members of the family are labor assets in the family who could support rice farming activities and other sources of income activities. Apart from being a source of income, the number
of family members is also related to household expenses. Murdani et al [15] stated that the existing of family members who still depend on the farm household, in some cases, will lead farmers to efficiently allocate their farming income to meet household expenditure. On the other hand, farmers with a greater number of family dependents will also increase family needs [16].

Although the level of education of farmers was at the level of junior high school, farming experience of farmers was between 8-63 years with an average of 33 years. Those experiences indicate that farmers already have enough experience in rice farming in rain-fed rice fields. Farmers with enough experience usually do not hesitate to learn and apply a new farming technology that could increase their yield production. Farmers with long experiences will find it easier to implement new technological innovations [14].

The land area used by farmers to cultivate rice varied between 500 - 5,000 m2 with an average of 2,297.50 m2. It indicates that rice farming in rain-fed lowland was developed on a small scale farming activities. These small scale activities support the fact that the proportion of farmers who owned land less than 2,500 m2 as much as 63.35% and only 36.67% of farmers have land larger than 2500 m2. Susilowati and Maulana [17] suggested that the average land area owned by farmers in rural areas less than 0.5 ha is the main cause of poverty in rural populations. Therefore, increasing rice production has become important to increase farm household income.

3.2. Farmer household income

3.2.1. The structures of household income. Farm household incomes are generated mostly from more than one source namely on-farm (rice farming), off-farm (non-rice farming), and non-agricultural activities (non-farm). Teame and Woldu [9] support the statement by describing that the sources of farmer incomes are from the farm income, off-farm labor income, and non-labor income or income from the non-agricultural sector. Farmers in the rain-fed areas work in their land or garden and non-agricultural businesses. As many as 70% of respondents had main job as a farmer and 30% of the other respondents had main job as traders, retirees, and rural officials.

Farmers in the rain-fed areas have three cropping patterns a year, namely paddy-paddy-crops/peanuts, while upland farming is managed by growing vegetables. Other vegetables produced by farmers are used for household consumption and increasing household income. The average farmer income is presented in Table 2.

| No | Sources of Income       | Value (IDR/month) | Percentage (%) |
|----|-------------------------|-------------------|----------------|
| 1  | Rice farming            | 1,589,894         | 30.21          |
| 2  | Other crops' farming    | 946,823           | 17.99          |
| 3  | Vegetable farming       | 900,000           | 17.11          |
| 4  | Non-agriculture         | 1,825,670         | 34.69          |
|    | total                   | 5,262,387         | 100.00         |

Source: Primary data, 2020 (processed)

The average household income of farmers was IDR 5,262,387/month. The total average income consisted of rice, crops, and vegetable farming or agricultural activities with a proportion of 65.31% or IDR 3,436,717/month and non-agricultural activities around IDR 1,825,670/month or 34.69% of total household income. Income from non-agricultural activities came from trade, salaries as village official workers, retirees, and transfers/remittances from children. The average income from rice farming was IDR 1,589,894/month as the second-largest position (31.21% of total household income), while off-farm income (palawija and vegetable farming) ranks third and fourth with their respective proportions 17.99% and 17.10% respectively.

Different results were found in the study of Murdani et al [15] that found rice farming (on-farm activities) in Pingsewu District as the biggest contributor to the total income of farmers which was
around IDR 11,292,223/year with a proportion of 57.64%, while off-farm income as the second contributor with IDR 2,550,000/year or 13.02% of the total income of farmers. The relatively small area of farming has become one of the reasons for farmers to find an additional income from non-farm activities. The study by Hariati [18] found that the upland rice farming income in North Buton Regency was IDR 930,605/month or 12.46% and the largest contribution from non-rice farming or 87.54% of total household income.

3.2.2. Factors affecting farmer’s household income. The results of the multiple regression analysis of the factors affecting farm household income are presented in Table 3.

Table 3. Factors affecting the household income of farmers in Tegalgiri Village, Nogosari Sub-District, Boyolali Regency in 2020

| No | Variables                  | Estimated Coefficient | t-stat | VIF |
|----|----------------------------|-----------------------|-------|-----|
| 1  | Constant                   | 16.59                 | 3.32*** | 0   |
| 2  | Rice production            | 0.48                  | 2.00**  | 1.16|
| 3  | Number of working family members | 0.65          | 1.18   | 3.26|
| 4  | Age of farmer              | -1.50                 | 1.47   | 2.12|
| 5  | Farmer Education           | 0.71                  | 2.08**  | 2.08|
| 6  | Dummy other job            | 0.05                  | 0.16   | 2.95|
|    | F-stat Coefficient of determination (R2) | 4.88 |       |     |
|    |                            | 0.73                  |       |     |

Source: Primary data, 2020 (processed)
Note: *** = significantly different at 99% confidence level; ** = significantly different at 95% confidence level

The model was used to determine the factors that affect the income of farm households. The results show the coefficient of determination \( R^2 \) at 0.73. It means that 73% of farm household income was influenced by the variables determined in the model, while the remaining 27% were influenced by other factors that were not in the model. The F-statistic value obtained is 4.88. The value of F-statistic indicates that the independent variables have simultaneously influenced the household income of farmers. Among those variables determined, rice production and the education level of farmer respondents have significantly influenced farm household income.

