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Analysis of the Rice-Orange Farming Pattern in Rainfed Land in Astambul District Banjar Regency

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ABSTRACT
This study aims to analyze two main aspects related to the *paddy–citrus farming system* in Astambul District, Banjar Regency. First, it seeks to examine the production, costs, revenues, and income generated from the *paddy–citrus farming system*. Second, the study evaluates the financial feasibility of implementing this farming system on rainfed agricultural land. A survey method was employed, using a two-stage random sampling technique. In the first stage, three villages in Astambul District were randomly selected. In the second stage, 36 farmers were randomly chosen from a total population of 180 farmers across the three villages. The data were analyzed using descriptive statistics and Revenue Cost Ratio (RCR) analysis. The average production from the *paddy–citrus farming system* was 4.04 tons of paddy and 7.88 tons of citrus per farm. The average total cost incurred was IDR 17,695,620.84 per farm, consisting of explicit costs of IDR 15,644,622.62 and implicit costs of IDR 2,050,998.22 per farm. The average revenue was IDR 87,521,252.78 per farm. With an average explicit cost of IDR 15,644,622.62, the resulting average income was IDR 72,710,978.31 per farm. Based on the Revenue Cost Ratio (RCR) analysis, with an average revenue of IDR 87,521,252.78 and an average total cost of IDR 17,695,620.84 per farm, the RCR value was 5.15. This figure is significantly greater than 1, indicating that the *paddy–citrus farming system* is profitable and financially feasible. For every IDR 1 of cost incurred, a return of IDR 5.15 is generated.

Introduction

Agriculture is a strategic sector in the global economy, especially in developing countries, where it supports food security, livelihoods, and economic growth (Bai et al., 2020). According to the FAO, this sector faces significant challenges, including rising food demand, climate change, and the degradation of natural resources (FAO, 2022). Key commodities such as rice and citrus play an essential role in meeting nutritional needs and ensuring global food sustainability, with demand expected to increase as the world population is projected to reach 9.7 billion by 2050 (Hussain et al., 2021). The FAO reported that in 2022, global rice production reached 759 million tons, while citrus production stood at 78.7 million tons,

positioning Indonesia strategically as an agricultural country (FAO, 2022; Tanaka et al., 2020). As global food demands increase, especially for staple crops like rice, ensuring sustainable agricultural practices becomes crucial for long-term food security (Wang et al., 2021). The growth of the citrus industry also plays a significant role in providing essential vitamins and supporting global nutrition (Dixon & Middleton, 2020). Efforts to improve crop productivity and environmental sustainability in agriculture are critical to meeting future food security needs (Bello et al., 2022).

However, national agricultural commodity prices remain volatile due to external factors such as climate conditions and global trade, which directly impact farmers—especially those involved in export activities (Li & Zhang, 2021). Despite these challenges, agriculture remains a cornerstone of food security and a major contributor to the national GDP, accounting for 13.2% in 2023, and even higher in South Kalimantan at 23% (Fadillah & Sari, 2022). Rice production in Indonesia reached approximately 54.42 million tons, with most of this output derived from rainfed land (Adhi & Hadi, 2020). The volatility in agricultural commodity prices is often exacerbated by unpredictable weather patterns and global trade policies (Perry & Goldstein, 2021). In addition, climate change has significantly affected the predictability and stability of crop yields, contributing to the rise in food prices (Goh & Tan, 2020). Despite these factors, the agricultural sector continues to play a vital role in supporting the livelihoods of millions of people, particularly in rural and agrarian communities (Rahmawati & Sugiharto, 2021).

Nevertheless, Indonesian agriculture faces complex challenges, particularly its heavy reliance on unpredictable weather conditions, especially in rainfed areas (Amandaria et al., 2025). Global climate change has rendered rainy and dry seasons increasingly uncertain, posing significant risks to crop productivity (Rhodes, 2014; Schleussner et al., 2018). To support the agricultural sector, the Indonesian government, through the Ministry of Agriculture, has launched several initiatives, including the UPSUS Program (Special Efforts for Rice Self-Sufficiency), aimed at boosting rice production and developing horticultural crops—particularly citrus.

National citrus production has also demonstrated a positive trend. According to BPS data in 2023, citrus production reached 2.83 million tons, marking an increase of 9.86% compared to the previous year. Siam citrus (*Citrus reticulata* Blanco), a nationally superior variety, is known for its high quality and adaptability to various land conditions, including rainfed areas. Rice and citrus production data in Indonesia from 2019 to 2023 are presented in Table 1.

