

THE IMPACT OF THE IR NUTRIZINC (*Oryza sativa*) CULTIVATION PROGRAM ON FARMERS' INCOME AND EXCHANGE VALUE IN SERANG REGENCY, BANTEN PROVINCE

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Abstract

Stunting has long been a major issue in Indonesia, encouraging the government to implement a policy under the Ministry of Agriculture Regulation No. 39 of 2020, which mandates biofortification of rice varieties, including IR Nutrizinc rice, to improve food quality in Indonesia. This study aims to analyze the impact of the IR Nutrizinc rice cultivation program on farmers' income and exchange value in Serang Regency, Banten Province, from October 2024 – December 2024. The feasibility analysis showed that IR Nutrizinc rice farming was profitable, as indicated by an R/C ratio greater than 1. The Policy Analysis Matrix (PAM) results showed that the NPCI value of IR Nutrizinc rice was 1.06 (>1), indicating government support through input policies within the IR Nutrizinc program. However, the NPCO value of 0.96 (<1) indicated that the output price received by farmers was still below the ideal economic price. The PCR and DRC values of less than 1 indicated that IR Nutrizinc rice farming was economically efficient and had both competitive and comparative advantages. Nevertheless, the EPC value of 0.95 and PC value of 0.85 showed that policy distortions still caused farmers' profits to be suboptimal. This condition was also reflected in the SRP value of -0.14, indicating a disincentive effect where private profits were lower than social profits. Despite this, the IR Nutrizinc program still contributed positively to farmer welfare, as reflected by the increase in the farmer exchange rate from 1.03 in non-IR Nutrizinc farming to 1.30 in IR Nutrizinc farming in Serang Regency.

Keywords: *Impact, Program, IR Nutrizinc Rice, Farming, Farmer Exchange Value.*

INTRODUCTION

Indonesia is a country where rice is the primary staple food. The average per capita rice consumption per week in 2023 was approximately 1.558 kg, followed by corn at 0.036 kg (Statistics Indonesia, 2023). The availability of rice as a staple food to meet the community's needs is crucial. This is why the availability of food, such as rice, influences many aspects, and the availability of rice as a staple food is one of the foundations of the concept of food security. One of the important points in food security, apart from the issue of availability and affordability, is the issue of nutritional content. In order to increase the nutritional content of rice, the government issued a policy of the Ministry of Agriculture No. 39 of 2020, Article 6, concerning the program for planting biofortified rice varieties in 2020. IR Nutrizinc variety is a type of rice that has a high nutritional content in the form of zinc with a biofortification method, which is expected to meet community nutritional intake standards and can overcome the problem of stunting in children. The biofortified rice planting program was prioritized based on Indonesia's 2020 stunting index data. This priority targets areas considered prone to stunting, such as Serang Regency in Banten Province. Planting biofortified rice varieties in Serang Regency, Banten Province, can be a strategic step to improve the quality of local food to reduce cases of malnutrition. This program is in the form of support for farmer groups in the form of seed availability, procurement of agricultural inputs, and assistance in planting biofortified rice of the nutrizinc variety.

Farmers' interest in implementing cultivation practices and their confidence in Serang Regency have made Serang Regency the largest producer in Banten Province, contributing to the success of this program. The success of planting in Serang Regency is evidenced by the significant annual increase in Inpari NutriZinc rice production, from 6,000 tons of dry grain in the first year of 2021 to 136,447 tons of dry grain in 2024. The increase in the number of IR Nutrizinc rice harvests each year, accompanied by the expansion of planting areas, is expected to have a positive impact on farmers in terms of agriculture and communities affected by stunting.

The development of the IR Nutrizinc rice variety can increase farm income in Serang Regency, as this variety tends to yield higher yields than other varieties grown on the same planting area. This high yield indirectly adds value to farmers in Serang Regency. Farmers' challenges in implementing this program lie in marketing their produce, where selling IR Nutrizinc rice is difficult due to its relatively small size and somewhat bland taste. In 2024, the government began directing relevant agencies to collaborate in making this program a success, such as the Women's Empowerment, Child Protection, and Family Planning Agency, the health agency, and the company appointed to explore IR Nutrizinc seeds in Serang Regency to contribute to the program's success.

