Analysis of income distribution as prevention of environmental damage in agribusiness management of cassava in Bengawan Solo watershed, Wonogiri regency

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Abstract. This research was conducted with the aim of 1) knowing the income distribution or income gap among cassava farmers, 2) looking for solutions to increase cultural values in preventing environmental damage related to the management of cassava agribusiness in the Bengawan Solo Wonogiri watershed, which indicates environmental damage in land degradation and erosion which leads to silting of the Wonogiri Reservoir. This research used a survey approach with cross-sectional data, with a questionnaire research instrument. Data were analyzed with income analysis and income distribution analysis by looking for the Gini Index value and depicted by the Lorentz curve. The results showed that the level of income gap was quite high with the Gini Index number reaching 0.4 in the management of cassava agribusiness. It is recommended to strengthen cultural values through increasing the capacity of farmers' human resources in social empathy.

1. Introduction
One of SDG's goals is to eradicate extreme poverty and hunger (Eradicate Extreme Poverty and Hunger). Poverty causes a decrease in the quality of life of the community. Poverty results in high socio-economic burdens for society, low quality, and productivity of human resources as well as the decline in public order. The majority of poor people depend on the agricultural sector for their livelihoods so that the role of agricultural actors increases in the development process [1]. Poverty is often defined only as an economic phenomenon. Poverty is often defined as low income or not having a sufficiently stable livelihood to depend on life. Poverty is related to social problems, access to water resources, shelter, health and sanitation services, education, and transportation [2]. The roots of poverty are dependence, isolation, vulnerability, and low life expectancy. The Bengawan Solo Watershed (DAS) is the longest river in Java Island with an estimated river length of 548.53 Km and divides into two provinces, namely Central Java and East Java, one of which is in Wonogiri Regency. Keduang Sub-watershed is one of the sub-watersheds in the Upper Solo Watershed as the largest contributor to the erosion rate of the silting of the Wonogiri reservoir [3]. The condition of the catchment area is of concern, especially the high rate of erosion and decreasing productivity of land, causing the phenomenon of the socio-economic conditions of the community to be in poverty shackles. The socio-economic characteristics of the community allow farming processes to be carried...
out without heeding conservation principles. Although the community's actions in the farming process are not fully realized, they all stem from the insufficient demands for the living needs of the surrounding community and the existence of the reservoir has not had a significant impact on the socio-economic aspects of the surrounding community, the limited source of reliable income has an impact on the tendency of community repressive actions. on the empowerment of natural resources in the vicinity, which is reflected in cropping patterns, types of plants, and farm management patterns that are not accompanied by conservation principles, which will worsen the rate of erosion and sedimentation. One type of plant that is cultivated is cassava. Therefore, cassava agribusiness as a type of crop in a cropping pattern is important and urgent to be matched to income and distribution related to resource and environmental management for the sustainability of the Wonogiri reservoir.

2. Methods
The basic research method used is the descriptive-analytic method which aims to focus on solving problems that exist in the present. Types and sources of data that were used in this study are primary data and secondary data. Primary data collection methods using questionnaires and in-depth interviews were conducted on respondents who were taken by simple random sampling in 2 districts in the Keduang sub-watershed area, namely Ngadirojo and Jatipurno districts. Respondents are farmers who own cassava farming in the area. Data were analyzed with income analysis and income distribution analysis by looking for the Gini Index value and depicted by the Lorentz curve.

The Gini Index formula is presented as follows [4].

\[
IG = 1 - \sum_{i=1}^{n} f_i \left( Y_i + Y_{i-1} \right)
\]

Where:
- \( f_i \) = Proportion of the number of households in i-class
- \( Y_i \) = Proportion of cumulative amount of income in i-class
- \( Y_{i-1} \) = Proportion of cumulative amount of income in previous class
- \( IG \) = Gini Index

In general, analysis using Lorenz Curve aims to know in more detail the pattern of the income distribution, complementing the results of the analysis of the Gini Index. The Lorenz curve can fill the weakness of the Gini Index because it can describe the distribution of income more fully and show an overview of inequality whether it occurs in the downward spiral or the upper spiral [5].

3. Results and discussion
The problem of socio-economic inequality (income distribution) and environmental damage is rooted in cultural values and social capital in local communities [6,7]. It is further stated that the causes of massive environmental damage are a group of poor people whose livelihoods are very dependent on natural resources and the environment, especially land for subsistence farming activities. The land for agricultural activities will determine the amount of income used for household needs.