Table 1. Rice and Citrus Production in Indonesia (2019–2023)

Year	Rice Production (tons)	Citrus Production (tons)
2019	54.604.033,34	2.444.518
2020	54.649.202,24	2.593.384
2021	54.415.294,22	2.401.064
2022	54.748.977,00	2.551.999
2023	53.980.993,19	2.831.099

Sumber: BPS, 2023

The data in Table 1 indicate that rice production remained relatively stable, while citrus production experienced a significant increase of nearly 10% in 2023, highlighting the market potential of Siam citrus as a leading horticultural commodity. South Kalimantan Province heavily relies on rainfed land for its agricultural sector, with 38% of its 214,284 hectares of farmland categorized as rainfed. This sector contributes more than 23% to the province's GDP. In 2023, rice production reached approximately 54 million tons, while Siam citrus production

totaled 123,937 tons—demonstrating the vital role of horticultural commodities in food security and farmer income.

Banjar Regency holds great potential for developing the *paddy–citrus farming system*, particularly with Siam citrus, which has been nationally recognized as a superior variety through the Decree of the Minister of Agriculture No. 862/Kpts/TP.240/11/98. Local farmers implement the surjan system, a combination of lowland areas for rice and higher, drier land for citrus—to optimize land use and mitigate the risk of crop failure due to climate variability. This system has proven effective in enhancing both land-use efficiency and farmers' economic resilience.

Astambul District is one of the areas implementing the surjan system, with approximately 8,420 hectares of rainfed land. In 2023, the district recorded a production of 10,564 tons of rice and 5,200 tons of citrus. The villages of Sungai Alat and Kaliukan were the largest contributors, with a combined production of over 2,700 tons of rice and 1,300 tons of citrus. This distribution illustrates that the *paddy–citrus farming system* holds widespread potential and offers sustainable development opportunities on rainfed land.

This study aims to analyze the production, costs, revenues, and income from the *paddy–citrus farming system* in Banjar Regency, as well as to assess the feasibility of this farming system on rainfed land. Through a comprehensive analysis, this research is expected to provide a thorough overview of the economic aspects of the farming system, which is crucial for the development of the local agricultural sector. The results of this study will be beneficial for various stakeholders: for the government, as a reference for formulating targeted agricultural development policies; for farmers, by providing valuable information on costs, income, and efficiency to help optimize citrus farming; for academics, by enriching the literature and empirical data; for investors, by highlighting promising investment opportunities in the horticulture sector; and for students, as a scientific reference for future related research.

Research methods

This research was conducted in Astambul Subdistrict, Banjar Regency. The research process took place from October 2024 until completion, covering the stages of preparation, field data collection, data processing, and report writing.

The primary data used in this study were obtained directly from farmers practicing the rice-orange farming pattern. Secondary data were collected from relevant agencies and institutions related to this research.

The research location was selected using purposive sampling technique because it is one of the main orange production centers using the rice-orange farming pattern in Banjar Regency. The subdistrict consists of 22 villages, from which three villages were randomly selected as data collection sites: Sungai Alat Village, Kaliukan Village, and Sungai Tuan Ulu Village.

The research population consisted of 180 farmers practicing the rice-orange farming system in these three villages. From this population, a sample of 20% was selected using stratified random sampling based on the age strata of the orange trees, resulting in a total of 36 farmer respondents.

Table 2. Population and sample size of orange farmers per age stratum.

Age Group	Age Strata (Years)	Population (People)	Sample (People)
1	1-5	80	16
2	6-10	40	8
3	11-15	30	6
4	16-20	20	4
5	21-25	10	2
Total		180	36

Data were collected using a survey method, including direct interviews and questionnaire administration to the selected farmer respondents. The information gathered included rice and orange production, production costs (both explicit and implicit), selling prices, farming revenue, and net income. In addition, data on the age of orange trees were also collected for stratification purposes.

