IAARD’s new high-yielding varieties maize farming revenue in Gorontalo Province

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Abstract. The agricultural sector for Gorontalo Province has a very strategic role. Agriculture is a business that provides the largest contribution to gross regional domestic product (GRDP). It is recorded that the agricultural sector has a GRDP value of about 38.8 percent of the total. One of the leading agricultural commodities for Gorontalo is maize. One of the ways to increase maize production is by using superior seeds. The study was done in Sukadamai Village, North Bulango, Bone Bolango Regency from October 2020 to January 2021. The study involved 6 cooperative farmers with a land area of 3 Ha. The results of the study showed that the JH 37 and JH 29 varieties had the highest productivity levels compared to other varieties. IAARD’s is feasible because it has an RC ratio value above 1 and has a positive profit value.

1. Introduction
The Agricultural sector plays a crucial role in Gorontalo Province. [1] Agriculture is a business that provides the largest contribution to gross regional domestic product (GRDP). It is recorded that in 2020, the agricultural sector has a GRDP value of 16.2 trillion rupiah or accounted for 38.8 percent of the total GRDP. The food crops sub-sector contributed the highest value compared to other sub-sectors with a value of 8.15 trillion. One of the leading food commodities for Gorontalo is maize. For local people, corn becomes the staple food, beside rice. Both are consumed as sources of carbohydrates and usually, they are processed into corn rice.

Maize is one of the leading commodities that are widely cultivated by Gorontalo people. This can be seen from the trend of maize production for 5 years which continues to increase from 719,780 tons (2014) to 1,619,649 tons (2018) which means that the increase is more than 100 percent [2]. The positive performance of maize commodities is also reflected in the realization of maize exports to foreign countries in the last few years. In 2020, Gorontalo has exported 37,100 tons of maize with a foreign exchange value that is equivalent to US$ 8,892 thousand [3].

However, it is seen from the level of maize productivity, there is an opportunity to increase the total production. Based on BPS data, it is known that in 2018, the Gorontalo maize productivity was 5.03 t/ha lower than the national average that is 5.25 t/ha. On the other hand, the highest productivity value, 7.63 t/ha, was achieved by West Java Province [4]. The factors that need to be considered in an effort to increase the production are land, seeds and fertilizers. Those factors have a significant effect on increasing the maize production [5–7]. The development of maize varieties in Indonesia has been started since the 1940s with the assembly of free pollinated varieties and the development of hybrid varieties in the 1980s [8]. The new high-yielding varieties are known to have the advantage of being able to...
increase productivity by 40% compared to local varieties and to be more resistant to pests and diseases [9]. On the other hand, [10] stated that the new hybrid varieties had a higher productivity level of 63.1% than the composite varieties. The NASA 29 variety had a productivity of 12.4 t/ha while Sukmaraga was 7.6 t/ha. The purposes of this study were to analyze/evaluate the productivity of new high-yielding varieties and the potential income that can be obtained.

2. Materials and Methods

The study was conducted in Sukadamai Village, North Bulango, Bone Bolango Regency from October 2020 to January 2021. The new high-yielding varieties planted at the location included HJ 21, JH 37, JH 29 and SINHAS. These varieties were selected based on medium-mature age, high production and specifically for the SINHAS variety, which has the advantage of being tolerant of sub-optimal or low nitrogen elements.

The land was prepared by tillling the field to improve soil structure and remove weeds. The seeds were treated by a mixture of the fungicide Metalaxyl (3 g/kg seed) to prevent Downy Mildew and insecticide Chlorantraniliprole (10 ml/kg seed) to prevent FAW armyworm attacks during the early growth period.

The spacing used was 80 x 40 cm with a total of 2 seeds per planting hole, so it was estimated that there were 66,666 plans in an area of 1 ha. The fertilizer given was 300 kg/ha Phonska and 200 kg/ha Urea. Weed control was carried out 2 times while insecticides were given based on the level of pest and disease attack.

