Performance of several varieties of maize and upland rice in the intercropping system in Northern Gorontalo

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Abstract. This study aims to: 1) knowing the performance of several varieties of maize and upland rice on the application of monoculture and intercropping system cultivation technology, and 2) Financially analyzing maize and upland rice farming with monoculture and intercropping systems in dry land agroecosystems in Gorontalo Province. This assessment activity was carried out with a participatory approach involving 15 cooperative farmers on 12 ha of land in Durian Village, Gentuma Raya District, North Gorontalo Regency on dry climate dry land agroecosystem with a wavy topography in 2018. Maize varieties planted were Nasa 29, Bima 2, Bima 20, HI 21, JH 27, Bisi 18, NK 22, and Pioneer 35. The varieties of upland rice planted were Situ Bagendit, Inpago 8, Inpago 11, Inpari 42, Ponelo, and Towuti. The results of the study showed that the average productivity of maize with a monoculture system (5.13 t / ha) was higher than the average productivity of maize with an intercropping system (3.61 t / ha). In the monoculture system, maize varieties with the highest productivity was JH 27 (6.4 t / ha). In the intercropping system, maize varieties of the Indonesian Agency for Agricultural Research and Development (IAARD) of BIMA 2 achieved the highest productivity at 4.83 t / ha. The average productivity of upland rice with a monoculture system (4.46 t / ha) was higher than the average productivity of upland rice with an intercropping system (2.17 t / ha). In the monoculture system, the highest productivity was Inpago 11 variety (5.67 t / ha). Whereas in the intercropping system, the highest productivity was the Ponelo variety (3.95 t / ha). Based on farming financial analysis, efficient farming systems were successively from highest to low, namely upland rice monoculture, maize intercropping systems with upland rice, and maize monoculture.

1. Introduction

The potential of dry land in Indonesia is relatively high and still needs more attention for its development. Sukarman et al [1] states that the total area for the development of dry land food crops in Indonesia reaches 25.09 million ha where if sorted according to its climate it is divided into wet climate dry land by 22.86 million Ha and dry climate dry land as much as 2, 23 million Ha. If examined further, from the existing data on dry land use, it shows that the dependence of agriculture on dry land farming is far greater than the wet land / paddy fields which are only 7.8 million ha, and half the area of 3.24 million ha is in Java.

One of the provinces in Indonesia which has the potential to develop dry land for agriculture is Gorontalo. The total area of Gorontalo reaches 1,221,544 hectares, with potential agricultural land of 443,140.28 ha. Of this total area, dry land area reaches 285,449 ha, of which the largest is in Pohuwato Regency, which is 76,998 ha (27%), followed by Gorontalo District, 66,348 ha (24%),
Boalemo District 64,655 ha (23%) and North Gorontalo District 42,557 ha (15%). Meanwhile, the area of irrigated and non-irrigated paddy fields in Gorontalo Province reached 35,685 ha consisting of irrigated paddy fields totalling 27,674 Ha and non-irrigated 8011 ha [2].

Utilization of dry land for food crops for the people of Gorontalo is the main thing. Moreover, the commodity of maize is a brand of Gorontalo Province. The trend of maize growing area shows an increasing trend where in 2012 it reached 135,543 Ha and then increased to 195,606 Ha in 2016 [2]. The highest planting area of maize was in Pohuwato Regency reaching 67,469 (34.5%) ha and Gorontalo Regency 60,897 ha (31.13%). Maize production in Gorontalo Province also showed significant results which reached 644,755 tons (2012) and increased to 1,477,222 tons (2017). Similarly, upland rice production showed a positive trend from 120 tons (2012) to 7,836 tons (2015). As for the planting of upland rice concentrated in North Gorontalo Regency with an area of 2,858 hectares (95% of the total upland rice in Gorontalo Province), the remaining 143 hectares in Bone Bolango Regency.

The large potential of dry land in Gorontalo Province requires strategic efforts in the management of dry land so that it can be utilized for the development of agricultural crops optimally given several obstacles to the use of dry land, among others: 1) Most of the dry land has low fertility rate and limited water resources except from rainfall whose distribution cannot be controlled according to need, 2) Topography is generally uneven, located on slopes and hills, has a relatively high level of erosion that has the potential to cause land fertility degradation, 3) Economic infrastructure is not as good as in paddy fields, 4) Biophysical limitations land, farmers’ land tenure, and economic infrastructure make farming technology relatively expensive for dry land farmers, and 5) Limited land quality and application of technology causes relatively high variability of dry land agricultural production.