The analysis method used to achieve the first objective of this study analyzing the production, revenue, costs, and income of the rice-orange farming system in Banjar Regency involves several formulas:

Rice and Orange Farming Production

$$\mathbf{Yt_{is} = Y_{ps} + 2\,(Y_{js})}$$

Where :

Yt_{is} : Total production of farming system i, stratum s (kg)

Y_{ps} : Rice production (kg)

Y_{js} : Orange production (kg)

i : Farming component i (1 = rice, 2 = orange)

s : Age stratum of orange trees s (I, II, ..., V)

Total Cost of the Rice-Orange Farming System

$$\mathbf{TR_{is} = (P_i \times Q_{ps})}$$

Where:

TR_{is} : Total revenue of farming system i in stratum s (IDR/year)

P_i : Selling price of production from farming system i (IDR/kg)

Q_{is} : Production of farming system i in stratum s (kg)

i : Farming component i (1 = rice, 2 = orange)

s : Age stratum of orange trees s (I, II, ..., V)

Total Cost of the Rice-Orange Farming System

$$\mathbf{TC_{is} = TCis_{exp} + TCis_{impl}}$$

Where:

TC_{is}	:	Total cost of farming system i in stratum s (IDR)
$TC_{is\ exp}$	:	Total explicit cost of farming system i in stratum s (IDR/year)
$TC_{is\ impl}$	:	Total implicit cost of farming system i in stratum s (IDR/year)
i	:	1 (rice) and 2 (orange)
s	:	Age stratum of orange trees s (I, II, ..., V)

The total explicit cost (TCis exp) is the actual monetary expense incurred in the rice-orange farming activities. The costs are calculated separately and then summed up, even if some components are similar. The calculation is done by multiplying the quantity of each input used by its corresponding price, using the following formula for each component:

$$\mathbf{TCis_{exp} = \sum_{i=1}^{2}(Xjis)\ x\ (PXjis)}$$

Where :

$TC_{is\ ekp}$	:	Total explicit cost of farming system *i* in stratum *s* (IDR)
Xj_{is}	:	Quantity of input *j* used in farming system *i* , stratum *s* (kg/L)
PX_{is}	:	Price of input *j* in farming system *i* , stratum *s* (IDR/unit)
i	:	1 (rice) dan 2 (orange)
s	:	Age stratum of orange trees *s* (I, II, ..., V)
j	:	Input *j* : (family labor, fertilizer, seeds and seedlings, pesticides, irrigation costs)

Total Implicit Cost (TCis $_{impl}$), Implicit cost refers to non-monetary costs that are not directly paid by the farmer but are considered in the farming analysis. These include the value of family labor used in the rice-orange farming system. The implicit cost is calculated using a similar approach as the explicit cost, depending on the type and amount of unpaid resources used. The general formula used is:

$$\mathbf{TCis_{impl} = \sum_{i=1}^{2}(Xjis)\ x\ (PXjis)}$$

Where :

$TC_{is\ impl}$	:	Total implicit cost of farming system *i* in stratum *s* (IDR/year)

Xj_{is}	:	Quantity of input *j* used in farming system *i* , stratum *s* (hours/day or unit)
PX_{is}	:	Estimated value of input *j* in farming system *i* , stratum *s* (IDR/hour or IDR/unit)
i	:	1 (rice) dan 2 (orange)
s	:	Age stratum of orange trees *s* (I, II, ..., V)
j	:	Input *j* : mainly family labor in this case

Income of the Rice-Orange Farming System

$$\mathbf{I_{is}} = TR_{\mathbf{is}} - TC_{\mathbf{is\ (eksplist)}}$$

Where:

I_{is}	:	Income of farming system *i* in stratum *s* (IDR/year)
TR_{is}	:	Total revenue of farming system *i* in stratum *s* (IDR/year)
$Tcis_{\ eksp}$	:	Total explicit cost of farming system *i* in stratum *s* (IDR/year)
i	:	1 (jeruk) dan 2 (orange).
s	:	Age stratum of orange trees *s* (I, II, ..., V)

The analysis method used to achieve the second objective — assessing the feasibility of the rice-orange farming system on rain-fed land — is conducted using the Revenue-Cost Ratio (R/C Ratio), which is the ratio between total revenue and total production costs. This analysis aims to determine the economic viability of the farming system based on the revenue-to-cost ratio for each plant age group. The formula used is:

$$RCRis = \frac{Total\ Revenue\ (TRis)}{Total\ Production\ Cost\ (TCis)}$$

Where:

RCRis	:	Revenue Cost Ratio for farming system *i* in stratum *s*
TRis	:	Total revenue of farming system *i*, stratum *s* (IDR)
TCis	:	Total production cost of farming system *i* , stratum *s* (IDR)
i	:	1 (rice) dan 2 (orange).
s	:	Age stratum of orange trees *s* (I, II, ..., V)

The decision criteria based on the RCR value are as follows:

RCRis <1	:	The farming system *i* in stratum *s* is operating at a loss and is not economically feasible.
RCRis = 1	:	The farming system *i* in stratum *s* is breaking even; it generates neither profit nor loss.
RCRis > 1	:	The farming system *i* in stratum *s* is profitable and is considered economically feasible.
i	:	1 (rice) dan 2 (orange).
s	:	Age stratum of orange trees *s* (I, II, ..., V)

Results and Discussion

Farmers' Profile (Age, Education, Farming Experience)

The respondents in this study consist of farmers with varying ages, educational backgrounds, and farming experiences, all of which influence how they manage their rice-orange farming systems.

