Asian Journal of Agriculture and Rural Development
Volume 16, Issue 2 (2026): 46-58

Determinants of profitability in organic rice farming: Evidence from Sakon Nakhon province, Thailand

Thanada Konkan[a]
Narawut Rapankum[b†]
Chanoknan Srilapat[c]
Jantima Rapankum[d]
Busadee Rattanakorn[e]

[a,b,c]*Department of Agribusiness Administration, Faculty of Agricultural Technology, Sakon Nakhon Rajabhat University, Sakon Nakhon, 47000, Thailand.*
[d,e]*Mueang Sakon Nakhon District Agricultural Office, Government Center Road, Sakon Nakhon, 47000, Thailand.*

narawut@snru.ac.th (Corresponding author)

Article History
Received: 17 November 2025
Revised: 30 January 2026
Accepted: 6 March 2026
Published: 29 April 2026

Keywords
Cost-benefit analysis
Logit model
Net profit margin
Organic rice farming
Profitability
Sakon Nakhon.

ABSTRACT
This study aimed to examine the costs and benefits and scrutinize the factors determining the profitability of organic rice farming in Sakon Nakhon, Thailand, to address the financial challenges faced by producers. The study employed a cross-sectional design and a multistage sampling method to select 300 organic rice farmers as respondents. Data collection was conducted through face-to-face interviews using a structured questionnaire. Cost-benefit analysis, net profit margin assessment, and binary logistic regression modeling were employed for data analysis. Results revealed that the organic rice farming business is profitable, generating an average net profit of $2,029.81 per crop/ha, with a net profit margin of 37.39%. These findings indicate that organic rice production in the study area is highly profitable for small-scale farmers. Statistical analysis identified that farmers' training, off-farm income, organic rice farming size, and expenditure on organic pest control products are significantly associated with profitability ($p < 0.01$). The study concludes that although organic rice farming can be profitable, policy interventions should prioritize enhancing the effectiveness of training programs through practical applications, encouraging larger-scale operations to improve efficiency, and supporting optimal pest management.

Contribution/Originality: This study contributes to the existing literature by empirically analysing profitability determinants of organic rice farming in Northeast Thailand. The paper's primary contribution is finding that training, off-farm income, farm size, and pest control expenditures are critical to financial viability, providing specific evidence to guide policy interventions in low-adoption regions.

DOI: 10.55493/5005.v16i2.5994
ISSN(P): 2304-1455/ ISSN(E): 2224-4433
How to cite: Konkan, T., Rapankum, N., Srilapat, C., Rapankum, J., & Rattanakorn, B. (2026). Determinants of profitability in organic rice farming: Evidence from Sakon Nakhon province, Thailand. *Asian Journal of Agriculture and Rural Development, 16*(2), 46–58. 10.55493/5005.v16i2.5994

1. INTRODUCTION

Organic agriculture is increasingly recognized as a critical pathway to sustainable food production, driven by rising consumer demand for health-conscious, ecologically sound products (Reganold & Wachter, 2016). Organic rice, produced without synthetic inputs, not only meets this demand but also commands a significantly higher economic value than conventional rice, aligning with global market trends (Willer & Lernoud, 2019; Willer, Schlatter, Trávníček, Kemper, & Lernoud, 2020). Despite this clear market potential, producers face substantial obstacles, including elevated production costs compared to traditional methods, complex challenges in non-synthetic pest and disease management, and barriers to market access (Padel & Lampkin, 2007). These factors create significant economic pressures that directly affect farmer profitability, necessitating research to support the sector's sustainable expansion (Seufert, Ramankutty, & Foley, 2012).

In Thailand, these global challenges are compounded by specific systemic issues. Despite government policies promoting organic farming, significant obstacles remain. These include a national certification system that lacks alignment with international standards (Baird, 2024), limited farmer access to high-value international certifications (Hérique & Faysse, 2021), and socio-demographic hurdles such as an aging farmer population and a lack of access to adequate finance and extension services to motivate conversion. This policy-practice gap is evident in Sakon Nakhon Province, a major rice-producing region. In the 2023/24 season, organic cultivation accounted for 0.38% of the province's total rice area (Sakon Nakhon Provincial Statistical Office, 2024). This extremely low adoption rate is widely attributed to perceptions that organic farming is limited to small-scale operations, is prohibitively costly, and yields lower average yields than conventional methods.

While the literature confirms that profitability is broadly influenced by production costs, marketing, and policy (Crowder & Reganold, 2015; Mendoza, 2004; Thapa & Rattanasuteerakul, 2011), most studies focus on the limitations of widespread technology application or on comparing production efficiency rather than analyzing specific determinants of profitability. A key question that remains unclear is what operational and socio-economic factors at the farm level differentiate operations from those experiencing losses in areas with low technology adoption rates. Existing literature has not examined these economic barriers using quantitative methods in Sakon Nakhon Province. This study addresses this gap by employing a binary logistic regression model to analyze the causal relationship between variables such as training, off-farm income, and input costs, and the probability of farm financial success.

The main objective of this study was to investigate the factors determining the profitability of organic rice production in Sakon Nakhon, Thailand, by analyzing costs and benefits and identifying key factors that affect its profitability. The study's results provide empirical data to inform proactive policies that address specific economic problems rather than relying on general promotional approaches. To achieve this objective, the study focuses on the following research questions: 1) Is organic rice farming in Sakon Nakhon province economically viable in terms of net profit margin? 2) What are the key socio-economic and operational factors that influence the profitability of organic rice farming? This paper is structured as follows: Section 2 reviews the literature on the concept of profit and the factors influencing organic agriculture. Section 3 describes the research methodology in detail, including the research model and data collection process. Section 4 presents empirical research findings and a discussion. Finally, Section 5 provides the conclusion and policy implications.

2. LITERATURE REVIEW

2.1. Profitability Concepts

Profitability is a key indicator for evaluating financial performance and the long-term sustainability of agribusiness (Mankiw, 2022). It is widely recognized as the most comprehensive indicator for evaluating the true economic sustainability of organic farming (Puspitaningtyas, Toha, & Prakoso, 2018), whereas accounting profit focuses on explicit costs, economic analysis requires a broader perspective on resource allocation efficiency. In this study, profitability was assessed using the Net Profit Margin (NPM), defined as the percentage of profitability from organic rice farming generated by farmers. It is calculated as.

