International Journal of Sustainable Agricultural Research
2024 Vol. 11, No. 4, pp. 125-137
ISSN(e): 2312-6477
ISSN(p): 2313-0393
DOI: 10.18488/ijsar.v11i4.4007

Factors affecting rice domestic production output in Preah Vihear province, Cambodia: A study using OLS regression model

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Article History
Received: 6 September 2024
Revised: 7 November 2024
Accepted: 12 November 2024
Published: 19 December 2024

Keywords
Cambodia
OLS regression
Preah Vihear
Rice domestic production
Rice production costs
Rice production function
Rice production output
Stepwise model.

ABSTRACT

This study explores the attitudes of domestic farmers toward rice production practices and identifies factors affecting rice yields in Preah Vihear Province. Cambodia's economy is heavily reliant on rice cultivation. Rice is a staple food and a major export, significantly contributing to the nation's food security. However, rice production in the entire country faces challenges such as limited irrigation, small farm sizes, and geographical constraints. Preah Vihear province, a remote, mountainous area in northern Cambodia bordering Thailand and Laos, is a key rice-producing region characterized by hilly terrain and small-scale farming. Known for its stunning natural beauty and the famous Preah Vihear Temple, a UNESCO World Heritage site, the province offers unique opportunities for farmers to increase their income and gain access to international markets through distinctive and renowned rice seeds. To better understand factors affecting rice domestic production in Preah Vihear, a primary statistical ordinary least squares (OLS) model will be applied to analyze rice output and related variables. The findings of this study are instrumental in developing targeted strategies that aim to enhance rice yields and improve the livelihoods of rural farmers. By identifying key controllable factors, farmers can make informed decisions to increase their profits, ensure sustainable rice production, and contribute to the overall economic growth of farming communities.

Contribution/Originality: This research contributes to the existing literature by providing empirical data on factors affecting rice production in Preah Vihear, Cambodia. Using OLS regression, the study offers insights for policymakers, farmers, and market intermediaries to enhance rice production and improve livelihoods.

1. INTRODUCTION

Cambodia's economy is heavily reliant on agriculture, with approximately 80% of the population residing in rural areas and primarily engaged in subsistence farming (MAFF, 2015; Siek, Xu, Wyu, & Ahmed, 2017). According to the (ADB, 2024) the agricultural sector experienced an estimated growth of 2.3% in 2023. The increasing demand for Cambodian agricultural products, both domestically and internationally, fuels this growth. Key exports, such as cassava, milled rice, cashew nuts, and rubber, have seen significant growth (B2B Cambodia, 2024; ITA, 2024; Sevea, 2022). Recent trade agreements with China, South Korea, and the United Arab Emirates, as well as Cambodia's participation in the Regional Comprehensive Economic Partnership, have further supported the positive trajectory of

the agriculture sector. Future forecasts anticipate this sector to grow at a rate of 2.5% and 2.7% in 2024 and 2025 (ADB, 2024). Conversely, the economic recovery is anticipated to be slow due to factors such as a decrease in real estate investment. Although the agricultural sector is progressing positively, it faces difficulties that necessitate ongoing attention and strategic planning to guarantee continuous growth and development (Ly et al., 2024).

Rice production, which constitutes about 80% of cultivated land, is the country's most significant agricultural export. As a staple food providing 60–70% of the necessary calories, rice is a cornerstone of Cambodian diets. Annual rice yields directly impact food security, GDP, and rural employment. Maintaining competitive prices for both domestic consumers and export markets is crucial. On the other hand, insufficient supply, high prices, inflation, and political instability can negatively affect these factors. Therefore, rice continues to be a strategic component in driving income growth, reducing poverty, and ensuring food security at both household and national levels (MAFF, 2015; MOWRAM, 2023). Similarly, rice holds a central position in Cambodia's agriculture and economy, serving as a staple food for its population and a valuable commodity for export. Rice exports from Cambodia have increased significantly, reaching 635,000 tons in 2017 from 105,259 tons in 2010. However, exports fell slightly to 626,255 tons in 2018 (ADB, 2021). The remarkable growth of Cambodia's rice export industry is primarily driven by the production of aromatic, long-grain white rice and long-grain steamed rice, which are exported to 61 countries (Hin, 2024). Although the industry is hampered by a shortage of high-quality rice seeds, which only accounted for 20% of annual demand in 2019, the lack of a comprehensive seed policy has hindered the establishment of quality standards and a reliable supply of improved rice varieties. Many countries, including Cambodia, share this common challenge in agriculture (Sarkar et al., 2024). Plus, many Cambodian farmers use traditional methods to grow rice and sell their crops right away, which means they frequently fail to get the best prices. While using machines to farm rice could help farmers work faster and earn more money, issues remain with the rice market and the quality of inputs such as pesticides and fertilizers. Despite the crucial role of rice in Cambodia's economy, resolving these issues is crucial to enable farmers to optimize their yield and sustain the country's economic growth (Cramb, Sareth, & Vuthy, 2020; GVI, 2020).