Age. The majority of farmers are between 45–64 years old, an age group considered to still be productive. Younger farmers tend to be more open to adopting new technologies, while older farmers generally rely more on traditional methods and personal experience.

Education. The farmers' level of education is relatively low; 42% have completed elementary school (SD), 38% junior high school (SMP), and only 15% senior high school (SMA), while the remaining 5% have no formal education. This has an impact on the adoption and implementation of modern agricultural technologies.

Farming Experience. In terms of experience, 72% of the farmers have been farming for more than 10 years, with 44% having 21–30 years of experience. This long experience contributes positively to land management and pest control practices, although most farmers still rely on traditional methods.

Table 3. Farmer Profile in Astambul Subdistrict

Category	Number of Respondents (People)	Percentage (%)
Farmer Age		
25 – 34 years		
35 – 44 years	0	0%
45 – 54 years	13	36%
55 – 64 years	14	39%
Over 65 years	7	19%
Education Level	2	6%
No formal education		
Elementary school	2	6%
Junior high school	14	39%
Senior high school	14	39%
Higher education	5	14%

Category	Number of Respondents (People)	Percentage (%)
Farming Exprience	1	3%
Less that 5 years		
5 – 10 years	3	8%
11 – 20 years	6	17%
21 – 30 years	16	44%
More than 30 years	10	28%

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 3, the majority of rice-orange farmers are aged 45–54 years old and have considerable farming experience. However, their low level of formal education limits the adoption of modern agricultural technologies. Farmers with more than 20 years of experience tend to rely on traditional methods, while those with less than 10 years of experience are more open to innovation. There is a need for intensive training and extension services to support technology adoption, alongside challenges in generational renewal due to the limited interest of younger generations in farming.

Cultivated Land Area and Farming System

The majority of farmers in Astambul Subdistrict own cultivated land areas ranging from 1.1 to 2 hectares (40%), followed by those owning 0.5 to 1 hectare (35%). A small proportion (10%) owns less than 0.5 hectares, and the remaining 15% own land between 2.1 and 2.5 hectares. This data indicates significant variation in land size, which affects productivity and farmer income. Table 4 presents a detailed distribution of land area, ownership status, and land management systems.

Table 4. Distribution of cultivated land area among farmers in Astambul Subdistrict

Category	Number of Respondents (persons)	Percentage (%)
Cultivated Land Area		
Less than 0.5 ha	3	10%
0.5 – 1 ha	12	35%
1.1 – 2 ha	14	40%
2.1 – 2.5 ha	5	15%
Land Ownership Status		
Own land	22	65%
Rented	9	25%
Sharecropping	4	10%
Land Management System		
Rainfed	31	85%

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 4, the majority of farmers in Astambul manage land areas ranging from 1.1 to 2 hectares. Of this land, 65% is owned, 25% is rented, and 10% is cultivated under a sharecropping arrangement. A total of 85% of farmers rely on rain-fed agriculture, making productivity highly dependent on rainfall patterns. The rice-orange farming system in the area follows the *surjan* (rice-fruit) pattern — cultivating rice in lowland areas and oranges in upland areas — to optimize land use, increase income, and support food security.

Production, Costs, Revenue, and Income of the Rice-Orange Farming System in Banjar Regency

Production of the Rice-Orange Farming System

The rice-orange farming system in Astambul enhances productivity and income diversification. This integrated system is efficient in land use and serves as an adaptive strategy for food security and economic stability among farmers.

Rice Farming. Rice cultivation within this integrated system varies depending on the condition and arrangement of orange trees on the same plot. On average, rice is cultivated on 0.80 hectares of land and produces 4.04 tons per cropping season, equivalent to a productivity of 5.37 tons per hectare. Despite relying solely on rain-fed irrigation, farmers are still able to maximize production with one planting cycle per year.