Net Profit Margin = (Net Profit /Total Revenue) x 100

2.2. Factors Influencing Organic Rice Profitability

The existing literature indicates that factors influencing the profitability of organic rice production can be broadly classified into two categories: 1) socio-demographic and operational factors, such as farmer age, education, experience, training, off-farm income, and cultivation area; and 2) production cost factors, including expenditures on seeds, fertilizers, pesticides, and labor.

The literature presents a view of the impact of farmer demographics. Some studies suggest that older farmers (>50 years) leverage extensive experience to achieve greater operational efficiency and profitability (Suswadi, 2018; Suswadi & Kartikasari, 2021). Conversely, other research indicates that younger farmers are more likely to join organic farming groups, thereby improving access to resources and markets (Phranakhone & Nanseki, 2015). Similarly, higher levels of education tend to lead to greater adoption of more sophisticated sustainable agricultural techniques and organic inputs, resulting in improved financial performance (Hoang, 2021; Tuan & Lee, 2021).

Beyond demographic factors, operational support is also crucial. Farmers' experiences are a key factor in achieving higher financial success through efficient resource management (Amani, Dharmawan, & Satriani, 2024; Dang, 2022). This is further enhanced by formal training, which improves financial management knowledge and provides a higher return on investment than traditional methods (Hidayat, Firdaus, & Novianti, 2024a; Quion & Ratilla, 2024). Furthermore, off-farm income plays a significant role in financial risk management, mitigating production volatility

and supporting funding for essential inputs (Drall & Mandal, 2024; Uchelue, Isibor, Nkamigbo, & Okonkwo-Emegha, 2023).

Farm size, or cultivation area, is a key determinant of profitability. Larger farmland is positively correlated with higher profits through two main mechanisms. 1) Economies of scale are achieved, resulting in lower unit production costs due to the redistribution of fixed costs (Laksono, Armando, Dewi, & Uliya, 2023), and 2) increased market access and bargaining power may result in higher selling prices (Susilowati et al., 2024).

The literature is most complex regarding production costs. While investment in certified seeds is shown to be economically viable due to higher yields (Quion & Ratilla, 2024; Savitri et al., 2024), other inputs present a significant financial challenge. Organic fertilizers and pesticides are reported to be more expensive and, in some cases, less effective than their chemical counterparts, posing risks of reduced productivity and profitability (Anand & Rai, 2024; Gao et al., 2023; Hidayat, Purwakusuma, & Nadalia, 2024b; Ichdayati, 2022). Similarly, labor costs are consistently higher in organic systems. However, several studies conclude that these elevated production and labor costs are often offset by significant price premiums for organic rice, ultimately resulting in higher overall profits than conventional farming (Namdev, Shrivastav, & Awasthi, 2013; Suwanmaneepong, Kerdsriserm, Lepcha, Cavite, & Llones, 2020) (Table 1).

Table 1. Summary of empirical studies on determinants of organic farming profitability.

Variables	Contexts	Methods	Findings/Argument	Expected Sign	Selected References
Socio-demographic					
Age	Smallholder rice farmers in Central Java, Indonesia.	Analyze performance using the R/C ratio	Older farmers possess greater experience and managerial efficiency.	(+)	Suswadi (2018) and Suswadi and Kartikasari (2021)
Education	Smallholder farmers in Vietnam	Descriptive and inferential statistics, including a binary logistic regression	Higher education is associated with greater adoption of complex organic technologies.	(+)	Hoang (2021) and Tuan and Lee (2021)
Operational factors					
Training	Group of farmers in Indonesia, Experimental plots in the Philippines	Descriptive statistical analysis, quantitatively and qualitatively , calculates net return and Benefit-cost ratio	Training improves technical knowledge and financial management (cost-benefit)	(+)	Hidayat et al. (2024a) and Quion and Ratilla (2024)
Farm Size	Smallholder rice farmers in Indonesia	Measure profitability and business viability using the R/C ratio	A larger scale allows for economies of scale and stronger bargaining power.	(+)	Laksono et al. (2023) and Susilowati et al. (2024)
Experience	Smallholder rice farmers in Vietnam and Indonesia	Multiple Regression	Farmers' experience is a key factor in achieving higher financial success and effective resource management.	(+)	Dang (2022) and Amani et al. (2024)
Off-farm income	Smallholder farmers in India, Smallholder rice farmers in Nigeria	Tobit Model, Descriptive statistics analysis	Non-agricultural income plays a crucial role in financial risk management, helping to reduce production volatility and supporting financing.	(+)	Uchelue et al. (2023) and Drall and Mandal (2024)
Production Costs					
Input Costs (seeds, fertilizer, pesticides, labour, etc.)	Middle-class farmers in Indonesia, the rice production system in China	Multiple linear regression, one-way ANOVA, and Scenario simulation	Higher input expenditures increase the denominator in profit equations, potentially reducing margins if yield gains are not proportional.	(-)	Ichdayati (2022) and Gao et al. (2023)

3. METHODOLOGY

This study is based on profitability ideas, especially the Net Profit Margin (NPM), which examines how well farmers perform when growing organic rice. Moreover, certain socio-demographic attributes of farmers were incorporated into the research model to evaluate their correlation with the profitability potential of organic rice farming. Further, a binary logistic regression model was used to analyze factors influencing the profitability of organic rice farming. This model differs from general linear regression, which is used to predict continuous values, because it is specifically designed to handle only two dependent variables. The independent variable (Y) is the farmer's profitability. This approach differs significantly from most research on agricultural profitability. Past research often used traditional production function analysis methods, such as the OLS method or the Cobb-Douglas function. It focuses on estimating the elasticity of profit or output. However, such linear models have a significant limitation as they are sensitive to outliers and extreme variations.

This comprehensive approach establishes a solid basis for understanding the factors influencing profitability in organic rice production. The hypothesized relationships are described in the following section.

3.1. Research Model and Study Hypotheses

Figure 1 shows the research model. From the synthesized literature (Table 1), a specific directional relationship has been proposed. Socio-demographic factors such as age, education, and experience are expected to positively impact profitability due to the accumulation of management skills and openness to innovation (Hoang, 2021; Suswadi, 2018; Suswadi & Kartikasari, 2021; Tuan & Lee, 2021). Similarly, operational support, such as training and off-farm income, is expected to have a positive impact by improving technical efficiency and building financial (Hidayat et al., 2024a; Laksono et al., 2023; Quion & Ratilla, 2024; Susilowati et al., 2024). Hence, the following alternative hypotheses were established.