This study aims to analyze the impact of the IR Nutrizinc rice cultivation program on farmers' income and farmer exchange rates in Serang Regency, Banten Province. In addition, this study also analyzes the feasibility of farming, the level of competitive and economic efficiency, and the impact of government policies on input use and production costs in both IR Nutrizinc and non-IR Nutrizinc rice farming systems. The study further examines the role of the program in improving farmer welfare through increased productivity, profitability, and economic performance of rice farming activities. The results of this research are expected to provide useful information and policy recommendations for the government and related stakeholders in developing and strengthening the IR Nutrizinc rice cultivation program to improve farmer welfare and support food security in Serang Regency.

RESEARCH METHODS

Research Type and Design

The study uses a mixed methods approach, a combination of quantitative and qualitative methods, with data from the farming business analysis. Determination of the samples in this study used the *multivariate* sampling method, with the Roscoe sampling formula, so that 50 farmer group samples were obtained from the 77 farmer groups in 2.274 farmers in Serang district. Sampling technique: stratified random sampling method with the proportional criteria for the sample taken were farmer groups who received Nutrizinc seed assistance from the government; the respondents interviewed were farmers who planted IR Nutrizinc rice in the farmer group.

In this study, the variables are defined operationally as follows: (1) **Farmer Characteristics** is the age, education, income, farming experience, and dependents in the family. (2) **Farming Business Analysis (Usahatani)** is the all cost of rice farming, total revenue (TR), and profit $\pi = \text{Total Value Production (TVP)} - \text{Total Fixed Cost (TFC)}$. (3) **Impact of the Program** is the production cost as private price and production cost as social price in tradable input cost and non-tradable input cost: product result, profit and expense ratio analysis. (4) **Farmer's Exchange Rate** (Nilai Tukar Petani / NTP) is the ratio between the price index received by farmers (IT) and the price index paid by farmers (IB).

Location and Time of Research

The research was conducted in Serang Regency, Banten province, which is one of the areas where the program is being implemented. The primary survey was conducted directly with farmers and agricultural extension workers in the Serang district from October 2024 to December 2024.

Data Analysis Technique

The analysis stages include (1) identification of the input and output of the cultivation of IR Nutrizinc. (2) shadow price determination of cultivated inputs and output (3) shortening cost into tradable and non-tradable (4) calculation of income from IR Nutrizinc cultivation. (5) calculation and analysis of various indicators that Policy Analysis Matrix (PAM) can produce such as estimation indicator nominal protection coefficient of output (NPCO), NPCI (nominal

protection coefficient of Input), private cost ratio (PCR), domestic resource cost coefficient (DRC), effective protection coefficient (EPC), profitability coefficient (PC), subsidy ratio producers (SRP) (6) finally for the impact of the program on the farmer's exchange rate using the farmer exchange rate index > 100 is profit, farmer exchange rate index = 100 is stable condition, NTP <100 is trading loss (Riyadh, 2015) and the impact analysis can be proven in the T-test is the T statistic > T table and to see the significant impact of the program.

RESULTS AND DISCUSSION

The characteristics of farmers based on gender in Serang Regency consist of 2 groups, the male group (Kelompok Tani / POKTAN) and the female group (Kelompok Wanita Tani /KWT), both groups contribute to the running of rice farming in the Serang Regency area (**Table 1**). The comparison of the number of farmer groups is dominated by men (74%), however in practice, the contribution of female farmers in the rice farming production process is the most dominant during planting and harvesting if the harvest is done manually. The level of education of farmers in Serang Regency is dominated by elementary school graduates (Table 2). The low level of education of farmers in Serang Regency is a challenge in providing information on the benefits and advantages of the IR Nutrizinc variety rice planting program in Serang Regency by agricultural extension workers from the relevant service.

Education level and age are simultaneous factors that support performance (Harahap et al., 2019). Farmers who are of productive age will usually work better and more optimally compared to farmers who are of less productive age (Gusti et al., 2021). The age distribution of farmers shows that the majority are over 50 years old, accounting for 68% of the total respondents, while farmers aged 31–49 years represent 28%, and those under 30 years account for only 4% (**Table 3**). This condition indicates an aging farming population and highlights the importance of farmer regeneration to ensure the sustainability of the agricultural sector.

In another factor, land ownership is an important factor for rural residents whose livelihoods depend on the agricultural sector (Suhaimi, 2019). The land ownership status of IR Nutrizinc rice farmers in Serang Regency is predominantly leased and not privately owned. This creates a burden for farmers with land rental costs, where the range of land rental costs is 7 million / Ha to 10 million / Ha, and there are also in the form of a profit-sharing percentage of between 20% to 50% per Ha. Limited community land ownership causes farmers to be limited in developing their farming businesses.