Table 5. Production, area, and productivity of the rice-orange farming system

Age Strata (Years)	Rice Production (tons/farm)	Farm Area (ha)	Productivity (tons/ha)
1 – 5	4.26	0.89	5,33
6 – 10	3.37	0.64	5,33
11 – 15	5.12	0.82	6,40
16 – 20	4.02	0.60	5,03
21 – 25	2.58	0.53	3,22
Average	4,04	0.80	5.37

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 5, Stratum I (orange tree age: 1–5 years) and Stratum III (11–15 years) have the largest rice cultivation areas (0.89 ha and 0.82 ha, respectively), indicating that rice is the main source of income in these strata. In Stratum I, orange productivity is still low because the trees are young, while in Stratum III, both rice and orange productivity are optimal, with rice reaching 5.37 tons/ha.

Strata II, IV, and V have smaller rice areas (0.53–0.64 ha) and production ranging from 2.58 to 3.46 tons. The planting pattern follows the topography: rice is cultivated in lowland areas, while oranges are planted on higher ground.

Orange Farming. In the rice-orange farming system in Astambul Subdistrict, the average orange cultivation area is 0.59 hectares per farm, producing an average of 7.88 tons per farm or 13.13 tons/ha. Orange productivity highly depends on tree age.

At ages 1–5 years, productivity is still low at 6.49 tons per farm or 12.82 tons/ha, as the trees are still in their early growth phase. Productivity increases in the 6–10 years age group to 6.96 tons per farm or 13.16 tons/ha, indicating the trees are beginning to enter their productive phase.

The highest productivity occurs in Stratum III (11–15 years), with 13.26 tons per farm or 16.30 tons/ha, marking the peak of orange productivity. However, for trees aged 16–20 years, productivity declines to 9.85 tons per farm or 13.45 tons/ha. This highlights the need for intensive maintenance strategies or replanting programs to sustain high yields.

Table 6. Orange Production and Productivity by Age Stratum

Age Strata (Years)	Orange Production (tons/farm)	Farm Area (ha)	Productivity (tons/ha/ year)
1 – 5	6.49	0.51	12.82
6 – 10	6.96	0.53	13.16
11 – 15	13.26	0.81	16.30
16 – 20	9.85	0.73	13.45
21 – 25	6.05	0.53	11.52
Average	7,88	0.59	13.13

Source: Authors' Compilation Based on Primary Data (2025)

At the 21–25 year age stratum, orange production dropped sharply to 6.05 tons per farm (11.52 tons/ha), indicating the final stage of productivity and increasing vulnerability to pests. Plant rejuvenation should be considered. Most farmers in Astambul still manage orchards in the early to mid-age stages, offering opportunities for improved productivity through better management and timely rejuvenation.

Production Costs of the Rice–Orange Farming Pattern

Production costs influence the sustainability and profitability of farming operations, comprising explicit costs (purchased inputs and paid labor) and implicit costs (family labor and non-monetary resources). The cost analysis of rice–orange farming in Astambul is detailed by orange tree age strata, covering all growth stages (Table 7).

Table 7. Explicit, Implicit, and Total Costs of the Rice–Orange Farming Pattern

Orange Age Stratum (years)	Explicit Costs (Rp/farm/year)		Implicit Costs (Rp/farm/year)		Paddy-Orange Total Cost
	Rice	Orange	Rice	Orange	Padi-Jeruk
1 – 5	7.459.410	5.119.364	969.277	1.053.255	14.601.308
6 – 10	7.511.272	5.925.182	940.657	979.581	15.356.694
11 – 15	11.258.089	9.911.193	1.069.169	1.070.200	23.308.652
16 – 20	10.663.995	9.088.858	1.021.673	1.140.438	21.914.965
21 – 25	6.543.928	5.787.009	1.338.202	976.211	14.645.351
Average	8.409.253	6.575.219	1.005.883	1.045.114	17.035.471

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 7, the average production cost of rice–orange farming in Astambul is Rp 17,035,471, consisting of 88% explicit costs and 12% implicit costs. The highest cost was recorded in the 11–15 year stratum (Rp 23,308,652), due to intensive care required during peak productivity. The lowest cost was found in the 1–5 year stratum (Rp 14,601,308), when trees are still young. After the peak, costs decreased in the 16–25 year strata, though implicit costs increased, indicating the need for efficiency and rejuvenation efforts.