After the plant reached the age of 7 days, it could be given basic fertilization with the amount of 1/3 Urea and 100% Phonska and the remaining 2/3 urea was given at the age of 30 DAP. Some of the herbicides used included: systemic herbicides in the form of concentrated suspensions with the active ingredients of atrazine 500 g/l and mesotrion 55 g/l at a dose of 2 l/ha or nicosulfuron 80g/l at a dose of 2 l/ha for the first weeding, while the second weeding using a herbicide with the active ingredient paraquat dichloride 297 g/L as much as 3 l/ha. In addition, considering that the low rainfall level, irrigation was also carried out on maize plantations with the aim of optimal plant growth.

Plant observations were made at the time of harvest. Some of the characters observed were mainly related to yield components such as cob length, number of rows, number of seeds per row, weight of 100 seeds, yield and productivity. The data of plant parameters were analyzed following the analysis of variance and the mean differences were adjusted with Duncan’s Multiple Range Test. Besides, the calculation of income analysis, RC ratio was also carried out with this following formula:

\[
RC\ Ratio = \frac{TR}{TC}
\]

Where:

- \( TR \) = Total revenue
- \( TC \) = Total cost

3. Results and Discussion

3.1. New High-Yielding Varieties (NHYV) productivity

High production is a goal that is expected by farmers. In order to determine the productivity achievement, the measurement of yield components and productivity levels was carried out. It can be seen in Table 1.

The field. There were 6 parameters observed, namely the cob length, the number of rows, the number of seeds per row, yield, weight of 100 seeds and maize productivity. Based on the analysis of variance, it was found that 4 of the 6 components observed were not significantly different or in other words, the performance of the 4 varieties seemed to be the same. The other two components, however, namely weight of 100 seeds and productivity, had significantly different appearances between the observed varieties. JH 37 had the highest weight of 100 grains compared to other varieties with a weight of 36.2
g, followed by JH 29, HJ 21 and SINHAS. The SINHAS has the lowest weight of 100 seeds compared to other varieties, which is 28.7 g. Meanwhile, the productivity of JH 37 (10.6 t/ha) and JH 29 (10.0 t/ha) was significantly different from that of HJ 21 (6.1 t/ha). [11] Stated that the productivity of HJ 21 was 8.5 t/ha so that this yield was still lower than previous study. It was because during the vegetative growth period the crop experienced drought which caused the growth was less than optimal growth and delay in obtaining fertilizer. On the other hand, the productivity of JH 37 was higher than the research in Kupang Regency, East Nusa Tenggara with a yield of 5.8 t/ha [12]. Meanwhile, the study concluded that the SINHAS variety had an average productivity of 7.82 t/ha but under drought conditions the yield would decrease to 6.27 [13]. Meanwhile, based on the report by [14] which stated that JH 29 has an average productivity of 11.7 t/ha. [15] The application of high-yielding varieties is influenced by internal and external factors. Farmers' knowledge of the advantages of new varieties is very important as well as the availability of capital to buy these seeds which is reflected in the level of farmer income. External factors that need to be considered include the availability of seeds in the market, the role of extension workers in disseminating high-yielding varieties to farmers and the level of resistance of the maize to disease. Therefore, in an effort to increase the implementation of IAARD’s NHYV, all these aspects need to be considered. It is then expected that the NHYV maize can be utilized by most Indonesian farmers.

Table 1. NHYV productivity rate and yield components

| Variety | Cob length (cm) | Number of rows (unit) | Kernel per row (unit) | Yield (%) | 100 grain weight (unit) | Productivity (t/ha) |
|---------|----------------|-----------------------|-----------------------|-----------|------------------------|---------------------|
| JH 37   | 14.2a          | 16.4a                 | 32.1a                 | 79.4a     | 36.2c                  | 10.6b               |
| JH 29   | 14.1a          | 16.2a                 | 31.1a                 | 81.8a     | 33.7bc                 | 10.0b               |
| HJ 21   | 14.2a          | 13.0a                 | 32.05a                | 80.8a     | 30.5ab                 | 6.1a                |
| SINHAS  | 14.6a          | 15.2a                 | 33.5a                 | 78.3a     | 28.7a                  | 8.5ab               |