The results of the study of the area of land managed by farmers for cassava agribusiness based on the ecosystem (tegal land, yards, or rainfed rice fields). tegal (0.26 Ha), rice fields (0.22 Ha) and yards (0.19). The location of the moor is spread over 3 locations, two fields of rice fields, 2 plots of yards, so that seen from the distribution, the average respondent has 7 small plots of land and is spread out with a total land occupied by 0.67 Ha. Thus, seen from the area of land ownership of the cassava farmers, it is included in the criteria for low/narrow land ownership. (<1 ha) with scattered locations. Analysis of land use distribution (inequality) for cassava agribusiness is presented in Table 1.
Table 1. Calculation of the Gini ratio value of cassava farming land mastery

| No. | Land area | F | \( P_n \) | \( K_{\text{um}} \) | Y | Relative | \( Q_n \) | \( Q_n + Q_{n-1} \) | \( P_n (Q_n + Q_{n-1}) \) | GR |
|-----|-----------|---|--------|-----------|---|----------|---------|-----------------|------------------|-----|
| 1   | 0.43      | 8 | 0.20   | 0.20      | 3.44 | 0.14     | 0.14   | 0.14            | 0.03             |
| 2   | 0.47      | 8 | 0.20   | 0.40      | 3.76 | 0.15     | 0.29   | 0.44            | 0.09             |
| 3   | 0.56      | 8 | 0.20   | 0.60      | 4.48 | 0.18     | 0.48   | 0.78            | 0.16             |
| 4   | 0.72      | 8 | 0.20   | 0.80      | 5.76 | 0.24     | 0.72   | 1.20            | 0.24             |
| 5   | 0.85      | 8 | 0.20   | 1.00      | 6.80 | 0.28     | 1.00   | 1.72            | 0.34             |
| Total | 3.03  | 40 |         | 24.24    |     |          | 0.86   | 0.14             |

Source: Primary Data Analysis

Based on Table 1, it is known that the Gini ratio (GR) value of the cassava farming land is 0.14. This value indicates that the level of inequality of land tenure for cassava farming in each class is classified as very low because of the Gini ratio (GR) value <0.2. This means that the level of evenness of the cassava farming land is in the high category. The area of land cultivated by farmers for cassava agribusiness shows the ownership and area of arable land evenly but is classified as narrow land. Farmers with arable land > one hectare and above (20%) and (40%) own land area of 0.50-0.90 ha and the rest have land with an area ranging from 0.20-0.40 ha. More details The picture related to the evenness level of land tenure for cassava farmers can be seen in the following curve.

Figure 1. Lorenz curve of tenure

Data Source: Primary Data Analysis, 2020

The curve (Figure 1) shows the degree of curvature that is not too convex (almost approaching the diagonal line). The diagonal line is a perfect evenness line. If the Lorenz line of land tenure is getting closer to the line, it can be said that it is in the high level of evenness category but with a narrow cassava agribusiness area. This land area affects the amount of cassava agribusiness income. The distribution of cassava agribusiness income can be seen in Table 2.
Table 2. Calculation of the gini ratio value of cassava agribusiness income

| No. | Average Income (thousands of IDR) | F | Pn | Kum Pn | Y (thousand) | Y Relative | Qn | Qn + Qn-1 | Pn (Qn + Qn-1) | GR |
|-----|----------------------------------|---|----|--------|-------------|------------|---|------------|----------------|----|
| 1   | 1952.50                          | 8 | 0.20| 0.20   | 15620       | 0.08       | 0.08| 0.08      | 0.08           | 0.25 |
| 2   | 3218.75                          | 8 | 0.20| 0.40   | 25750       | 0.14       | 0.22| 0.30      | 0.06           | 0.12 |
| 3   | 4243.75                          | 8 | 0.20| 0.60   | 33950       | 0.18       | 0.40| 0.62      | 0.12           | 0.12 |
| 4   | 6061.25                          | 8 | 0.20| 0.80   | 48490       | 0.26       | 0.66| 1.06      | 0.21           | 0.21 |
| 5   | 8011.75                          | 8 | 0.20| 1.00   | 64094       | 0.34       | 1.00| 1.66      | 0.33           | 0.33 |
|     | Total                            | 23488 | 40 |     | 187904     | 0.75       | 5  | 0.25      |                |     |

Source: Primary Data Analysis

Based on Table 2. It can be seen that the value of the Gini ratio in cassava agribusiness income is 0.25, this value is in the interval range 0.20-0.35. This means that the level of income inequality in each class (group) is categorized as low with a high level of evenness. This is influenced by the area of land that is owned, in this study shows very high evenness. If the cultivated land area tends to be the same between one farmer and another, then the income from farming on that land also tends to be the same at the same cultivation. Besides, the cost of cultivating cassava is not too big even for labour to rely on family members. To see the even position of cassava farming income, it can be seen in the Figure 2.