The geography of Cambodia significantly influences its agricultural sector. The country's landscape is a mix of vast flatlands and major rivers, particularly the Tonle Sap Lake and the Mekong River, which are essential for rice farming and other crop cultivation (MFA, 2018). The fertile central plains, enriched by these waterways, are the heart of Cambodian agriculture. While the hilly regions in the country's uplands also support farming, the southern coastal area remains largely underdeveloped for agriculture. Cambodia's economy heavily relies on agriculture, which is shaped by the unique interaction between its land and water resources (Overton & Chandler, 2024). While rice cultivation in Cambodia is heavily reliant on water, effective water management remains crucial for boosting rice yields. To achieve multiple harvests per year, irrigation is indispensable. Data from 2010 highlights the stark difference in rice production between the dry and rainy seasons, with significantly higher yields in the dry season due to better water availability (CIR, 2010; Cramb et al., 2020; RGC, 2010). Cambodia's rice output lags behind its Southeast Asian neighbors primarily because of insufficient irrigation infrastructure. Between 1993 and 2004, Cambodia's average rice yield was notably lower than Vietnam's Mekong Delta. As of the early 2000s, only a small percentage of rice fields had irrigation for dry season cultivation, a situation that persisted into the 2010s, with just 20% of the total rice-growing area suitable for dry season farming with irrigation (Filloux, 2020).

Preah Vihear province is a remote, mountainous region in northern Cambodia, bordering Thailand and Laos. Renowned for its breathtaking natural beauty, including the Dangrek Mountains, the province is home to the iconic Preah Vihear Temple, a UNESCO World Heritage site perched dramatically on a cliff edge (TAA, 2024). Additionally, the Temple of Preah Vihear is a magnificent Khmer temple with a series of interconnected sanctuaries arranged along a long axis. It is renowned for its distinctive architectural style, intricate decorations, and breathtaking natural setting (UNESCO, 2020). While still relatively untouched by development, visitors can experience authentic Cambodian rural life and explore stunning landscapes. Besides, Preah Vihear province is a key rice-producing area in northern Cambodia. Like many agricultural regions, it faces various challenges, but it also

offers substantial potential for growth and development. To address these challenges and tap into new opportunities, over 4,300 small-scale rice farmers, including 3,000 women, have joined forces to form a network of 25 cooperatives. This united group has created a distinct brand for their rice, aiming to increase their income and expand their market reach beyond Cambodia (WIPO, 2022). Preah Vihear province is a hilly and plateau-like area with a substantial amount of farmland, covering nearly 29,200 hectares. The average farm in the region is relatively small, about 2.7 hectares, with most farms falling into the medium-sized category, ranging from 1 to 4 hectares. Agriculture is the backbone of the province's economy, contributing to 85% of its overall economic activity. Rice, cassava, soybeans, cashews, and various vegetables are the primary crops cultivated in the region. Rice and cassava are particularly significant, with large, cultivated areas and substantial production volumes. Despite the province's agricultural productivity, a notable portion of the population lives in poverty, with a rate of 19.4% (Sevea, 2022). Figures 1 and 2 display a close-up view of a rice crop in its flowering stage and the four distinct rice seed samples in Preah Vihear province. All four types appear to be long-grain rice with a light brown color. Khmer farmers identify the rice grains as Kaun Khmum Rice, Neang Om Rice, Kratié Rice, and Rumduol Rice (Lun, 2013).