Table 1. Gender of IR Nutrizinc Rice Farmers in Serang Regency

No	Gender	Amount	Percentage
1	Male	37	74
2	Female	13	26
Amount		50	

(Source: Primary Data, 2024)

Table 2. Classification of IR Nutrizinc Rice Farmers Based on Education Type

No	Educational Classification	Amount	Percentage
1	Elementary School	24	48
2	Junior High School	11	22
3	Senior High School	13	26
4	Bachelor Degree	2	4
Amount		50	

(Source: Primary Data, 2024)

Table 3. Age Classification of IR Nutrizinc Rice Farmers in Serang Regency

No	Age Classification	Amount	Percentage
1	Under 30 Years	2	4
2	31 - 49 Years	14	28
3	Over 50 Years	34	68
Amount		50	

(Source: Primary Data, 2024)

Table 4. Grouping Based on Land Ownership Status

No	Land Ownership Type Status	Number of (people)	Percentage
1	One's own	11	22
2	Rent	21	42
3	Working Rights	18	36
Amount		50	

(Source: Primary Data, 2024)

Farming experience refers to the length of time a farmer has been engaged in their farming endeavors. Farmers with extensive farming experience typically have a better understanding and knowledge of land conditions than those new to the industry (Maghfiroh, 2021). Table 5 shows that IR Nutrizinc rice farmers in Serang Regency have varying farming experience, ranging from less than 15 years to more than 31 years. The respondents in this study had the most farming experience, at 56%, between 16 and 30 years. This indicates that the farmers have considerable farming experience.

Table 5. Farming Experience of Farmers in Serang Regency

No	Farming Experience	Amount	Percentage
1	Less than 15 Years	5	10
2	16 s/d 30 Years	28	56
3	> 31 Years	17	34
Amount		50	

(Source: Primary Data, 2024)

The IR Nutrizinc rice planting program in Serang Regency is a program to reduce stunting rates in the region through the benefits of the rice produced, and the program is expected to be able to provide other benefits to provide added income for IR Nutrizinc rice farmers. To see the comparison of farmers' income from the IR Nutrizinc variety of rice, researchers compared farming with the same farmers, when farmers planted other varieties of rice, and with the farmers who planted the IR Nutrizinc variety of rice (**Table 6**). The income from rice farming IR Nutrizinc varieties in Serang Regency is higher than the income from non-Nutrizinc varieties for the 2024 planting period (R/C Ratio 1,58 > 1,38), with an average income of IDR 35,100,000/Ha, while for non-IR Nutrizinc varieties it is IDR 33,093,000/Ha. It means that the farming business is feasible to be run (Suryaningsih & Nurvania, 2023). To determine the success of the program that has been implemented, an evaluation is needed to determine the effectiveness and impact of the program. Researchers used PAM analysis to evaluate the program that has been implemented in the Serang Regency area by comparing private prices and social prices. The difference is that private prices focus on independent profits, while social prices focus on community welfare, such as assistance in the form of subsidies from the government (Pearson, 2005).

Table 6. Financing of Other IR Varieties and IR Nutrizinc Farming Businesses

Description	Variety	
	Non Nutrizinc	IR Nutrizinc
Land Rental Cost (A)	9.094.000	9.094.000
Seed Cost / Ha (B)	333.000	-
Fertilizer Cost / Ha (C)	1.620.000	1.440.000
Pesticide Cost / Ha / Ha (D)	1.300.000	1.167.000
Labor Cost / Ha (E)	1.773.000	1.773.000
Post-Harvest Cost / Ha (F)	-	-
Production Cost (Excluding Land Cost) / Ha (G)	5.026.000	4.380.000
Total Production Cost / Ha (TF)	14.120.000	13.474.000
Production (Kg/Ha) (Q)	6.000	6.500
Price Received by Farmers (GKP/Kg) (P)	6.000	6.500
Total Revenue /Ha (TR)	33.093.000	35.100.000
Profit (Loss) / Ha (π)	18.973.000	20.921.000
R / C Ratio	1,38	1,58

(Source: Primary Data, 2024)