The positive sign of the coefficient parameter of rice production and the education level shows a positive correlation of rice production and farmers’ education to the household income. That means increasing rice production and the education level of farmers substantially increase farm household income. The value of rice production coefficient parameter of 0.48 indicates that every 100% increase in rice production would increase the household income by 48%. Tuyen [19] supported the results through their study that found a significant relationship between the production and farmers’ income. By assuming the price was fixed, the greater the production obtained, the greater the income would be received. The land area as an asset for farmers to increase family income [20,21]. When the land area used by farmer for production was smaller, farmers would receive lower production and income, conversely, larger areas of cultivation could increase production and revenue.

The formal education of farmers has a positive influence on household income, indicated by a regression coefficient of 0.705. This value indicates that farmers who have higher formal education have higher incomes than farmers who have lower level of education. The results are supported by the study of Norfahmi et al [22] that farmers who have high levels of education would easily adopt new innovations to increase production and household income. The study of Tumiwa [23] also found that education was significantly influenced household income with a regression coefficient of 0.163 and thus, the higher the education level of farmers, the higher income farmers would be. Julianto and Utari [24] stated that farmers with lower education had a lower income than farmers with higher education. Some of these results imply that formal education has a positive correlation with the level of household income.
The number of family members who work, the age of the farmer and dummy side jobs do not have a significant effect on the household income of the farmer. Total family members who work in the household ranged between 1 and 3 people with an average of 1.3 people. Most households (73.33%) had only one person working in their rice farming. The remaining households had 2 people (23.33%) and 3 people (3.37%) work in their rice farming. The smaller number of family members who work in the rice farming justifies the insignificant effect of the number of family members to household income since the household still has to hire more external laborers.

The age of farmers was not significantly influenced the household income because the average age of farmers was 61.83 years. In that age average, their ability to work in the farm had a declining trend. The idea is supported by Putri and Setiawina [25] who mentioned the relationships between a person's physical strength to carry out activities and age. When the age of productive period has passed, the physical strength decreased and substantially decreased the productivity and the income. Similar results were obtained in the study of Titimiranti et al [26] that found the age of farmers did not have a significant effect on household income in Demak Regency.

The activity of rice farming in rain-fed lowland as a side job does not have a significant effect on household income. The insignificant effect of side job to household income could be explained by looking at the number of farmers who used rice farming as their side job. There were only 30% of farmer respondents who used rice farming as their side job, while 70% of others used rice farming as their main source of income. Therefore, it is rational if the rice farming as a side job could not significantly influence the household income.

3.3. Farmer household expenditure

3.3.1. Structure of household expenditure. Farmer household expenditure consisted of food and non-food expenditure [27] and production costs. Food expenditure consisted of unpurchased food, namely rice and some vegetables produced from their farms, and purchased food or other foods that were not cultivated in their farms. The structure of farm household expenditure is presented in Table 4.

Table 4. The monthly expenditure of farm household in the rain-fed land areas in Tegalgiri Village, Nogosari Sub-District, Boyolali Regency in 2020

| No | Expenditure Category | Value (IDR/month) | Percentage (%) |
|----|----------------------|-------------------|----------------|
| 1  | Food:                |                   |                |
|    | a. Unpurchased Food  | 329,039           | 6.25           |
|    | b. Food purchased    | 1,259,000         | 23.92          |
| 2  | Non-food             | 1,259,592         | 23.94          |
| 3  | Farming capital      | 1,022,003         | 19.42          |
|    | Expenses             | 3,869,634         |                |
| 4  | Savings              | 1,392,753         | 26.47          |
|    | Total Expenses       | 5,262,387         | 100.00         |

Source: Primary data, 2020 (processed)

Farmers allocated their income to fulfill the household needs and production costs. The largest proportion of income was allocated to buy food, which is 30.17 %, while non-food were 23.94% of income. The proportion of food expenditure is greater than the proportion of non-food expenditure. The biggest expenditure of farmers' household in Aceh Besar Regency and Central Lampung Regency was to buy food (63.7% and 80.94%) [28,29]. The expenses for food have the largest share compared to other expenses since food is a basic daily need for the household and the share is also influenced by the number of family members.

Additionally, farmers also used their income to fund their farming activities. The average expense spent by farmers to fund their farming was around IDR 1,022,003/month with a proportion of 19.42%. Therefore, farmers have spent IDR 3,869,634/month to buy food, non-food, and farming inputs. Of all these expenses, farmers were still able to use the remaining income around IDR...
1,392,753/month or 26.47% of income for savings. The ability of farm household to save and less expenditure on food (30.17%) indicate that the majority of farmers are not poor and food secured. If the share of food expenditure is less than 60% then households are categorized as food resistant [13, 30]. By savings their income, the households have easy access to money anytime they have financial and production problems as well as have the purchasing power to buy food and non-foods.