Table 8. Average Explicit and Implicit Costs of Rice–Orange Farming Pattern

Description	Avg. Cost (Rp/Farm/Year)		Total Avg. Cost of Rice–Orange (Rp)	% of Total Cost
	Rice Farming	Orange Farming		
Explicit Costs:				
1. Fertilizer	2.451.416	1.925.152	4.376.569	25,69
2. Pesticides	1.151.333	1.461.333	2.612.666	15,34

Description	Avg. Cost (Rp/Farm/Year)		Total Avg. Cost of Rice–Orange (Rp)	% of Total Cost
	Rice Farming	Orange Farming		
3. Hired Labor	2.151.453	1.956.083	4.107.536	24,11
4. Irrigation	400.195	0	400.195	2,35
5. Depreciation of Tools	902.000	601.333	1.503.333	8,82
6. Transportation	730.632	282.901	1.013.533	5,95
7. Miscellaneous Expenses	622.222	348.415	970.637	5,70
Total Explicit Costs	8.409.253	6.575.219	14.984.472	(87,96)
Implicit Costs:				(12,04)
1. Family Labor	1.005.883	1.045.114	2.050.998	12,04
Total Cost (TC)	9.415.137	7.620.333	17.035.471	100

Source: Authors' Compilation Based on Primary Data (2025)

Cost of rice farming. In the rice-orange farming system, rice production accounts for 55.27% of the total cost, with an average explicit cost of IDR 9,415,137 per farm. The largest components come from fertilizer (26.04%), external labor (22.85%), and pesticides (12.23%), while irrigation, depreciation of tools, and transportation each contribute less than 10% (Table 8). Implicit costs amount to 10.68%, mainly from family labor, which represents a non-monetary contribution.

Cost of orange farming. Orange production costs in Astambul reach IDR 7,620,333 per year, dominated by explicit costs (86.29%) with the remaining share being implicit (13.71%). The main components are labor (25.67%), followed by fertilizer (25.26%), and pesticides (19.18%), indicating a high dependence on manual labor and fertilization. Depreciation of equipment and transportation account for 7.89% and 3.71%, respectively. Implicit costs stem from family labor and represent a significant non-monetary contribution.

Revenue from the Rice-Orange Farming System

The rice-orange farming system in Astambul integrates two commodities to optimize land use. Rice income is influenced by cultivated area, productivity, and market price; while orange income depends on tree age, harvest yield, and selling value. The average revenue per orange tree age stratum is presented in Table 9.

Table 9. Average Revenue of the Rice-Orange Farming System

Citrus Tree Age Strata (years)	Rice Revenue (IDR/farm/year)	Orange Revenue (IDR/farm/year)	Total Revenue (IDR/farm/year)
1 - 5	25.191.625	52.837.500	78.029.125
6 - 10	20.013.875	50.639.375	70.653.250
11 - 15	30.194.183	102.305.500	132.499.683
16 - 20	24.575.750	76.250.500	100.826.250
21 - 25	14.935.000	54.450.000	69.385.000
Average	24.236.530	63.284.722	87.521.252

Source: Authors' Compilation Based on Primary Data (2025)

Table 9 shows that the average annual revenue from the rice-orange farming system in Astambul is IDR 87,521,252, varying according to the age of the orange trees. Stratum 1–5 years generates IDR 78,029,125, with a significant contribution already coming from oranges. Revenue drops to IDR 70,635,250 in stratum 6–10 years due to lower prices and production.

The peak occurs in stratum 11–15 years (IDR 132,499,683.33), when orange productivity reaches its maximum. Revenue declines again in stratum 16–20 years (IDR 100,826,250) and reaches the lowest level in stratum 21–25 years (IDR 69,385,000) due to a sharp decrease in orange productivity.

Revenue from rice farming. Rice revenue in the rice–orange farming system in Astambul averages IDR 24,236,530 per farm annually, with an average yield of 4.04 tons at IDR 6,009/kg. In the 1–5 year stratum, revenue reaches IDR 50,258,953 (8.53 tons at IDR 5,893/kg) due to minimal competition from young orange trees. In stratum 6–10 years, revenue drops to IDR 40,039,600 (6.46 tons at IDR 6,200/kg) as tree growth limits rice cultivation. The highest revenue is in stratum 11–15 years at IDR 61,887,433 (10.29 tons at IDR 6,016/kg). In stratum 16–20 years, revenue is IDR 49,071,450 (8.04 tons at IDR 6,100/kg).