Figure 1. Rice crop in flowering stage.

Figure 2. Four distinct rice seed samples.

Geographical, infrastructural, and socioeconomic factors significantly influence rice production in Preah Vihear province. The province's hilly terrain and limited irrigation infrastructure pose challenges for optimal rice cultivation, particularly during the dry season. Small farm sizes and a reliance on subsistence farming further hinder productivity. While cooperatives have emerged as a promising avenue for improving farmers' livelihoods, addressing the root causes of low yields remains crucial. To gain a deeper understanding of the factors influencing rice production in Preah Vihear Province, an ordinary least squares (OLS) regression model can be employed to examine rice output and key determinants of production. The findings will provide valuable insights for farmers, policymakers, and agricultural stakeholders in developing targeted interventions to enhance rice production and livelihoods in the region.

2. MATERIALS AND METHODS

2.1. Descriptive Statistics

Based on the percentage analysis of the attitudes of domestic rice farmers toward rice production (Table 1), the data provides a comprehensive overview of farmers' satisfaction with various rice production practices. Notably, farmers expressed the lowest satisfaction with harvesting activities, with 45% dissatisfied at level 2. At level 4, 24% of farmers reported positive sentiment, marking the fourth highest level of satisfaction. Land preparation through plowing found the highest satisfaction level at 5 (25%), while the lowest satisfaction was at level 3 (25%). Neutral satisfaction was at level 4 (49%). Regarding fertilizer use, the highest satisfaction was at level 5 (5%), followed by level 2 (1%), with the lowest satisfaction at level 2 (8%). Satisfaction with herbicide use was lowest at level 1 (14%) and level 2 (39%). Similarly, neutral satisfaction was at level 4 (39%). In the context of rice seed quality, the highest

satisfaction reached its highest level at level 3 (43%), whereas the lowest was at level 2 (24%). Level 4 also showed high satisfaction (33%).

Table 1. The attitudes of domestic rice farmers towards rice production.

Variable	Definition	%					Mean	SD
		1	2	3	4	5		
F_RiceHarve	Satisfaction with the harvest	0	45	31	24	0	2.8	0.81
F_LandPrepa	Satisfaction with land prep. (Plowing)	0	0	25	49	25	4.0	0.72
F_Fertilize	Satisfaction with fertilizer use	0	8	61	29	2	3.3	0.63
F_weedicide	Satisfaction with herbicide use	14	39	39	8	0	2.4	0.83
F_riceSeed	Satisfaction with rice seed quality	0	24	43	33	0	3.1	0.76
ri_havest	Rice yield (Ton/Ha)	-					1.75	0.72
land_total	Total land area (Ha)	-					2.86	1.67

Note: 1 = Very dissatisfied; 2 = Dissatisfied; 3 = Neutral; 4 = Satisfied; 5 = Very satisfied.

Table 2 lists the following descriptive data on the value of input variables and the total output of the rice production. This table enhanced readers' understanding of the data presented in the previous tables by providing detailed information on potential variables, cost values in riels and dollars, groups, number of observations, and standard deviation. Different expenditure threshold in farming categorize the costs of rice production and various components involved in the right process. The input components included the cost of herbicides (*cost_weedicides*) at 140,000 riels (approx. $35), land preparation costs (*other_serv*) at 1,213,000 riels (approx. $303), transportation costs (*tranCost*) at 43,000 riels (approx. $11), labor costs for rice harvesting (labor) at 139,000 riels (approx. $35), and rice prices (*ri_priceTon*) at 1,172,000 riels (approx. $293). In addition, the total cost of rice harvested (*ri_harTotcos*), stood out as having had the highest cost of 5,149,000 riels (approx. $1,287). Also, 417,000 riels (approx. $104) were attributed to rice yield for food (*ri_foodcos*), and 669,000 riels (approx. $167) to rice yield for sale (*ri_salcos*).

Table 2. The value of input variables and total rice production output.