H_{a1}: There is a significant positive relationship between farmers' age and the probability of achieving profitability.

H_{a2}: There is a significant positive relationship between the farmer's education level and the probability of achieving profitability.

H_{a3}: There is a significant positive relationship between a farmer's experience in organic rice production and the probability of achieving profitability.

H_{a4}: There is a significant positive relationship between farmers' training in organic rice production and the probability of achieving profitability.

H_{a5}: There is a significant positive relationship between farmers' off-farm income and the probability of achieving profitability.

H_{a6}: There is a significant positive relationship between the organic rice planting size and the probability of achieving profitability.

Conversely, in terms of production costs, economic theory indicates that if income remains constant, an increase in the cost of production factors will reduce the net profit margin. Therefore, variables representing the costs of seeds, fertilizers, pesticides, and labor are expected to show a negative correlation with profitability, as high costs without proportional increases in yield will threaten financial survival (Gao et al., 2023; Ichdayati, 2022). Therefore, the following alternative hypotheses were established.

H_{a7}: There is a significant negative relationship between seed cost and the probability of achieving profitability.

H_{a8}: There is a significant negative relationship between organic fertilizer cost and the probability of achieving profitability.

H_{a9}: There is a significant negative relationship between expenditure on organic pesticides and the probability of achieving profitability.

H_{a10}: There is a significant negative relationship between labour cost and the probability of achieving profitability.

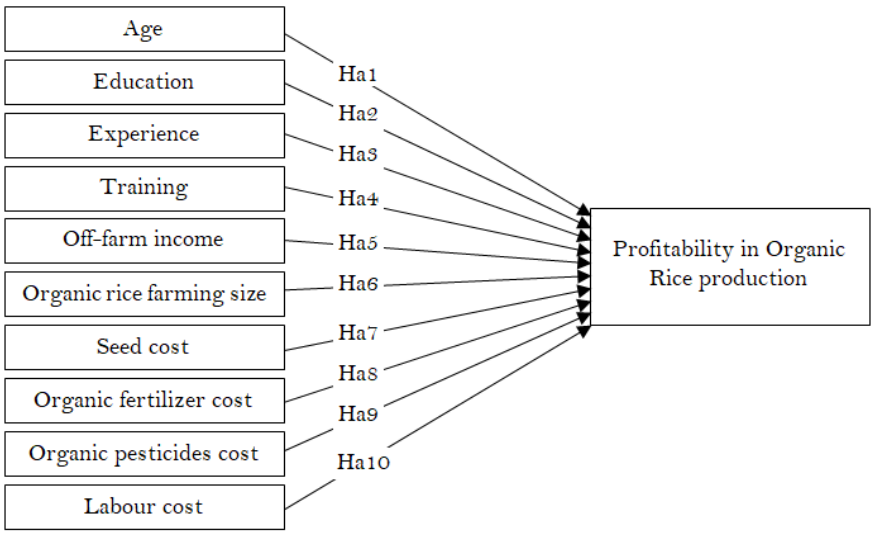

Figure 1. The research model for exploring the determinants of the profitability in organic rice production.

3.2. Sampling Procedures, Questionnaire Structure, and Data Collection

Figure 2 depicts maps of Sakon Nakhon Province, Thailand, which is the location of this study. A total of 1,197 organic rice farmers were listed for the 2023/2024 production year, as reported by the Sakon Nakhon Provincial Statistical Office (2024). The sample size was determined following Taro Yamane's formula at a 95% confidence level and a 5% margin of error (Yamane, 1973), yielding a sample size of 300. The selection of respondents followed a multistage sampling method. In the first step, a non-probability random sampling method, quota sampling, was used to ensure the sample proportions matched the number of organic rice farmers in each of the 13 districts. Next, one sub-district was randomly selected from each district. Based on the selected sub-districts, two villages from each sub-district were randomly chosen. Finally, after identifying the villages, a simple random sampling was used to select 300 farmers from each of the 26 villages on the list of organic rice farmers. Therefore, the total number of respondents was 300 farmers. Data collection was conducted through face-to-face interviews using a structured questionnaire. The questionnaire was reviewed for content validity by three experts using the Index of Item Objective Congruence (IOC) method. Experts rated the questions on a scale of -1, 0, and +1, and the results were used to calculate the IOC value. Questions with an IOC value of 0.50 or higher were considered relevant to the content and included in the final version of the tool. In this study, the questions met the threshold, indicating that the questionnaires' content was accurate and suitable for field data collection. The structured questionnaire covered the following sections: 1) organic rice farmers' profile, 2) organic rice farming characteristics, 3) production costs and returns from organic rice production, 4) opinions on adopting organic rice production, and 5) problems and/or obstacles in organic rice farming operations.

Figure 2. The map of the research location, in Sakon Nakhon province, Thailand.
Source: The German Thai Link (2006).

3.3. Data Analysis

The data were analyzed using descriptive and inferential statistics. The frequency, mean, and percentage described the demographic characteristics of organic rice farmers, while binary logistic regression examined the relationship

between explanatory and dependent variables. Statistical Package for the Social Sciences (SPSS) version 31 and Microsoft Excel were used as analytical tools.

This study uses a binary logistic regression model to analyze the factors that determine the profitability of organic rice farmers. These statistical techniques are suitable for analyzing the binary relationship between independent and dependent variables and can estimate the probability of the event of interest occurring. The dependent variable (y) is dichotomous, where y = 1 when the net profit rate is equal to or greater than the mean, and y = 0 when the net profit rate is lower than the mean. Denoted as β_0, β_1, β_2, …, and β_{10}, the estimated coefficients measure the relationship between each predictor variable and the log-odds of the dependent variable. Table 2 details the independent variables under study. The 10 independent variables are age (age), education level (edu), experience (exp), training (tra), off-farm income (off-farm), organic rice farming size (area), seed cost (seed), organic fertilizer cost (fer), organic pesticide cost (pest), and labor costs (wage). The following equation mathematically specifies the logistic regression model.

$$\ln(Y) = \ln\left(\frac{P_y}{1-P_y}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n \quad (1)$$

The study model of factors affecting the profitability of organic rice farming business is specified as follows.

$$Y = \beta_0 + \beta_1 age + \beta_2 edu + \beta_3 exp + \beta_4 tra + \beta_5 off\text{-}farm + \beta_6 area + \beta_7 seed + \beta_8 fer + \beta_9 pest + \beta_{10} wage \quad (2)$$

Table 2. The descriptions of variables used in the binary logistic regression model.