One effort that can be done in overcoming land biophysical limiting factors is through the application of technological innovations to increase productivity. The Agricultural Research and Development Agency has produced various technological innovations to increase farm productivity and income on dry land for both maize and rice commodities. The main technology that has been produced is new superior varieties (VUB) that are suitable with dry land agro-ecosystems. VUB is a major component that has a large influence in increasing maize and rice production. New improved varieties (VUB) maize seeds are one way to make better yields and can increase farmers’ income [3]. Another technological component, which is being developed, is the jajar legowo planting system. Unlike rice, the application of the legowo system in maize plants is more directed at increasing the reception of sunlight intensity for the optimization of photosynthesis and assimilation. The application of jowo legowo in maize on dry land, can be optimized by planting upland rice in the legowo, so that land use can be optimized. This cropping pattern is known as intercropping cultivation system.

Intercropping cultivation system is a form of cropping pattern that cultivates more than one type of plant in a certain time unit [4]. This intercropping is an effort of the agricultural intensification program with the aim of obtaining optimal production results, and maintaining soil fertility. Chatarina [5] states that intercropping is a form of alternative agricultural intensification program that is right to multiply agricultural output in less productive areas. Intercropping systems are intended so that food shortages due to crop failure can be prevented and pest and disease attacks can be suppressed. Intercropping systems practiced by farmers are low yielding because crop spacing is not regulated, crop combinations are not right and not complementary. If the composition of plants and spacing are arranged properly, the yield of the combination of plants per unit area is higher than the monoculture system. This can be a solution and a breakthrough in achieving food self-sufficiency.

Several previous studies have been conducted related to the application of intercropping cultivation technology. Aprianti et al [6] revealed that the intercropping of maize with rice affected the growth and yield of maize. The study of [7] states that maize intercropping with soybean influences the growth and yield of hybrid maize plants. Research conducted in China shows that intercropping of maize with soybean yields a Land Equivalent Ratio of 1.14 [8]. Land equality value of more than 1 indicates the existence of farming benefits [7]. From the financial analysis [9], stated that the intercropping of the maize legowo row system with soybeans adds to the amount of costs incurred by farmers, but the amount of revenue and intercropping farming revenue is greater than that of monocultures of maize farming.
However, intercropping systems of cereals with legumes commonly used by farmers do not always give good results due to the selection of inappropriate varieties [10]. Research on intercropping of upland rice with sweet maize did not affect the yield of upland rice.

Maize and upland rice cultivation with intercropping systems is relatively unusual for farmers in Gorontalo. Therefore, it is important to study the application of technology for cultivation of maize and upland rice in the dryland agroecosystem in Gorontalo Province to support increased production and productivity of these two commodities. Application of maize and upland rice cultivation technology on dry land with intercropping system is expected to be able to increase production and productivity of maize and rice by optimizing land use and regulating plant populations, as well as using appropriate cultivation technology especially the use of suitable varieties of maize and rice for intercropping systems.

The objectives of this study are to: 1) Knowing the performance of several varieties of maize and upland rice on the application of monoculture and intercropping system cultivation technology, and 2) Financially analyzing maize and upland rice farming in monoculture and intercropping systems in Gorontalo Province.

2. Research method

2.1. Research Location and Time
The study was conducted in Durian Village, Gentuma Raya District, North Gorontalo Regency on a dry climate dry land with wavy topography in March to December 2018.

2.2. Research methods
This assessment activity was carried out with a participatory approach by involving cooperative farmers, researchers, extension workers and other stakeholders in escorting and assisting technology. The technology applied comes from Puslit / Balit Commodities. The assessment was carried out on 12 hectares of farmer's land involving 15 cooperative farmers in the Durian Jaya II farmer group, Gentuma Raya District, North Gorontalo District.

The assessment was carried out using the Zero One Relationship Approach method by comparing the introduction of Indonesian Agency for Agricultural Research and Development (IAARD) technology to existing farmers' technology. The farming system being studied is the application of corn and upland rice cultivation technology on dry land in Gorontalo Province which consists of three farming systems namely corn monoculture, upland rice monoculture, and corn - upland rice intercropping.