Variable	Definition	Obs.	Value		Group	Obs.	Total output of rice production		SD
			*1000 Riels	Dollars			*1000 Riels	Dollars	*1000 Riels
Cost_Weedicides	The cost of herbicides	51	140	35	> 140	25	939	235	427.0
					≤ 140	26	1229	307	663.3
Other_Serv	Land preparation costs	51	1213	303	>1213	25	967	242	470.2
					≤ 1213	26	1201	300	646.1
Trancost	Transportation costs	51	43	11	>43	9	946	236	350.3
					≤ 43	42	1117	279	609.7
Labor	Labor cost for rice harvesting	51	139	35	>139	20	1087	272	632.3
					≤ 139	31	1086	272	543.0
ri_priceTon	Rice price (Riel per ton)	51	1172	293	>1172	30	1081	270	548.6
					≤ 1172	21	1095	274	620.9
ri_harTotcos	The total cost of rice harvested	51	5149	1287	>5149	22	1228	307	542.4
					≤ 5149	29	979	245	582.2
ri_foodcos	The cost of rice yield for food	51	417	104	>417	22	1410	352	602.5
					≤ 417	29	842	210	413.1
ri_salcos	The cost of rice yield for sale	51	669	167	>669	21	1608	402	489.4
					≤ 669	30	722	181	260.4

Note: The riel is the currency of Cambodia; * indicate that the Riel values are multiplied by 1000.

2.2. Data Collection and Study Area

Data methods used for this paper were collected based on quantitative methods. Structured questionnaires were administered to approximately 51 households in five villages (Table 3) of Preah Vihear province, Cambodia. A purposive sampling technique was employed to select only rice farmers for the survey. Data were gathered to describe the costs of production, farmers' satisfaction with cultivating rice, and the collection process began with:

Direct observation was initially used to gain a comprehensive understanding of the target area's overall conditions and population demographics. This tool determined the agricultural processes and farming systems of the specific ecological area based on living conditions and modern rice cultivation practices. Additionally, it estimated how one village's cultivating circumstances differed from another's.

Table 3. Sampling size in the target study of Preah Vihear province.

Province	District	Commune	Village	Purposive sample with rice domestic households in non-random sampling selection		
				H.H population	H.H sample	% sample
Preah Vihear	Rovieng	Reaksa	Doun Ma	270	20	39
			Samraong	39	7	14
			Rumdaoh	54	12	24
			Preal	119	6	12
			Sanlung Chey	67	6	12
01 province	01 district	01 commune	05 villages	549	51	100

Key informant interviews were carried out with the chief of district, commune, and village, as well as other local authorities, to obtain general details regarding consumable equipment, the total amount of land used for cultivating rice, and interactions with middlemen claiming information on price and market demand.

Survey-structured questionnaires were used to conduct face-to-face interviews with farmers who cultivate rice. These interviews covered various aspects of labor and land preparation, including rice harvest, plowing, fertilizer use, herbicide use, rice seed quality, rice yield, herbicide cost, land preparation costs, transportation costs, labor cost for rice harvesting, rice price (Riel per ton), percentage of rice yield for sale and for food, and the total cost of rice harvested. Based on the analysis an additional study was conducted to examine the statistical significance of each variable and their impact on the output of rice production. This study employed ordinary least squares (OLS) regression as the primary analytical tool to investigate the relationships between various factors and rice production in Preah Vihear province. Stepwise regression was used as a secondary model to identify the most significant predictors. By analyzing these relationships, the researchers aimed to gain insights into the current state and future trends of rice cultivation in the region, contributing to the understanding of sustainable agricultural practices.

2.3. Data Analysis Technique

STATA software was used to conduct the statistical analysis for this study. Zhining (2010) employed ordinary least squares (OLS) and stepwise regression models to analyze the data. OLS was used to estimate the relationship between rice production output and identify the most significant variables. Stepwise regression, a variable selection method, was used to identify the most significant predictors of rice yield from a wider range of potential factors, enhancing model efficiency and interpretability (Hutcheson, 2011; Siek et al., 2024; Stock, James, & Mark, 2015).