Variables	Descriptions	Symbol	Measurement
Dependent variable			
Profitability in organic rice production	The net profit margin of organic rice production: net profit margin above or equal to the average equals 1, and below the average equals 0.	-	Binary
Independent variable			
Age	Age of the organic rice farmer (years)	age	Scale
Education	Education level of the organic rice farmer primary school and lower = 0, higher = 1	edu	Binary
Experience	Farmers 'experience in organic rice production (years)	exp	Scale
Training	Farmers' training in the organic rice programme Trained = 1, other = 0	tra	Binary
Off-farm income	Off-farm household income (USD)	off-farm	Scale
Organic rice farming size	Organic rice farming size (ha.)	area	Scale
Seed cost	Seed cost (USD)	seed	Scale
Organic fertilizer cost	Expenditure on organic fertilizer (USD)	fer	Scale
Organic pesticides cost	Expenditure on organic pesticides (USD)	pest	Scale
Labour cost	Labour cost (USD)	wage	Scale

Source: The exchange rate is 34.0938 THB to 1 USD as of January 2, 2024 (Bank of Thailand, 2024).

4. RESULTS AND DISCUSSION

4.1. Respondent Profile

Table 3 presents the demographic profile of organic rice farmers in Sakon Nakhon Province. The majority of organic rice farmers were female (56.33%), with an average age of 53.96 years and aged 51-60 years, findings that align with those for small-scale farmers (Amani et al., 2024; Hoang, 2021).

Education level was mainly primary (47%) or secondary (43.34%) school, with only 9.66% holding a Bachelor's degree or higher. However, this contrasts with studies suggesting that higher levels of education are typically associated with conversion to organic farming (Hoang, 2021).

Most farmers (49%) had 5 to 6 years of experience in organic rice production, and a majority (76%) attended training during the 2023/24 production year. Operationally, most farmer households (67.67%) involved two family members in organic rice production, highlighting the role of family labor, a key factor in agricultural security (Triyono, Azzahra, & Kamarudin, 2025).

Regarding the structure and economics of organic rice farms, the average farm size was 1.24 ha. Most farmers (30.33%) cultivated 0.5-0.9 ha. The household income profile indicates a significant reliance on off-farm income. Off-farm income averaged USD 2,439.45 per year (65.93% of total income). Income from organic rice was USD 868.51 (23.47%), substantially higher than income from conventional paddy at USD 392.02 (10.67%).

Table 3. Respondent profile.

Characteristics	Frequency (n=300)	Percentage (%)
Gender		
Male	131	43.67
Female	169	56.33
Age		
Less than 40 years	20	6.67
41 -50 years	92	30.67
51 -60 years	127	42.33
60 -70 years	46	15.33
Above 70 years	15	5.00
Mean	53.96	
Education level		
Primary school	141	47.00
Secondary school	130	43.34
Bachelor's degree or higher	29	9.66
Family members engage in organic rice production.		
1 people	44	14.67
2 people	203	67.67
3 people	43	14.33
4 people	10	3.33
Organic rice farming size		
Less than 0.5 ha.	58	19.33
0.5 -0.9 ha.	91	30.33
1.0 -1.4 ha.	52	17.33
1.5 -1.9 ha.	52	17.33
2.0 -2.4 ha.	26	8.67
More than 2.5 ha.	21	7.00
Mean	1.24	
Training (in the production year 2023/24)		
Attended	228	76.00
Never	72	24.00
Experience in organic rice production		
Less than 2 years	57	19.00
3 - 4 years	74	24.67
5 - 6 years	147	49.00
7 - 8 years	13	4.33
More than 8 years	9	3.00
Mean	4.43	
Household income (Average baht per year)		
Paddy income	392.02	10.60
Organic rice income	868.51	23.47
Off-farm income	2,439.45	65.93

4.2. Costs, Returns, and Profitability of Organic Rice Production

The cost and return analysis of organic rice production for a single crop cycle (per ha./crop) is presented in Table 4. Based on an average cultivation area of 1.24 ha per farmer, farmers achieved a mean net profit of $2,029.81. This profit was derived from gross income of $5,428.19 and total production costs of $3,398.38 per farmer. Variable costs accounted for the majority of expenses at $2,789.00 (82.07% of total costs), with labor as the most significant component at $1,223.38 (36.00%). Such a high level of labor dependency is consistent with previous studies (Mehmood, Anjum, & Sabir, 2011; Rozaki et al., 2025; Setiono, Sidhi, Pamujiati, & Arissaryadin, 2024). Fixed costs totaled $609.38 (17.93%), with equipment maintenance and repair accounting for the largest share at $277.38 (8.16%). Therefore, this study revealed that organic rice cultivation is profitable for farmers.

For profitability assessment, the net profit margin was used to evaluate organic rice production. The study revealed the net profit margin was 37.39%, indicating that organic rice production in the study area is a highly profitable and economically viable enterprise.

Table 4. Costs, returns, and net profit margin of organic rice production.

Component	Costs ($ per ha.)	Percentage (%)
1. Total cost	3,398.38	100.00
1.1 Variable cost	2,789.00	82.07
Land preparation	764.69	22.50
Seeding	54.44	1.60
Organic fertilizer	247.25	7.28
Compost	43.31	1.27
Organic pesticides	61.69	1.81
Labor cost	1,223.38	36.00
Soil amendments	41.44	1.22
Electricity, water, and fuel	299.44	8.81
Transportation	53.38	1.57
1.2 Fixed cost	609.38	17.93
Equipment maintenance and repair	277.38	8.16
Depreciation	164.69	4.85
Machinery wages	59.25	1.74
Land use	101.69	2.99
Land tax	3.06	0.09
Interest	3.31	0.10
2. Total income	5,428.19	
3. Net profit	2,029.81	
4. Net profit margin (%)	37.39	

Source: The exchange rate is 34.0938 THB to 1 USD as of January 2, 2024. (Bank of Thailand, 2024).

4.3. Factors Affecting the Profitability of Organic Rice Production

To assess for multicollinearity, the correlation coefficients among the 10 independent variables were examined (Table 5). The resulting inter-variable correlations ranged from 0.006 to 0.461. As all coefficients were well below the critical threshold of 0.80 (Wanichbancha, 2007), it was concluded that multicollinearity was not a significant issue in the model.

Table 5. Correlation coefficient between independent variables.