Table 7. Policy Analysis Matrix (PAM) for Rice in Serang Regency

<i>Varietas Non IR Nutrizinc</i>				
	Revenue (Rp)	Cost		Profit
		Tradabels (Input tradable)	Non Tradable (Domestic)	
Private	33.093,000	2.920.000	1.773.000	28.400.000
Social	33.093,000	3.253.000	1.773.000	31.613.000
Divergence	-	(333.000)	-	(3.213.000)
<i>Varietas IR Nutrizinc</i>				
	Revenue (Rp)	Cost		Profit
		Tradables (Input tradable)	Non Tradable (Domestic)	
Private	35.100.000	2.750.815	1.773.000	30.720.333
Social	36.400.000	2.606.666	1.871.046	35.520.231
Divergence	(1.300.000)	144.148	(98.046)	(4.799.897)

(Source: Primary Data, 2024)

Table 7 explains that there are cost components in the PAM Matrix table, where there are tradable and non-tradable cost inputs for IR Nutrizinc and Non-Nutrizinc rice. In IR Nutrizinc rice, tradable cost inputs have a positive result, IDR 144,148, compared to non-tradable costs (IDR 98,046). This means that agricultural production costs are greatly influenced by the prices of production inputs traded on the market. So it can be concluded that the agricultural input assistance provided by the government has a significant impact on the input costs of IR Nutrizinc rice farming production. IR Nutrizinc's social financing is higher than private financing at Rp 1,871,046 compared to Rp 1,773,000. This is because IR Nutrizinc mostly sources labor from online workers and incurs additional post-harvest costs. In the IR Nutrizinc variety, it can be explained that social income is higher than private income, resulting in a divergence that indicates the impact of market distortion. Market distortion is a condition where input and output prices do not reflect their true value (social prices) due to cartels (prices received by farmers are lower than the actual price) and dependence on local markets or deviations that cause market imbalances that must be regulated by the government through policy (Vitadiar, 2023).

The impact felt by IR Nutrizinc rice farmers in 2024 is different from the previous year, especially in the Serang Regency area, there is a real increase in income from the dry harvested grain sales revenue side for IR Nutrizinc varieties compared to non-Nutrizinc varieties if there is government intervention in regulating the marketing of IR Nutrizinc rice production results, so that farmers can feel the optimal benefits and not only benefit certain groups. To estimate the distortion that occurred in the non-IR Nutrizinc rice planting program with IR Nutrizinc in Serang Regency, researchers compared seven Policy Analysis Matrix (PAM) ratios, as follows in **Table 8**. NPCO non-Nutrizinc value is 1, meaning there is no increase in income due to government policy. This is because non-Nutrizinc rice is rice cultivated by farmers as a food source and also as a rice farming business. The NPCO value of IR Nutrizinc rice is $0.96 < 1$. This value shows that the level of protection for IR Nutrizinc rice farmers in this planting program through the price they received in 2024 is below the ideal price if there is no intervention by the government.

Table 8. Estimated Distortion Ratio for Non-Nutrizinc and Nutrizinc IR Rice Planting Programs

No	Rasio	Ratio Non IR Nutrizinc	Ratio IR Nutrizinc
1	NPCO (Nominal Protection Coefficient on Output)	1,00	0,96
2	NPCI (Nominal Protection Coefficient on Input)	0,89	1,06
3	PCR (Private Cost Ratio)	0,06	0,05
4	DRC (Domestic Resource Cost Coefficient)	0,06	0,05
5	EPC (Effective Protection Coefficient)	1,01	0,95
6	PC (Profitability Coefficient)	0,89	0,85
7	SRP (Subsidy Ratio to Producers)	(0,09)	(0,14)

(Source: Primary Data, 2024)

The NPCI value for non-Nutrizinc rice was 0.89. The NPCI value < 1 means that farmers do not receive support from the government. This is in accordance with the fact that non-Nutrizinc rice does not receive significant subsidies, and conversely. The NPCI IR Nutrizinc value is $1.06 > 1$, meaning that the planting receives full support from the government. PCR and DRC values < 1 mean that non-IR Nutrizinc and Nutrizinc rice farming are economically efficient, but the potential social benefits are not fully achieved due to the impact of policy distortions on IR Nutrizinc varieties (EPC and $PC \leq 1$), so that when $EPC = 0.95$, IR Nutrizinc farmers only receive suboptimal profits of 95%, and farmers lose 5% of their potential profits. This is different from the EPC and PC values > 1 in non-Nutrizinc varieties, where the condition of non-Nutrizinc rice farming is in good condition, from the profits obtained by farmers, with the note that the entire non-Nutrizinc rice harvest is sold. The SRP value of -0.14 for the IR Nutrizinc variety indicates the presence of a disincentive effect caused by government policies or market distortions within the commodity system. This negative value shows that the private profits received by farmers were lower than the social profits. Meanwhile, the SRP value of -0.09 for the non-IR Nutrizinc variety also indicates a disincentive effect, although at a lower level compared to the IR Nutrizinc variety. Thus, both varieties were still affected by policies that had not fully provided protection or incentives for farmers' profits.