Microsoft Excel was initially used to code and group variables from the collected data. Following that, STATA was used for data cleansing, regression analysis, and further modeling. Within STATA, multiple regression models were employed to estimate rice production output (Output_{total})considering a set of cost variables representing outputs of rice production. These variables included the cost of herbicides, land preparation costs, transportation

costs, labor costs for rice harvesting, rice price (riel per ton), the total cost of rice harvested, the cost of rice yield for food, and the cost of rice yield for sale.

2.4. Model Description

This equation represents the rice production function with total output as the dependent variable. The following tables and constructed models visually present the econometric results (Wooldridge, 2009).

$$Output_{total} = \beta_0 + \beta_1 f1\_riceharvest + \beta_2 f1\_landprepar + \beta_3 f1\_fertilizer + \beta_4 f1\_weedicides + \beta_5 f1\_riceseed + \beta_6 ri\_havest + \beta_7 land\_total + \varepsilon_i$$

Where: β_0 is the intercept.

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_6, \beta_7$, are the coefficients for each independent variable.

ε_i represents the error term.

f1_riceharvest	:	Satisfaction with the harvest.
f1_landprepar	:	Satisfaction with land prep. (Plowing).
f1_fertilizer	:	Satisfaction with fertilizer use.
f1_weedicides	:	Satisfaction with herbicide use.
f1_riceseed	:	Satisfaction with rice seed quality.
ri_havest	:	Rice yield (Ton/ha).
land_total	:	Total land area (ha).

This equation represents rice production costs with total output as the dependent variable. The following tables and constructed models visually present the econometric results.

$$\text{Output}_{total} = \beta_0 + \beta_1 lncost\_weedicides + \beta_2 lnother\_serv + \beta_3 lntranCost + \beta_4 lnlabor + \beta_5 lnri\_priceTon + \beta_6 lnri\_salcos + \beta_7 lnri\_foodcos + \beta_8 lnri\_harTotcos + \varepsilon_i$$

Where: β_0 is the intercept.

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_6, \beta_7, \beta_8$, are the coefficients for each independent variable.

ε_i represents the error term.

lncost_weedicides	:	The logarithm of the cost of herbicides.
lnother_serv	:	The logarithm of land preparation costs.
lntranCost	:	The logarithm of transportation costs.
lnlabor	:	The logarithm of labor cost for rice harvesting.
lnri_priceTon	:	The logarithm of rice price (Riel per ton).
lnri_salcos	:	The logarithm of percentage of rice yield for sale.
lnri_foodcos	:	The logarithm of percentage of rice yield for food.
lnri_harTotcos	:	The logarithm of the total cost of rice harvested.

3. RESULT AND DISCUSSION

The study employed both ordinary least squares (OLS) and stepwise regression analyses to assess the statistical significance of each variable and understand how various factors impact rice harvest outcomes. By transforming all numerical data into values, the study provided a comprehensive analysis of the factors influencing rice farmers' income.

Asterisks indicate the statistical significance of the coefficient values in Table 4. Among all variables, "*ri_harvest*," representing rice harvesting yields (ton/ha), indicates the highest significance level of 1% in both OLS and stepwise models. With the remarkable coefficient value of 201,285.9 (p-value < 0.01), this variable is a potential key factor influencing rice domestic production outcomes. In this scenario, certain issues such as pests, diseases, and droughts significantly affect rice harvesting yields, thereby reducing farmers' incomes. Farmers may eventually become indebted.

Moreover, farmers who suffer from low yields get depressed as they find it difficult to upgrade their farming practices and adapt to new issues like climate change. Alternatively, consistently high yields can foster long-term financial stability for farmers. This enables them to invest in better tools, technology, and farm improvements, leading to increased rice productivity in the future (Sary, Wen, Darith, & Chand, 2020).

The subsequent variables are considered significant, involving both the herbicides used for rice cultivation (*f1_weedicides*) and the rice harvest (*f1_riceharvest*). It also suggests evidence for a real effect at 5% and 10% significance levels. According to farmers in Preah Vihear province, the use of herbicides can boost rice production by eliminating competing weeds, but their costs, potential environmental damage, and human health risks require careful consideration as well.