Variables	age	edu	exp	tra	off-farm	area	seed	fer	pest	wage
age	1									
edu	-0.475**	1								
exp	0.196**	-0.194**	1							
tra	0.060	-0.034	0.312**	1						
off-farm	-0.101	0.163**	0.229**	0.146*	1					
area	0.190**	-0.212**	0.328**	0.207**	-0.052	1				
seed	-0.021	-0.077	0.015	-0.042	-0.140*	0.224**	1			
fer	0.006	-0.028	-0.030	0.079	-0.117*	0.109	0.052	1		
pest	-0.095	0.044	-0.059	-0.041	-0.244**	0.174**	0.461**	0.181**	1	
wage	0.099	-0.114*	0.068	0.113	-0.089	0.436**	0.114*	0.135*	0.119*	1

Note: ** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

A binary logistic regression was performed to identify factors influencing profitability in organic rice production (Table 6). The overall model was statistically significant (χ^2, $p < 0.01$), indicating a good fit compared to the null model. The independent variables collectively explained 25.5% of the variance in profitability (Pseudo $R^2 = 0.255$). The analysis showed that farmer training (tra), off-farm income (off-farm), organic rice farming area (area), and expenditure on organic pesticides (pest) were statistically significant predictors of profitability ($p < 0.01$). Details of the key factors that can predict profitability using binary logistic regression analysis are presented in Table 6.

Table 6. Results of the binary logistic regression analysis.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95 %C.I .Exp (B)	
							Lower	Upper
Constant	-1.836	0.973	3.560	1	0.059	0.159		
Age	0.022	0.017	1.669	1	0.196	1.022	0.989	1.058
Edu	-0.315	0.307	1.055	1	0.304	0.730	0.400	1.331
Exp	-0.101	0.079	1.642	1	0.200	0.904	0.774	1.055
Tra	1.882	0.594	10.031	1	0.002**	6.567	2.049	21.049
Off-farm	0.000	0.000	7.015	1	0.008**	1.000	1.000	1.000
Area	1.023	0.314	10.622	1	0.001**	2.782	1.504	5.148
Seed	0.003	0.002	2.123	1	0.145	1.003	0.999	1.008
Fer	0.000	0.000	0.028	1	0.867	1.000	1.000	1.000
Pest	0.005	0.002	8.878	1	0.003**	1.005	1.002	1.009
Wage	-0.001	0.000	3.498	1	0.061	0.999	0.999	1.000
Log-pseudolikelihood	343.184							
Chi-square; df = 8	8.619							
Prob. Chi-square	0.000							
Pseudo R2	0.255							

Note: * significant at $p < 0.05$; **significant at $p < 0.01$.

Logistic regression analysis revealed that farmer training (tra) had a statistically significant positive influence on profitability (B = 1.882, $p < 0.01$, odds ratio = 6.567). The odds ratio indicates that trained farmers have a 6.567 times higher chance of achieving profitability than untrained farmers.

These findings are consistent with previous research, such as that by Hidayat et al. (2024a) and Quion and Ratilla (2024), which found that training enhances financial and economic efficiency in organic farming. Furthermore, these findings align with numerous theoretical concepts and empirical evidence confirming the positive impact of training on farmer productivity and income (Alsiken-Nanglegan, 2023; Kijima, Ito, & Otsuka, 2012; Nakano, Tanaka, & Otsuka, 2018; Suryani & Riga, 2022).

Off-farm income (off-farm) had a statistically significant positive influence on profitability (B = 0.000, $p < 0.01$, Odds ratio = 1.000). Although the relationship between off-farm income and profitability is statistically significant, the odds ratio of 1.000 indicates a very small effect. This indicates that these variables have virtually no influence on the practical chances of farmers making a profit. In other words, although the p-values show a statistically significant relationship between off-farm income and profitability, the magnitude of the true effect is of very low practical significance (Agresti, 2013; Hosmer, Lemeshow, & Sturdivant, 2013).

These findings are inconsistent with previous research, which found that off-farm income is a significant source of funding for investment in agricultural activities and the transition to organic farming, resulting in increased productivity and efficiency (Eyhorn, Van den Berg, Decock, Maat, & Srivastava, 2018; Norfahmi, Kusnadi, Nurmalina, & Winandi, 2017; Sapkota, Subedi, Tripathi, & Dhakal, 2021; Takahashi & Otsuka, 2009). The very small impact found in this study may be due to the specific socio-economic context of the study area, where farmers' off-farm income is not significantly invested in organic rice production.

The organic rice farming size (area) had a statistically significant positive influence on profitability (B = 1.023, $p < 0.01$, Odds ratio = 2.782). The odds ratio of 2.782 indicates that each additional ha increases a farmer's odds of being profitable by 178.2%. The study results indicate that expanding the production area increases profits through economies of scale, as fixed costs are spread across a larger output volume, resulting in lower unit production costs and higher production efficiency.

This is consistent with numerous empirical studies (Handayani, 2022; Laksono et al., 2023; Mukhlis, Wisra, Hendriani, & Sari, 2023; Winahyu, Atika, & Maharani, 2024). Furthermore, scaling up farms also provides increased market access and enhanced bargaining power (Susilowati et al., 2024). However, achieving these benefits requires effective management to ensure that expanding cultivated areas lead to tangible profit increases.

Organic pesticide cost (pest) had a statistically significant positive influence on profitability (B = 0.005, $p < 0.01$, Odds ratio = 1.005). The odds ratio of 1.005 indicates that every dollar increase in a farmer's odds of being profitable by 0.5%. This study highlights the economic justification for investing in effective organic pest management, as it can increase productivity and reduce agricultural damage. This research is consistent with previous studies on the integrated application of biological pesticides (Hoesain et al., 2021) and sustainable agricultural practices (Wiranti, Suamba, & Djelantik, 2022).

However, these findings remain controversial in the relevant literature. Other studies have indicated that the higher costs and complex certification processes associated with organic pesticides may negatively impact profitability (Anand & Rai, 2024). Furthermore, there are concerns about potentially inferior efficiency compared to synthetic chemicals, which could lead to reduced yields and ultimately economic losses (Ichdayati, 2022; Irawan & Nuzuliyah, 2022).