Tabel 10. Average Rice Farming Revenue Based on Orange Tree Age per Stratum

Orange Tree Age Stratum (years)	Rice Production (tons/farm/year)	Selling Price (IDR/kg)	Rice Revenue (IDR/farm/year)
1 - 5	4,26	5.908	25.191.625
6 - 10	3,23	6.198	20.013.875
11 - 15	5,01	6.028	30.194.183
16 - 20	4,02	6.109	24.575.750
21 - 25	2,58	5.800	14.935.000
Average	4,04	6.008	24.236.530

Source: Authors' Compilation Based on Primary Data (2025)

Although declining, rice remains an important source of income in the rice-orange farming system. In stratum 21–25 years, rice production drops to 5.15 tons with a price of IDR 5,800/kg, generating revenue of IDR 29,870,000. This decline is caused by high competition from older orange trees that consume more water, light, and nutrients.

Revenue from orange farming. Orange revenue is influenced by yield and selling price, both of which depend on tree age. With an average production of 7.88 tons per farm and an average price of IDR 7,984/kg, the average annual orange revenue reaches IDR 63,284,722 per farm (Table 11).

Table 11. Average Revenue from Orange Farming Based on Tree Age Stratum

Strata Usia Tan. Jeruk	Produksi Jeruk (ton/usaha tani/Tahun)	Harga Jual Jeruk (Rp/kg)	Penerimaan Jeruk (Rp/usahatani/ tahun)
1 - 5	6,49	8.144	52.837.500
6 - 10	6,96	7.275	50.639.375
11 - 15	13,19	7.758	102.305.500
16 - 20	9,85	7.742	76.250.500
21 - 25	6,05	9.000	54.450.000
Average	7,88	7.984	63.284.722

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 11, orange farming revenue varies according to tree age. Stratum 1–5 years generates IDR 52,837,500 (6.49 tons, IDR 8,144/kg), while stratum 6–10 years earns IDR 50,639,375 (6.96 tons, IDR 7,275/kg). The highest revenue is achieved in stratum 11–15 years at IDR 102,305,000 (13.19 tons, IDR 7,758/kg). Revenue declines in stratum 16–20 years to IDR 76,250,000 (9.85 tons, IDR 7,742/kg), and further drops in stratum 21–25 years to IDR 54,450,000 (6.05 tons, IDR 9,000/kg).

Income from the Rice-Orange Farming System

The rice–orange farming system in Astambul yields an average revenue of IDR 90,278,662 with explicit costs of IDR 15,644,623, resulting in a net income of IDR 74,634,039 per farm. This highlights its profitability and positive impact on rain-fed farmers' welfare.

Table 12. Income from Rice–Orange Intercropping Farming System

Orange Tree Age Stratum (years)	Total Revenue (IDR/farm/year)	Explicit Cost (IDR/farm/year)	Net Income (IDR/farm/year)
1 - 5	78.029.125	12.578.775	65.450.350
6 - 10	70.653.250	13.436.455	57.216.795
11 - 15	132.499.683	20.124.091	112.375.591
16 - 20	100.826.250	19.752.853	81.073.396
21 - 25	69.385.000	12.330.937	57.054.062
Average	87.521.252	15.644.622	72.710.978

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 12, the average net income from Based on Table 12, net income in the rice–orange farming system varies by orange tree age. Stratum 1–5 years yields IDR 65,450,350 (revenue: IDR 78,029,125; cost: IDR 12,578,775), and 6–10 years drops to IDR 57,216,795 (revenue: IDR 70,635,250; cost: IDR 13,436,455). The peak occurs in stratum 11–15 years with IDR 112,375,591 (revenue: IDR 132,499,683; cost: IDR 20,124,091). Income declines in stratum 16–20 years to IDR 81,073,396, and further in 21–25 years to IDR 57,054,062. This shows maximum profitability at mid tree age, followed by gradual decline.

Income from rice farming. The average revenue from rice farming is recorded at IDR 24,236,530 per farm per year, with an average explicit cost of IDR 8,409,253. Thus, the net income from rice farming reaches IDR 15,893,465 per farm per year. This income contribution accounts for approximately 22% of the total income from the rice-orange farming system, as shown in Table 13.