Figure 2. Lorenz curve of cassava farming income

Data Source: Primary Data Analysis, 2020

The curve image above which approaches the diagonal line indicates that the cassava agribusiness income is close to evenness or with a low level of inequality. Or high equity with low-income levels. This means that the land area and the cassava agribusiness income are parallel, if the land area is low, the income is low and if the land area is high, the cassava agribusiness income is high. Farm households get income from various sources, not only from cassava agribusiness. The amount of total household income of cassava farmers varies depending on the number of sources of income and the size of each contribution of these sources of income. The source of farmers' income for timber comes from on-farm (from non-cassava agribusiness) and non-farm (trading, MSMEs, services, shipments of children/relatives, etc.). Analysis of the distribution of the total household income of cassava farmers can be seen in Table 3.
Table 3. Calculation of the Gini ratio value of total cassava farmers’ income

| No. | Average Income (thousand IDR) | F  | Pn | Kum Pn | Y (thousand) | Y Relative | Qn | Qn + Qn-1 | Pn (Qn + Qn-1) | GR  |
|-----|-----------------------------|----|----|--------|-------------|-----------|-----|-----------|----------------|-----|
| 1   | 4445.40                     | 8  | 0.20| 0.20   | 35632.20    | 0.05      | 0.05| 0.05      | 0.01            |     |
| 2   | 8126.25                     | 8  | 0.20| 0.40   | 65010       | 0.09      | 0.15| 0.20      | 0.04            |     |
| 3   | 11857.75                    | 8  | 0.20| 0.60   | 94862       | 0.14      | 0.29| 0.44      | 0.09            |     |
| 4   | 19747.37                    | 8  | 0.20| 0.80   | 157979      | 0.23      | 0.52| 0.81      | 0.16            |     |
| 5   | 40098.25                    | 8  | 0.20| 1.00   | 320786      | 0.47      | 1.00| 1.52      | 0.30            |     |
| Total| 84275.03                    | 40 |     |        | 674200200   |           |     |           | 0.61            | 0.39|

Source: Primary Data Analysis

Based on the results of the analysis in Table 3, the GR value is 0.393601 or 0.39. This value is included in the category of moderate level of inequality or moderate level of evenness because the GR value is between the interval 0.35-0.50. This can be due to additional income from each member of the farming family. Farmers as heads of families who run cassava agribusiness can also have side jobs outside of cassava farming. Therefore, the distribution of the total income of cassava farmers can differ greatly from one farmer to another, the results of the study show that the income level varies between IDR 1,952,500 to IDR 8,011,750. To ensure the analysis, data on the level of total household income of cassava is needed. The results of the study show that the total household income of cassava farmers varies about IDR 4,445,400. To understand the evenness or inequality position of the total income of cassava farmers, the following figure is presented.

The difference in income will result in a difference in income distribution [8]. Differences in income distribution will result in income distribution inequality that eventually leads to a swath away from welfare. The type of livelihood of members of the farmer's family can also affect the level of the income distribution. Farmers as the backbone of the family also get additional income from family members, the income of family members affects the total household income. The level of inequality of the total income distribution of the farmer's household is influenced by the agricultural, non-agricultural, and family member income sectors [9].

Figure 3. Lorenz curve of total income of cassava farmers
According to what is seen in Figure 3, the level of curvature of the Lorenz curve is more convex or away from the diagonal line. The curve that is away from the diagonal line indicates that the distribution of the total income of the cassava farmers is away from evenness. Even so, the degree of curvature of the curve is not that large, because the calculation of the Gini ratio is in the medium evenness category.

The distribution of income moves increasingly unequal when the cassava farmer's household has an unequal additional income from non-farm income, meaning that not all farmers have access to sources of income outside of agriculture. When this happens, farmers will remain in a position on agricultural land as their only source of income. Therefore, repressive actions towards land will be higher to try to increase their income, this is what causes land damage which is driven by increasing demand. If the carrying capacity of the land is not optimal, it can be done with production technology, if the land has a maximum carrying capacity, the tendency of land exploitation will take place and lead to land damage or degradation. Production technology will also relate to the socio-cultural aspects of the community. The socio-culture greatly determines the community system in managing the environment and natural resources [10]. The occurrence of overshoot symptoms in natural resource management is rooted in constrained the value of greed that develops in society [6,11]. The results of the analysis show that the level of income of cassava farmers is still low, both the income of cassava farming alone and the total household income of cassava farmers, when there is an expansion of agribusiness to other crops due to pressure from poverty and the insistence on subsistence needs is inevitable and the economic position of the farmers is marginal, then the damage to the land ecosystem can be seen as a poverty trap (poverty trap) due to inequality of income or an even but low-income distribution.

4. Conclusion
The distribution of cassava agribusiness income is high evenly but with a low level of income comes from the distribution of cassava agribusiness land area which has an even distribution with a low land area with variations in the area of cassava agribusiness varying from 0.76 Ha to 0.85 Ha, while the distribution of the total household income of the cassava farmers tends to be moderate. This means that there is an indication that access of cassava farmer households to non-farm is limited, so there is a tendency for expansion to more repressive land use and exploitation to increase their income which leads to environmental damage to land/land degradation.

Efforts to prevent are to encourage farmer independence to increase the capacity of farmers' human resources in social empathy, a spirit of cooperation and appreciation for environmental knowledge and rational collective decision making, and a high level of accountability in cassava agribusiness management.

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