The research findings indicated that training, off-farm income, farm size, and pest control expenses were significantly associated with profitability. Nonetheless, various factors, such as age, education, farming experience, seed

expenses, fertilizers, and labor, were determined to have no statistically significant correlation with profitability. The rationale may be interpreted. The research revealed no correlation among the demographic factors of age, education, and experience, indicating that organic rice farming in Sakon Nakhon province is more reliant on farmers' skills than on their general characteristics. The input costs seed, fertilizer, and labor exhibited no significant correlation, potentially attributable to the characteristics of the local organic rice production system. The majority of farmers used seeds from the previous season and locally sourced organic fertilizers, resulting in negligible cost variation within the sample. No substantial correlation existed between labor costs and other variables. This indicates that labor patterns, whether familial or outsourced, are consistent among farmers.

5. CONCLUSIONS

5.1. Main Findings

This study aims to examine the financial feasibility and profitability determinants of organic rice production in Sakon Nakhon Province, Thailand, using cost-benefit analysis and a binary logistic regression model. The results indicate that organic rice production in the area is economically feasible, generating a positive net return.

In terms of factors influencing profitability, empirical evidence indicates that training, off-farm income, farm size, and expenditure on organic pest control are significant predictors associated with a higher probability of achieving profitability. In particular, the model shows that participation in specialized training and the use of larger farming areas are associated with greater financial success. This can be explained by increased technical knowledge and the benefits of economies of scale. Furthermore, off-farm income sectors and expenditure on organic pest control are positively correlated with farms' ability to maintain profitability.

However, demographic variables that contradicted the hypothesis, such as age and education, were found to be statistically significant predictors of profit in this study. Therefore, the success of organic rice production depends more on operational management efficiency and access to production resources than on the demographic characteristics of individual farmers.

5.2. Policy Implications

This research presents several practical insights for the government sector, agricultural extension agencies, and non-governmental organizations focused on supporting organic rice production in Thailand. The study found that production costs are high, particularly labor costs, which account for 36% of total costs. However, a net profit margin of 37.39% reflects that the premium received by farmers effectively offsets these increased costs, resulting in satisfactory profitability. This finding is highly significant, as it provides a strong economic justification for promoting organic rice production, demonstrating that financial returns can compensate for operational and input constraints.

Among the factors influencing the profitability of organic rice production, farmer training was found to be the most significant variable. Policymakers should promote equitable access to training programs, especially for specific farmer groups, including women (56.33%), with an average age of 53.96 years, and mostly with only primary or secondary education. All training and support programs should be designed to match the capabilities of the target group, taking into account their educational and practical limitations. Furthermore, empirical studies show that commercial-scale organic rice production generates significantly higher profits. Therefore, public policy should focus on promoting the cooperative model of organic rice production. Policymakers should support access to low-interest financing for land ownership and encourage the establishment of farmer organizations that can share resources, alleviate fixed costs, and strengthen their collective bargaining power in the market.

This study underscores the positive impact of using organic pesticides, reflecting the benefits farmers receive from high-quality inputs. Government agencies should take measures to ensure that high-quality, certified organic pesticides and biofertilizers are readily available and affordable for farmers. Furthermore, policies should promote training in Integrated Pest Management (IPM), which emphasizes effective solutions that are both economically viable and environmentally sustainable, rather than relying solely on production factors.

5.3. Limitations and Future Research Avenues

This study provides valuable insights; however, its limitations open opportunities for future research. Firstly, the scope of the study is limited to Thailand only. The results are therefore contextually specific and may have limitations in their application to other countries. Future research should conduct comparative studies across different geographical contexts and socio-economic conditions to verify and expand the findings. Secondly, cross-sectional study designs are limited in their ability to collect data at a single point in time, leading to the identification of associations rather than clear causal relationships.

For example, the benefits of training may emerge over time, which data collected at a single point cannot fully capture. Longitudinal studies, following a sample group of farmers over several years, can provide a more comprehensive understanding of the dynamics affecting profitability over time. Finally, the model's pseudo R^2 of 0.255 indicates that a significant proportion of the variance in profits remains unexplained by the study's variables. Future studies should include other variables that may influence profitability. For example, soil quality, market access, social capital and networks, specific farm management techniques, and farmers' risk attitudes should be considered to develop a more comprehensive profitability model.

Funding: This research is supported by Sakon Nakhon Rajabhat University, Thailand (Grant number: 67A155000018).
Institutional Review Board Statement: This study was approved by the Institutional Review Board of the Sakon Nakhon Rajabhat University, Thailand, under protocol number [IRB No. HE 66-123], dated [February 5, 2024]. Informed verbal consent was obtained from all participants, and all data were anonymized to protect participant confidentiality.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Disclosure of AI Use: The authors used Gemini to edit and improve sentences, making them clearer and enhancing readability in the introduction and literature review sections, and Grammarly for grammar checking. All results were thoroughly reviewed and verified by the author.