Table 13. Revenue, Explicit Cost, and Income from Rice Farming

Orange Tree Age Stratum (years)	Orange Revenue (IDR/farm/year)	Explicit Orange Cost (IDR/farm/year)	Net Orange Farming Income (IDR/farm/year)
1 - 5	25.191.625	7.459.410	17.732.214
6 - 10	20.013.875	7.511.272	12.502.602
11 - 15	30.194.183	11.258.089	18.936.093
16 - 20	24.575.750	10.663.995	13.911.754
21 - 25	14.935.000	6.543.928	8.391.071
Average	24.236.530	8.409.253	15.893.465

Source: Authors' Compilation Based on Primary Data (2025)

Income from rice farming based on orange tree age strata tends to vary, influenced by differences in land area, yield, and selling price, which are determined by harvest time, rice quality, and the variety cultivated.

Income from orange farming. calculated as the difference between revenue and the explicit costs incurred by farmers. On average, annual revenue reaches IDR 63,284,722 per farm, with explicit costs amounting to IDR 6,575,219. This results in a net income of IDR 56,817,513 per farm per year, contributing approximately 88% of the total income from the rice-orange farming system (Table 14).

Table 14. Revenue, Explicit Cost, and Income from Orange Farming

Orange Tree Age Stratum (years)	Orange Revenue (IDR/farm/year)	Explicit Orange Cost (IDR/farm/year)	Net Orange Farming Income (IDR/farm/year)
1 - 5	52.837.500	5.119.364	47.718.135
6 - 10	50.639.375	5.925.182	44.714.192
11 - 15	102.305.500	9.911.193	92.394.307
16 - 20	76.250.500	9.088.858	67.161.641
21 - 25	54.450.000	5.787.009	48.662.991
Average	63.284.722	6.575.219	56.817.513

Source: Authors' Compilation Based on Primary Data (2025)

Feasibility of the Rice-Orange Farming System

The feasibility of the rice–orange farming system in Astambul is confirmed by its RCR value of 5.15, indicating strong economic viability. With an average annual revenue of IDR 90,278,661.67 and total costs of IDR 17,695,620.84 (explicit: IDR 15,644,622.62; implicit: IDR 2,050,998.22), the system generates IDR 5.15 in revenue for every IDR 1 spent. This demonstrates that the farming model is both feasible and highly profitable (Table 15).

Table 15. Feasibility of the Rice-Orange Farming System

Orange Tree Age Stratum (years)	Rice-Orange Revenue (IDR/farm/year)	Explicit Cost (IDR/farm/year)	Implicit Cost (IDR/farm/year)	Total Cost (IDR/farm/year)	RCR
1 - 5	78.029.125	12.578.775	2.022.533	14.601.308	5,34
6 - 10	70.653.250	13.436.455	1.920.239	15.356.694	4,60
11 - 15	132.499.683	20.124.091	2.139.369	22.263.461	5,95
16 - 20	100.826.250	19.752.853	2.162.111	21.914.965	4,60
21 - 25	69.385.000	12.330.937	2.314.413	14.645.351	4,74
Average	87.521.252	15.644.622	2.050.998	17.695.620	5,15

Source: Authors' Compilation Based on Primary Data (2025)

Based on Table 15, the rice–orange farming system in Astambul remains economically viable across all orange tree age strata, with RCR values consistently above 1. The 1–5 year stratum shows an RCR of 5.34 (revenue: IDR 78,029,125; cost: IDR 14,601,308). In the 6–10 year stratum, the RCR slightly declines to 4.60 (revenue: IDR 70,635,250; cost: IDR 15,356,694). The highest profitability is found in the 11–15 year stratum with an RCR of 5.95 (revenue: IDR 132,499,683; cost: IDR 22,263,461). The 16–20 year group records an RCR of 4.60 (revenue: IDR 100,826,250; cost: IDR 21,914,965), while the 21–25 year stratum still achieves a solid RCR of 4.74 (revenue: IDR 69,385,000; cost: IDR 14,645,351).

CONCLUSION

Based on the study's results, the *paddy–citrus farming system* in Astambul District demonstrates strong economic performance, with average production levels of 4.04 tons of rice and 7.88 tons of citrus per farm. Farmers incur total costs of IDR 17,695,620.84, including explicit and implicit expenses, yet generate substantial revenue averaging IDR 87,521,252.78, leading to a net income of IDR 72,710,978.31 per farming unit. The high Revenue-Cost Ratio (RCR) of 5.15 confirms the system's profitability and financial viability, indicating a return of IDR 5.15 for every IDR 1 invested. For future research, it is recommended to explore the long-

term environmental sustainability and resilience of this farming pattern under varying climate conditions, as well as the socio-economic impacts on different farmer groups to optimize adoption and policy support.

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