Profit optimization is expected to increase the exchange rate index (the farmer's exchange rate), which is defined as the income value index against the expenditure value index. The income value index can be described as the income exchange rate, where the income exchange rate can be used as a benchmark for performance in food crop farming. The income exchange rate against production costs for the Non-Nutrizinc variety has a value of 6.58, lower than the Nutrizinc cost of 8.01, meaning that the use of non-Nutrizinc production costs is greater than its income (**Table 9**).

Table 9. Exchange Rate of Receipts and Farmer Exchange Rate

No	Description	Non-Nutrizinc	Nutrizinc
1	Exchange Rate of Revenue to Total Production Costs	6.58	8.01
2	Exchange Rate of Revenue to Production Inputs	2.68	3.00
3	Exchange Rate of Revenue to Seeds	99.28	100.00
4	Exchange Rate of Revenue to Fertilizers	20.43	24.38
5	Exchange Rate of Revenue to Wages	18.66	19.79
6	Exchange Rate of Revenue to Pesticides	25.46	30.09
7	Exchange Rate of Revenue to Household Consumption	16.55	17.55
8	Farmer Exchange Rate (GKP)	2.34	2.61
9	Difference in Farmer Exchange Rate	0.26	
10	Farmer Exchange Rate Index	1.03	1.30

(Source: Primary Data, 2024)

The increase in the Farmers' Exchange Rate from 2.34 to 2.61 indicates that the income received by IR Nutrizinc farmers increased relative to their expenditures, reflecting improved farmer welfare. Furthermore, the Banten provincial central statistics agency stated that the index farmer's exchange rate value in September 2024 was 1.13, increasing to 1.30, meaning that the IR Nutrizinc variety has a positive impact on improving the economy of farmers in the Serang district area. However, the IR Nutrizinc rice planting program has an impact on increasing farmers' income, but it is not significant. This can be seen from the results of the T count calculation $> T$ table, which is 0.309, so H_0 is rejected, meaning there is no significant difference between IR Nutrizinc rice and non-Nutrizinc rice. This means that activities carried out through the new variety planting program, aimed at increasing farmers' income and exchange rates, have a positive but insignificant impact.

CONCLUSIONS AND SUGGESTIONS

Characteristics of IR Nutrizinc rice farmers based on age are that the majority are non-productive, in the age range of >50 years, with the highest level of education being elementary school with an average farming experience of IR Nutrizinc rice farmers of 16-30 years, meaning that the farming skills of IR Nutrizinc farmers are classified as experienced and have been running rice farming businesses in Serang Regency for a long time. The feasibility analysis showed that IR Nutrizinc rice farming was profitable, as indicated by an R/C ratio greater than 1. The Policy Analysis Matrix (PAM) results showed that the NPCI value of IR Nutrizinc rice was 1.06 (>1), indicating government support through input policies within the IR Nutrizinc program. However, the NPCO value of 0.96 (<1) indicated that the output price received by farmers was still below the ideal economic price. The PCR and DRC values of less than 1 indicated that IR Nutrizinc rice farming was economically efficient and had both competitive and comparative advantages. Nevertheless, the EPC value of 0.95 and PC value of 0.85 showed that policy distortions still caused farmers' profits to be suboptimal. This condition was also reflected in the SRP value of -0.14, indicating a disincentive effect where private profits were lower than social profits. Despite this, the IR Nutrizinc program still contributed positively to farmer welfare, as reflected by the increase in the farmer exchange rate from 1.03 in non-IR Nutrizinc farming to 1.30 in IR Nutrizinc farming in Serang Regency.

Suggestions that can be provided by researchers as input and consideration material the government needs to continue the IR Nutrizinc rice planting program with innovations that have been upgraded to varieties that are more resistant to weather, because water shortages can affect the vegetative and generative processes of IR Nutrizinc rice plants and There needs to be collaboration between the agricultural departments so that the production of IR Nutrizinc rice can be distributed optimally.

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