REFERENCES

Agresti, A. (2013). *Categorical data analysis* (3rd ed.). Hoboken, New Jersey: John Wiley & Sons.
Alsiken-Nanglegan, M. J. (2023). Impact assessment of the organic agriculture production training program in Northern Philippines. *Plant Science Today*, *10*(3), 409-416. https://doi.org/10.14719/pst.2409
Amani, F. M., Dharmawan, B., & Satriani, R. (2024). Farmers' motivation for organic rice farming (case study in Dawuhan, Kalisube, and Watuagung Villages, Banyumas Regency). *Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis*, *10*(2), 1673-1684. https://doi.org/10.25157/ma.v10i2.13402
Anand, U., & Rai, N. R. (2024). Pesticide reduction through organic farming for promoting public health management and food security. *South Eastern European Journal of Public Health*, *23*(2), 246-250. https://doi.org/10.70135/seejph.vi.783
Baird, I. G. (2024). Going organic: Challenges for government-supported organic rice promotion and certification nationalism in Thailand. *World Development*, *173*, 106421. https://doi.org/10.1016/j.worlddev.2023.106421
Bank of Thailand. (2024). *Daily Foreign exchange rates*. Thailand: Bank of Thailand.
Crowder, D. W., & Reganold, J. P. (2015). Financial competitiveness of organic agriculture on a global scale. *Proceedings of the National Academy of Sciences of the United States of America*, *112*(24), 7611-7616. https://doi.org/10.1073/pnas.1423674112
Dang, T. H. (2022). Comparing the financial efficiency of traditional versus organic rice farming in Tieu Can District, Tra Vinh Province, Vietnam. *Tra Vinh University Journal of Science*, *11*(47), 1-10.
Drall, A., & Mandal, S. K. (2024). Non-farm income and environmental efficiency of the farmers: Evidence from India. *Heliyon*, *10*(10), e30804. https://doi.org/10.1016/j.heliyon.2024.e30804
Eyhorn, F., Van den Berg, M., Decock, C., Maat, H., & Srivastava, A. (2018). Does organic farming provide a viable alternative for smallholder rice farmers in India? *Sustainability*, *10*(12), 4424. https://doi.org/10.3390/su10124424
Gao, P., Wang, H., Sun, G., Xu, Q., Dou, Z., Dong, E., … Dai, Q. (2023). Integrated emergy and economic evaluation of the dominant organic rice production systems in Jiangsu province, China. *Frontiers in Plant Science*, *14*, 1107880. https://doi.org/10.3389/fpls.2023.1107880
Handayani, S. (2022). Optimization of organic rice production using linear programming analysis in Lampung Province. *Asia Pacific Journal of Management and Education*, *5*(3), 37-47. https://doi.org/10.32535/apjme.v5i3.1643
Hérique, O., & Faysse, N. (2021). A large-scale public programme to promote organic rice farming in Thailand: Building solid foundations to enable farmers to engage? *Organic Agriculture*, *11*(1), 27-40. https://doi.org/10.1007/s13165-020-00320-4
Hidayat, N. K., Firdaus, M., & Novianti, T. (2024a). Capacity development of closed-loop food (Rice) farmers in East Nusa Tenggara. *Agrokreatif Jurnal Ilmiah Pengabdian Kepada Masyarakat*, *10*(2), 250-258. https://doi.org/10.29244/agrokreatif.10.2.250-258
Hidayat, Y., Purwakusuma, W., & Nadalia, D. (2024b). Socialization of upland organic rice cultivation in Tasikmalaya Regency. *Agrokreatif: Jurnal Ilmiah Pengabdian kepada Masyarakat*, *10*(1), 51-58.
Hoang, H. G. (2021). Determinants of adoption of organic rice production: A case of smallholder farmers in Hai Lang district of Vietnam. *International Journal of Social Economics*, *48*(10), 1463-1475. https://doi.org/10.1108/IJSE-03-2021-0147
Hoesain, M., Prastowo, S., Suharto, S., Pradana, A. P., Asyiah, I. N., Alfarizy, F. K., & Adiwena, M. (2021). Combination of plant growth-promoting bacteria and botanical pesticide increases organic red rice yield and reduces the Leptocorisa acuta population. *Biodiversitas Journal of Biological Diversity*, *22*(4), 1686-1694. https://doi.org/10.13057/biodiv/d220411
Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression* (3rd ed.). Hoboken, New Jersey: John Wiley & Sons.
Ichdayati, L. I. (2022). The role of biopesticide in increasing rice farmer's profit. *Archives of Business Research*, *10*(9), 43-52. https://doi.org/10.14738/abr.109.13038
Irawan, D., & Nuzuliyah, L. (2022). Comparison of rice farming analysis using vegetable pesticides and synthetic pesticides in the IPDMIP program (case study of farmers in Sentebang Village, Jawai District, Sambas Regency). *Partner*, *27*(1), 1813-1827.
Kijima, Y., Ito, Y., & Otsuka, K. (2012). Assessing the impact of training on lowland rice productivity in an African setting: Evidence from Uganda. *World Development*, *40*(8), 1610-1618. https://doi.org/10.1016/j.worlddev.2012.04.008
Laksono, B. J., Armando, R., Dewi, R., & Uliya. (2023). Analysis income business farmers paddy ricefield organic in Pasar Terusan Village Muara Bulian District Regency Batang Hari Jambi Province. *Internasional Journal of Integrative Sciences*, *2*(10), 1537-1556.
Mankiw, N. G. (2022). *Principles of economics* (9th ed.). Boston: Cengage Learning.
Mehmood, Y., Anjum, B., & Sabir, M. (2011). Benefit cost ratio analysis of organic and inorganic rice crop production; Evidence from District Sheikhupura in Punjab, Pakistan. *Pakistan Journal of Science*, *63*(3), 174-177.

Mendoza, T. C. (2004). Evaluating the benefits of organic farming in rice agroecosystems in the Philippines. *Journal of Sustainable Agriculture*, *24*(2), 93-115. https://doi.org/10.1300/J064v24n02_09

Mukhlis, M., Wisra, R. F., Hendriani, R., & Sari, N. (2023). Analysis of factors affecting organic rice income in Harau district. *AGRIBIOS*, *21*(2), 183-190. https://doi.org/10.36841/agribios.v21i2.3680

Nakano, Y., Tanaka, Y., & Otsuka, K. (2018). Impact of training on the intensification of rice farming: Evidence from rainfed areas in Tanzania. *Agricultural Economics*, *49*(2), 193-202. https://doi.org/10.1111/agec.12408

Namdev, G. P., Shrivastav, A., & Awasthi, P. K. (2013). Economic viability of organic paddy production in central India. *Agricultural Science Digest – A Research Journal*, *33*(4), 241-246. https://doi.org/10.5958/j.0976-0547.33.4.018

Norfahmi, F., Kusnadi, N., Nurmalina, R., & Winandi, R. (2017). Analysis of the outpouring of household labor in rice farming and its impact on family income. *Informatika Pertanian*, *26*(1), 13-22.

Padel, S., & Lampkin, N. H. (2007). The development of governmental support for organic farming in Europe. In W. Lockeretz (Ed.), Organic farming: An international history. In (pp. 93–122). Wallingford, England: CAB International.

Phranakhone, P., & Nanseki, T. (2015). Study on profitability and factors influencing participation in organic farmer association: A case study of Sangthong District, Vientiane Capital, Laos. *Journal of the Faculty of Agriculture, Kyushu University*, *60*(1), 259-264.

Puspitaningtyas, Z., Toha, A., & Prakoso, A. (2018). Understanding the concept of profit as an economic information instrument: Disclosure of semantic meanings. *Accounting and Financial Control*, *2*(1), 27-36. https://doi.org/10.21511/afc.02(1).2018.03

Quion, K. L., & Ratilla, B. C. (2024). Comparative analysis of lowland rice (Oryza sativa L. var. PSB Rc18) performance across different farming systems. *Eurasian Journal of Soil Science*, *13*(4), 338-347. https://doi.org/10.18393/ejss.1522102

Reganold, J. P., & Wachter, J. M. (2016). Organic agriculture in the twenty-first century. *Nature Plants*, *2*(2), 15221. https://doi.org/10.1038/nplants.2015.221

Rozaki, Z., Hadi, S. S. A., Rahmawati, N., Triyono, T., Ardila, R. A., Pamungkas, H. W., & Fathurrohman, Y. E. (2025). The feasibility insights of organic rice farming from Central Java and Yogyakarta, Indonesia. *Asian Journal of Agriculture*, *9*(1), 122-130.