Table 1. Introduced technology packages

| No | Planting System | Technology Components |
|----|----------------|-----------------------|
| I  | Maize Monoculture System | 1 New superior varieties of maize Bima 2, Bima 20 URI, HJ 21, JH 27, Nasa 29, Bisi 18, NK 22, and Pioneer 35 |
|    |                 | 2 Seed treatment uses metalaxil |
|    |                 | 3 Jarwo planting system (100-50) x 20 cm, 1 seed per planting hole |
|    |                 | 4 Balanced fertilization, phonska: 300 kg / ha, urea: 200 kg / ha, ZA: 100 kg / ha) |
|    |                 | 5 Use of 1 handheld organic fertilizer per planting hole (as a cover for planting holes, a total dose of 1 ton / ha) |
II Upland rice monoculture system

1. New superior varieties of upland rice Situbagendit, Ponelo, Inpago 11 and Inpari 42
2. "Agrice Plus" biological fertilizer, dosage: 200gr / 25 kg
3. Biodekomposer “Agrodeko”, dosage: 2 lt/ha
4. Legowo row planting system: 2:1
5. Fertilization based on PUTK (urea: 100 kg / ha and NPK phonska 200 kg / ha)
6. Organic fertilizer
7. Bioprotector
8. Use of agricultural tools and machinery

III Intercropping system of maize and upland rice

1. New superior varieties of maize (Bima 2, HJ 21, JH 27, Nasa 29) dosage: 20 kg/ha and upland rice (Situbagendit, Ponelo, Towuti, Inpago 8, Inpago 11, Inpari 42) dosage: 40 Kg/ha
2. "Saromyl" maize seed treatment and "Agrice-Plus" rice seed treatment
3. Fertilization
   Maize= phonska (300 kg/ha), urea (200 kg/ha)
   Upland rice = phonska (200 kg/ha, urea (100 kg/ha)
4. Spacing of maize I (50 x 20) cm and II (40 x20) cm, 1 seed per planting hole
   Spacing of rice (20 x 10) cm, 3-5 seeds per planting hole

2.3. Types and Data Analysis Methods

The study uses primary data including farm data such as production inputs and outputs, input and output prices, labor costs, agronomic performance data. Measurement of yield performance was done through sampling both in the monoculture system and in the intercropping system. In the maize monoculture system, the uptake was done with the size of 4 rows of maize (2.8 m) x 5 m = 14 m². In the rice monoculture system, the uptake was done with the size: 2 m x 6 m = 12 m². In the intercropping system, harvesting of maize and rice was done with a size: 3.8 m x 5 m = 19 m². Productivity was measured by the following formula:

Productivity = weight of sample (kg) / area of sample (m²)

Data analysis was performed using descriptive methods, the data obtained were analyzed by tabulation which included data on growth performance and yield of maize and upland rice, farm financial finances including cost, revenue, profit, and R / C ratio.

Farming financial analysis is carried out to measure the level of farm success. This analysis is used to find out the level of profit received by farmers in maize farming by applying PTT during one production process period (one planting season). Indicators used in the calculation of farm profits are: (1) if the farm costs are greater than revenue then the farm is said to be a loss, (2) if the farm costs equal to revenue then the farm is at the break-even point, and (3) if the cost of farming is less than the income, so farming is said to be profitable. Farming profits are obtained from the difference between farm receipts and farming costs. In farming, the amount of costs incurred is generally divided into cash costs and non-cash costs (costs are calculated). Cash costs are incurred by farmers in cash. While the costs calculated by farmers are not in the form of money, they must be calculated in farming activities. Therefore, the formula for finding the magnitude of farming profits can be written as in the following equation:
\[ \pi = TR - (Bt + Bd) \]

Where:
- \( \pi = \) Net farm profit (Rp)
- \( TR = \) Total farm revenue (Rp)
- \( Bt = \) Cash costs (Rp)
- \( Bd = \) Cost calculated (Rp)

The results of the analysis of revenues and costs can also show the benefits of a farm through the calculation of \( R / C \) ratio. Analysis of the balance of revenue and costs (\( R / C \) ratio) is used to see the benefits of farming from the amount of revenue received by farmers for each rupiah that has been spent on farming. Calculation of the ratio of revenue and cost (\( R / C \) ratio) is divided into two, namely \( R / C \) over cash costs and \( R / C \) over total costs. \( R / C \) for cash costs is calculated by comparing total receipts with cash costs incurred. While the \( R / C \) of the total cost is obtained by comparing the total revenue with the total cost incurred. Where the total cost is the sum of cash costs with costs calculated. Farming is said to be efficient if the \( R / C \) ratio value is greater than one. The greater the value of \( R / C \) ratio, it shows the more efficient farming activities.