3.3.2. Factors affecting farm household expenditure. Table 5 shows the results for factors affecting household expenditures. According to Table 5, the coefficient of determination (R2) for factors affecting household expenditure is 0.58. The value of R2 indicates that 58% of farm household expenditures were influenced by the variables determined in the model, while the remaining 42% were influenced by other factors that were excluded. The simultaneous relationship between independent variable and dependent variables could be seen from the value of F-stat. The value of 6.51 means that the variables are simultaneously influenced farm household expenditures.

Table 5. The results estimation of factors affecting farm household expenditure in Tegalgiri Village, Nogosari Sub-District, Boyolali Regency in 2020

| No | Variables                  | Parameter Coefficients | t-Stat | VIF |
|----|----------------------------|------------------------|--------|-----|
| 1  | Constant                   | -5.26                  | 0.32   | 0   |
| 2  | Household income           | 0.44                   | 3.71*** | 1,171 |
| 3  | Land area                  | 0.23                   | 1.70**  | 1,595 |
| 4  | Number of family members   | 0.22                   | 1.63   | 1,028 |
| 5  | Labor Wages                | -0.31                  | 1.48   | 1,106 |
| 6  | Price of rice              | 1.49                   | 1.24   | 1,530 |
|    | F-Stat                     | 6.51                   |        |     |

Source: Primary data, 2020 (processed)
Note: *** = significantly different at 99% confidence level; ** = significantly different at 95% confidence level

According to Table 5, there are two factors that significantly affect household expenditures. Those factors are household income and land area. Both factors have a positive sign that indicates a positive correlation between those two variables and household expenditures. The estimated parameter coefficient for household income is 0.44. The value implies that a 100% increase in household income increase the household expenditure by 44%. According to Yanti and Murtala [31], higher income encouraged consumer to access better and variety goods and services. The lower proportion of farmers’ expenses illustrates the lower possibility for farmers to change their consumption pattern because of increasing income. In contrast to study of Sultan [32], farmers in Toli-Toli district had spent most of their expenses for household consumption. The fact that they used their majority income for household consumption could be seen from the value of the parameter coefficient around 0.94. Around 94% of farmers’ income in Toli-Toli District were used for household consumption and almost all income increases allocated to increase household consumption.

Land area variable has a significant effect on household expenditure with an estimated parameter coefficient of 0.23. This means the increasing land for plantation increase farmers’ expenditure. The increasing land area would substantially increase farmers’ expenditure to buy inputs (seeds, fertilizers, pesticides) or production costs. Sugesti et al [29] found similar results. The size of rice field area has a significant impact to household expenditure. The wider the land area used for cultivation, the higher the income would be received and the higher the expenditure would be spent for cost of production.

The number of family members does not significantly influence the household expenditure. The smaller number of household members could be one of the reasons for the insignificant influence of the size of household to household expenditure. Labor wages have no significant effect on household expenditure. The insignificant influence of labor wages is possible since the land area owned by
farmers is relatively small, which is only 2,297.50 m². Therefore, every changes in wages does not significantly affect spending. Saragih and Saleh [33] states that there is no significant effect of labor wages due to the relatively unchanging wage variations.

The price of rice in the research location does not significantly influence household income. It is assumed that farmers do not sell all of their production. Some rice and vegetables produced are used for household consumption. Therefore, the changes in the price of rice would not substantially increase their spending on rice.

4. Conclusion
Farmer households in the rain-fed lowland areas had many sources of income, namely rice, crops, vegetables farming and non-agricultural activities. The average household income of farmers in the research location was IDR 5,262,387 month with the largest proportion of income generated from rice farming (65.31%). Factors that affect farmers' household income were rice production and the education level of farmers with a positive correlation. This means the increasing rice production and the higher the education level of farmers increase farmers' income.

The average expenditure of farmer households was IDR 3,869,634/month. Farmers' expenditure consists of food, non-food, and capital expenditures. The proportion of food expenditure was 30.17%, non-food expenditure 23.94%, and farming costs 19.42%. The excess income of around 26.47% was used as savings. Factors affecting household expenditure were household income and land area. The higher the income and land area, the greater the expenditure would be. However, the proportion of expenditure was still lower than the proportion of increased income and land area. Therefore, to increase household income and welfare could be done by optimizing the management of rain-fed lowland and upland fields.

Acknowledgments
The author is greatly acknowledged the Agency for Agricultural Research and Development, specially Central Java Assessment Institute for Agricultural Technology (AIAT) for funding the Assessment for Largo Super Cultivation Technology in the Budget Year of 2020. The author would like to thank Mister Yuni Kamal as a technician from Central Java AIAT who provided technical and non-technical assistance to the activity, as well as the extension workers of Nogosari District for their assistance during the implementation of activities in Boyolali Regency in 2020.

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