Sakon Nakhon Provincial Statistical Office. (2024). *Farmer groups certified as organic rice production areas.* Retrieved from https://sakonnakhon.gdcatalog.go.th/dataset/skn_rrc_002

Sapkota, B. K., Subedi, A. P., Tripathi, K. M., & Dhakal, S. C. (2021). Economics of organic vs inorganic rice production: A case of Chitwan district of Nepal. *Journal of Nepal Agricultural Research Council*, *7*, 109-121. https://doi.org/10.3126/jnarc.v7i1.36933

Savitri, S., Setyaningrum, W. F., Parhusip, D., Girsang, S. S., Dani, F. Z. D. P., Dermoredjo, S. K., . . . Brauw, A. D. (2024). Impact of certified rice seed on farmers' income in Simalungun District, North Sumatra. *BIO Web of Conferences*, *119*, 02003. https://doi.org/10.1051/bioconf/202411902003

Setiono, P., Sidhi, E. Y., Pamujiati, A. D., & Arissaryadin, A. (2024). Constraints of rice farmers in implementing organic rice systems (case study: Damarwulan Village, Kepung District, Kediri Regency). *Jurnal Ilmiah Pertanian Nasional*, *4*(1), 44-51. https://doi.org/10.30737/jintan.v4i1.5323

Seufert, V., Ramankutty, N., & Foley, J. A. (2012). Comparing the yields of organic and conventional agriculture. *Nature*, *485*(7397), 229-232. https://doi.org/10.1038/nature11069

Suryani, O., & Riga, R. (2022). A training in preparation of organic fertilizer from wasted rice straw in rice valtivation Area-Nagari Dilam, Bukit Sundi District, Solok Regency. *Pelita Eksakta*, *5*(2), 87-91. https://doi.org/10.24036/pelitaeksakta/vol5-iss2/182

Susilowati, S. H., Swastika, D. K. S., Sudaryanto, T., Hasibuan, A. M., Agustian, A., Tarigan, H., . . . Permana, D. (2024). Financial feasibility of developing early-stage organic rice farming: A case study in Tasikmalaya of Indonesia. *BIO Web of Conferences*, *119*, 04005. https://doi.org/10.1051/bioconf/202411904005

Suswadi, S. (2018). Analysis of break even point (BEP), efficiency level and organic rice farms characteristic in Boyolali. *Jurnal Ilmiah Agrineca*, *18*(2), 43-58.

Suswadi, S., & Kartikasari, R. D. (2021). Farmers characteristics and efficiency levels of organic rice businesses. *E3S Web of Conferences*, *316*, 01002. https://doi.org/10.1051/e3sconf/202131601002

Suwanmaneepong, S., Kerdsriserm, C., Lepcha, N., Cavite, H. J., & Llones, C. A. (2020). Cost and return analysis of organic and conventional rice production in Chachoengsao Province, Thailand. *Organic Agriculture*, *10*(3), 369-378. https://doi.org/10.1007/s13165-020-00280-9

Takahashi, K., & Otsuka, K. (2009). The increasing importance of nonfarm income and the changing use of labor and capital in rice farming: The case of Central Luzon, 1979–2003. *Agricultural Economics*, *40*(2), 231-242. https://doi.org/10.1111/j.1574-0862.2009.00372.x

Thapa, G. B., & Rattanasuteerakul, K. (2011). Adoption and extent of organic vegetable farming in Mahasarakham province, Thailand. *Applied Geography*, *31*(1), 201-209. https://doi.org/10.1016/j.apgeog.2010.04.004

The German Thai Link. (2006). *Sakon Nakhon.* Retrieved from http://german-thai-link.de/Top/UK/Frameset.htm?/Details%20TH/UK/Provinces/North%20East/Sakon%20Nakhon.htm

Triyono, Azzahra, N. A., & Kamarudin, M. F. (2025). Factor affecting of food security in organic rice farming households: A finding in Sleman Yogyakarta, Indonesia. *Asian Journal of Dairy and Food Research*, *44*(1), 100-108. https://doi.org/10.18805/ajdfr.DRF-373

Tuan, C. M., & Lee, S. H. (2021). Factors affecting organic fertilizer adoption in rice production in Vietnam. *Journal of the Korean Society of International Agriculture*, *33*(2), 130-138. https://doi.org/10.12719/KSIA.2021.33.2.130

Uchelue, C. S., Isibor, C. A., Nkamigbo, D. C., & Okonkwo-Emegha, K. (2023). Socioeconomic determinants of off-farm income generating activities among smallholder rice farmers in Anambra State. *International Journal of Research and Review*, *10*(10), 222–229. https://doi.org/10.52403/ijrr.20231029

Wanichbancha, K. (2007). *Statistics for research* (3rd ed.). Bangkok: Chulalongkorn University Book Center.

Willer, H., & Lernoud, J. (2019). *The world of organic agriculture: Statistics and emerging trends 2019.* Frick, Switzerland & Bonn, Germany: Research Institute of Organic Agriculture (FiBL) & IFOAM – Organics International.

Willer, H., Schlatter, B., Trávníček, J., Kemper, L., & Lernoud, J. (2020). *The world of organic agriculture: Statistics and emerging trends 2020.* Frick, Switzerland & Bonn, Germany: Research Institute of Organic Agriculture (FiBL) & IFOAM – Organics International.

Winahyu, N., Atika, K. N., & Maharani, N. (2024). Analysis of allocative efficiency and factors affecting the production of inorganic and semi-organic rice farming. *Journal of Rural and Urban Community Studies*, *2*(2), 63-73. https://doi.org/10.36728/jrucs.v2i2.4012

Wiranti, N. P. S., Suamba, I. K., & Djelantik, A. A. A. W. S. (2022). Comparison of production and profits of organic and inorganic rice farmers. *Journal of Agribusiness and Agritourism*, *11*(1), 383–392.

Yamane, T. (1973). *Statistics. An introductory analysis* (3rd ed.). New York: Harper & Row.