3. Results and Discussion

3.1. Performance of maize and rice with monoculture and intercropping systems

The performance of new superior varieties (VUB) of the Agency for Agricultural and Multinational Research and Development on monoculture and intercropping systems can be seen in Table 2. In the monoculture system, the Bima 20 maize variety has a height above the other varieties that is equal to 252.1 cm while the lowest is the HJ 21 variety. As for the intercropping system, it is known that the pioneer maize varieties have a plant height of 212 cm or the highest compared to other varieties while the varieties are the lowest is HJ 21 with a plant height of 142.8 cm.

The long component of maize cobs in the monoculture system shows that Bima 2 has the longest cob of 20.6 cm and the shortest is HJ 21 variety. In the intercropping system, Bisi 18 variety has the longest length of 18.6 cm while the shortest variety of NK 22 is 15.8 cm. The length of the cobs in both systems showed that in intercropping (17.2 cm) the average length of the cobs was much shorter than 1 cm compared to the monoculture system (18.2 cm). The performance of upland rice in monoculture and intercropping systems can be seen in Table 3.

**Table 2. Results performance of maize in monoculture and intercropping systems**

| Varieties | Plant Height (cm) | Cob length (cm) | Number of Rows | Plant Height (cm) | Cob length (cm) | Number of Rows |
|-----------|------------------|-----------------|----------------|------------------|-----------------|----------------|
| Nasa 29   | 221.2            | 17.0            | 17             | -                | -               | -              |
| Bima 20   | 252.1            | 17.6            | 13             | -                | -               | -              |
| HJ 21     | 169.0            | 15.8            | 13             | 142.8            | 16.5            | 16             |
| JH 27     | 200.4            | 19.4            | 15             | 199.5            | 17.2            | 14             |
| NK 22     | 209.2            | 17.9            | 14             | 201.6            | 15.8            | 13             |
| Bisi 18   | 236.6            | 19.1            | 14             | 201.5            | 18.6            | 18             |
| Bima 2    | 233.0            | 20.6            | 19             | 206.5            | 18.0            | 15             |
| Pioneer 35| -                | -               | -              | 212.0            | 17.1            | 18             |
| Average   | 217.4            | 18.2            | 15.1           | 194.0            | 17.2            | 15.7           |
| Varieties     | Plant Height (cm) | Number of tillers (units) | Amount of Grain per panicle (unit) | Plant Height (cm) | Number of tillers (units) | Amount of Grain per panicle (unit) |
|--------------|-------------------|---------------------------|-----------------------------------|-------------------|---------------------------|-----------------------------------|
| Situ Bagendit| 114.8             | 21                        | 202                               | 98.2              | 16                        | 148                               |
| Inpago 11    | 110.5             | 14                        | 208                               | 162.1             | 13                        | 233                               |
| Ponelo       | 112.6             | 18                        | 174                               | 119.6             | 17                        | 194                               |
| Inpari 42    | 107.8             | 19                        | 147                               | 114.0             | 22                        | 218                               |
| Inpago 8     | -                 | -                         | -                                 | 113.3             | 14                        | 201                               |
| Towuti       | -                 | -                         | -                                 | 119.5             | 29                        | 130                               |
| Average      | 111.4             | 18.2                      | 182.7                             | 121.1             | 18.6                      | 187.2                             |

In the monoculture planting system, the variety that has the highest plant height is Situ Bagendit variety which is 114.8 cm and the lowest is Inpari 42 which is 107.8 cm. In the intercropping system, the highest plant is Inpago 11 as high as 162.1 cm and the lowest is Situ Bagendit which is 98.2 cm. Inpago 11 variety is higher compared to other varieties because the location of Inpago 11 demfarm is flooded due to the position of the planting location under the hill so that it becomes a place for water to gather. The location began to be inundated when planting was over 21 HST. This is thought to cause Inpago 11 to have a plant height above other varieties, while other varieties in the intercropping system have a height of less than 120 cm. The average height of rice plants in monoculture and intercropping systems has a difference of 9.7 cm. Plant height in the intercropping system is much higher than the monoculture system, this is presumably because rice cultivation has shaded conditions by maize cropping so that rice cropping responds to look for more light.