Notes: Numbers followed by the same letter are not significantly different (5%)

Table 1 shows the performance of yield components for new high-yielding varieties disseminated at New high-yielding varieties productivity

Based on farming analysis, it was concluded that the minimum revenue earned by farmers was Rp. 15 million as the sales value of maize with a selling price of Rp. 4200/kg. Meanwhile, the costs incurred by farmers consist of 3 types, namely 1) Variable costs for purchasing production facilities such as fertilizers, pesticides, herbicides, fungicides and growth stimulants with a value of IDR 3.4 million, 2) Equipment depreciation costs of IDR 86 thousand and 3) Labor costs consisting of land preparation, planting, fertilizing, weeding, pest control and harvesting are IDR 4.4 million (Table 2).

The profit obtained by farmers were positive, namely between IDR 15.1 million-29.3 million. This means that farmers benefit from maize farming. As for the feasibility analysis based on the RC ratio value, it is known that all varieties planted are feasible to cultivate based on the RC ratio indicator value, namely 2.91-4.68. This value means that every 100 units of costs incurred by farmers will get an revenue of 291-468 units. This is in line with the study conducted by [12] which concluded that maize farming in East Nusa Tenggara is feasible with an average profit value of IDR 15.5 million/ha/season with a BCR value of 1.94. Likewise, [16] reported that the hybrid NHYV maize farm in South Bengkulu can generate a revenue of IDR 17.4 million-22.2 million and has an RC ratio of 2.58-3.08.
Table 2. Analysis of new high-yielding varieties of maize farming (IDR/ha)

| Components           | JH 37       | JH 29       | SINHAS      | HJ 21       |
|----------------------|-------------|-------------|-------------|-------------|
| Revenue (A)           | 37,294,887  | 33,988,373  | 33,348,708  | 23,141,342  |
| Cost (B)              |             |             |             |             |
| Variable costs (B.1)  |             |             |             |             |
| Seeds                | 525,000     | 525,000     | 525,000     | 525,000     |
| Phonska              | 805,000     | 805,000     | 805,000     | 805,000     |
| Urea                 | 360,000     | 360,000     | 360,000     | 360,000     |
| Pesticide            | 852,500     | 852,500     | 852,500     | 852,500     |
| Herbicide            | 750,000     | 750,000     | 750,000     | 750,000     |
| Fungicide            | 90,000      | 90,000      | 90,000      | 90,000      |
| ZPT                  | 96,000      | 96,000      | 96,000      | 96,000      |
| Depreciation cost (B.2) | 86,667   | 86,667      | 86,667      | 86,667      |
| Cost of labor (B.3)   |             |             |             |             |
| Tilling              | 1,200,000   | 1,200,000   | 1,200,000   | 1,200,000   |
| Planting             | 800,000     | 800,000     | 800,000     | 800,000     |
| Fertilizing          | 400,000     | 400,000     | 400,000     | 400,000     |
| Weeding              | 400,000     | 400,000     | 400,000     | 400,000     |
| Pest controlling     | 600,000     | 600,000     | 600,000     | 600,000     |
| Harvesting           | 1,000,000   | 1,000,000   | 1,000,000   | 1,000,000   |
| Total cost (B.1+B.2+B.3) | 7,965,167 | 7,965,167   | 7,965,167   | 7,965,167   |
| Profit (A-B)         | 29,329,720  | 26,023,207  | 25,383,542  | 15,176,176  |
| RC ratio (A/B)       | 4.68        | 4.27        | 4.19        | 2.91        |

4. Conclusion
The HJ 37 variety has the highest productivity level of 10.6 t/ha while the lowest HJ 21 is 6.1 t/ha. All varieties are feasible for planting based on the RC value above one, which is 2.91-4.68. The maize farming profit obtained by the farmers is amounted to 15-29 million / ha.

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