As for the number of tillers in a monoculture system the average is 18 tillers, as well as the average in a intercropping system. In the monoculture system, Inpago 11 variety has the fewest number of children, 14 puppets while Situ Bagendit has the most number of tillers which is 21 puppies. In the intercropping system, the lowest number is reached by 13 tillers and the most is Towuti variety of 29 tillers. For the number of grains per panicle, in the monoculture system, Inpari 42 has the lowest number of grains per panicle which is 147 grains while the highest is achieved by Inpago 11 varieties are 208 grains. In the intercropping system, Towuti varieties have the lowest number of grain as many as 130 grains while the highest is achieved by Inpago 11 as much as 233 grains.

3.2. Performance of maize and upland rice productivity with intercropping system

Productivity is one of the main concerns of farmers. The results of the performance of the productivity of VUB maize and rice can be seen in Table 4.

Table 4 shows the performance of maize productivity in the demfarm of both dry land and monoculture technology. In the monoculture system, the highest productivity is achieved by JH 27 varieties with achievements of 6.4 t / ha and the lowest is HJ 21 varieties at 2.98 t / ha. The low productivity of HJ 21 is more due to the farmers' cultivation which is less than optimal, this is considering the location of HJ 21 plantations located across the river so that farmers are less than optimal in maintenance.
Table 4. Productivity performance of maize in monoculture and intercropping systems

| Varieties | Productivity (ton/ha) | Monoculture | Intercropping systems |
|-----------|-----------------------|-------------|-----------------------|
| Nasa 29   | 4.40                  | 0           |
| Bima 20   | 5.92                  | 0           |
| HJ 21     | 2.98                  | 3.98        |
| JH 27     | 6.40                  | 2.40        |
| NK 22     | 6.02                  | 3.14        |
| Bisi 18   | 4.73                  | 4.54        |
| Bima 2    | 5.46                  | 4.83        |
| Pioneer 35| 0                     | 2.80        |
| **Average**| **5.13**              | **3.61**    |

In the intercropping system, the highest productivity achievement obtained by BIMA 2 varieties was 4.83 t/ha and the lowest was JH 27 variety of 2.4 t/ha. Bima 2 maize has the highest productivity in intercropping systems compared to other maize varieties, allegedly because the Bima 2 maize variety has the advantage of having a narrow leaf angle (upright leaves) so that it is possible to get maximum sun exposure both on maize and intercropping plants. In addition, Bima 2 maize is a type of semi-erect plant to allow for more light interception. The average achievement of maize productivity in intercropping systems (3.61 t/ha) is lower than in monoculture systems (5.13 t/ha), considering that the planting area of maize per ha in intercropping systems is much lower than in monoculture systems. However, this result is still higher than the study of [11] which concluded that the yield of maize productivity in intercropping systems with rice between 1.4-2.7 t/ha. The performance of rice yields can be seen in Table 5.

Table 5 shows the productivity of upland rice with monoculture and intercropping cultivation. In the monoculture system the highest productivity achievement was achieved by Inpago 11 at 5.67 t/ha and the lowest was Inpari 42 with an achievement of 3.21 t/ha. In the intercropping system, the highest achievement was ponelo variety of 3.95 t/ha and the lowest was Inpago 11 of 0.46 t/ha. The low achievement of Inpago 11 is caused by the growth of plants that is less than optimal due to the inundation of the location of activities due to the location of the land under the hills. These conditions cause less optimal crop production.

Table 5. Productivity performance of upland rice in monoculture and intercropping systems

| Varieties        | Productivity (ton/ha) | Monoculture | Intercropping systems |
|------------------|-----------------------|-------------|-----------------------|
| Situ Bagendit    | 4.55                  | 2.50        |
| Inpago 11        | 5.67                  | 0.46        |
| Ponelo           | 4.41                  | 3.95        |
| Inpari 42        | 3.21                  | 1.87        |
| Inpago 8         | -                     | 2.06        |
| Towuti           | -                     | 2.16        |
| **Average**      | **4.46**              | **2.17**    |

If viewed from the average productivity, the average achievement of monoculture system rice productivity (4.46 tons/ha) was higher than the intercropping system (2.17 tons/ha). This is because in the intercropping system, rice plant was shaded by maize plants so that they get lower sunlight.
intensity compared to monoculture systems. On average rice achievements in the intercropping system are in accordance with previous studies which concluded that in the maize-rice intercropping system, rice productivity that can be achieved is 2.12 t/ha-2.51 t/ha while in the monoculture system is 3.56-3.91 t/ha.

**Table 6. Financial analysis of maize and upland rice farming in the intercropping system**

| Description                  | Maize Monoculture | Rice Monoculture | Intercropping systems of maize and rice |
|------------------------------|-------------------|------------------|----------------------------------------|
| Value (Rp./ha)               | %                 | Value (Rp./ha)   | %                                      |
| Rice Production              | -                 | 2,676            | 1,320                                  |
| Maize Production             | 5,131             | -                | 3,614                                  |
| Price of rice per kg         | -                 | 9,000            | 9,000                                  |
| Price of maize per kg        | 3,500             | -                | 3,500                                  |
| Revenue                      | 17,958,500        | 24,084,000       | 24,529,000                             |
| Cash Fee:                    |                   |                  |                                        |
| Land                         | 17,000            | 17,000           | 17,000                                 |
| Seed                         | 700,000           | 400,000          | 1,100,000                              |
| Biodestructor                 | -                 | 70,000           | -                                      |
| Biosfertilizer               | -                 | 82,000           | 82,000                                 |
| Urea Fertilizer              | 360,000           | 180,000          | 540,000                                |
| ZA Fertilizer                | 140,000           | -                | -                                      |
| Phonska Fertilizer           | 690,000           | 460,000          | 1,150,000                              |
| Organic Fertilizer           | 500,000           | 500,000          | 500,000                                |
| Biopesticide                 | -                 | 440,000          | -                                      |
| Herbicide                    | 910,000           | 650,000          | 1,170,000                              |
| Irrigation                   | 1,500,000         | 1,500,000        | 1,500,000                              |
| Outside the Family Workforce | 4,215,000         | 4,525,000        | 5,500,000                              |
| Cost calculated              |                   |                  |                                        |
| Labor in the family          | 1,558,000         | 1,721,000        | 1,721,000                              |
| Shrinkage of Equipment       | 24,000            | 24,000           | 24,000                                 |
| Total Cash Costs             | 9,032,000         | 8,824,000        | 11,559,000                             |
| Total Costs                  | 10,614,000        | 10,569,000       | 13,304,000                             |
| Advantages of Cash Costs     | 8,926,500         | 15,260,000       | 12,970,000                             |
| Advantages of Total Costs    | 7,344,500         | 13,515,000       | 11,225,000                             |
| R / C Over Cash Costs        | 1.99              | 2.73             | 2.12                                   |
| R / C Over Total Costs       | 1.69              | 2.28             | 1.84                                   |
| MBCR                         | 1.99              | 2.73             | 2.12                                   |

### 3.3. Analysis of maize and upland rice farming in monoculture and intercropping systems

The results of the analysis of maize and upland rice farming with monoculture and intercropping systems can be seen in table 6. From the results of farming analysis in table 6, it can be seen that the highest acceptance is achieved by farming with an intercropping system (Rp.24 529 000, - per ha), then successively, monoculture rice and monoculture maize. However, the results of the study in the study
area, the intercropping system also produced the largest total farm costs, reaching Rp. 13 304 000, compared to a monoculture system. The third largest cost structure of this farming system is the cost of labor outside the family (more than 39 percent).

The results of the analysis of the ratio of revenue to cost (R / C ratio) can be seen that the upland rice monoculture farming system produces the R / C ratio of the highest total cost (2.28). While intercropping farming systems produce the second largest R / C ratio, reaching 1.84, and the lowest is the maize monoculture farming system (reaching 1.69).

4. Conclusions and Suggestion

4.1. Conclusion
1. The average productivity of maize with intercropping system (3.61 t/ha), lower than the monoculture system (5.13 t/ha). In the intercropping system, the highest maize productivity was BIMA 2 of 4.83 t / ha, while in the monoculture system, the highest productivity was JH 27 of 6.4 t / ha. The average productivity of upland rice with an intercropping system (2.17 t / ha), lower than the monoculture system (4.46 t / ha). In the monoculture system, the highest productivity of upland rice was Inpago 11 of 5.67 t / ha. Whereas in the intercropping system, the highest productivity of upland rice was Ponelo variety of 3.95 t / ha.
2. Based on farm financial analysis, efficient farming patterns from highest to low were upland rice monoculture, intercropping system, and maize monoculture.

4.2. Suggestion
1. To produce maximum productivity in intercropping cultivation systems, it is recommended to use maize varieties that have narrow leaf angles (upright leaves) and use shade-resistant upland rice.
2. Further studies are needed related to optimal maize and upland rice population in intercropping cultivation systems, so as to increase production and productivity of the two commodities.

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