However, the effect of herbicide use on income depends on a variety of factors, including the type of herbicide, its cost, the effectiveness of alternative control methods, and the specific conditions of the farm. Similarly, the amount of rice harvested has a substantial effect on farming households' financial condition. A productive harvest usually increases farmers' profits from the sale of extra produce, which encourages local businesses. However, a failed harvest can lead to severe financial difficulties for farmers and negatively impact the community as a whole. Also, the market price of rice has an enormous effect on the profits and standard of living of farmers (Sary, Phearin, Sereyvatha, Saren, & Kulyakwave, 2023).

Table 4. The regression results of the rice production function with total output.

Variable	OLS model			Stepwise model		
	Coefficient	T-statistic	P-value	Coefficient	T-statistic	P-value
f1_riceharvest	228765.7*	1.94	0.059	229262.1**	2.200	0.033
f1_landprepar	-127854.0	-0.99	0.328	-	-	-
f1_fertilizer	-143526.0	-0.72	0.478	-	-	-
f1_weedicides	-211560.7*	-2.02	0.049	-189716.8*	-1.840	0.072
f1_riceseed	201285.9	1.61	0.115	-	-	-
ri_harvest	654807.8***	8.44	0.000	633844.9***	8.660	0.000
land_total	10115.4	0.28	0.779	-	-	-
_cons	-37376.7	-0.13	0.894	-55996.7	-0.350	0.729
Prob > F	0.000			0.000		
R-squared	0.649			0.621		
Adj R-squared	0.591			0.596		
Root MSE	370000			360000		

Note: *10% Significance level; **5% Significance level; ***1% Significance level.

The results in Table 5 present the results of the same analysis applied to the regression of total rice output. Notably, the variables of the cost of herbicides (*lncost_weedicides*), percentage of rice yield for sale (*lnri_salcos*), and total cost of rice harvested (*lnri_harTotcos*) were found to be highly statistically significant at the 1% level in both OLS and stepwise models, similarly to the above Table 3. This highlights the substantial effect of these cost factors on rice production income.

Generally, the amount of rice produced per hectare of land is defined as the rice yield. Multiple kinds of factors, such as climate, pests, and diseases, may influence the yield of rice. Income from rice production could decrease with a reduction in rice yield. The price at which farmers receive compensation for producing rice is essentially the cost of grain. The supply and demand of rice, as well as its quality, are two key factors that might affect its price. The price of rice can rise, which will boost the income from rice cultivation (Chun, Amoranto, & Zafaralla, 2014; Herdt & Capule, 1983).

Land preparation costs (*lnother_serv*) and the percentage of rice yield for food *(lnri_foodcos*) were also found to be significant factors influencing rice production income, though their impact was smaller compared to the other variables mentioned previously.

Table 5. The regression results of rice production costs with total output.

Variable	OLS model			Stepwise model		
	Coefficient	T-statistic	P-value	Coefficient	T-statistic	P-value
lncost_weedicides	-0.493***	-10.640	0.000	-0.476***	-11.820	0.000
lnother_serv	0.035**	1.740	0.100	0.030*	1.630	0.119
lntranCost	0.007	0.660	0.519	-	-	-
lnlabor	-0.010	-0.900	0.381	-	-	-
lnri_priceTon	-0.089	-0.560	0.583	-	-	-
lnri_salcos	0.513***	84.830	0.000	0.514***	90.230	0.000
lnri_foodcos	0.029	1.260	0.223	0.032*	1.520	0.144
lnri_harTotcos	0.431***	14.970	0.000	0.424***	17.080	0.000
_cons	6.644	2.980	0.008	5.277	18.780	0.000
No.of obs.	26			26		
Prob > F	0.0000			0.0000		
R-squared	0.9988			0.9987		
Adj R-squared	0.9982			0.9984		
Root MSE	0.0272			0.0260		

Note: *10% Significance level; **5% Significance level; ***1% Significance level.

4. CONCLUSIONS AND RECOMMENDATIONS

This study uncovers the rice production in Preah Vihear Province, Cambodia, delves into the factors influencing rice output, and identifies key variables that significantly impact farmers' income. The research acknowledged the challenges faced by rice farmers in the region, including limited resources and infrastructure, and underscored the importance of cooperatives in fostering sustainable agricultural practices and improving economic outcomes. The study fundamentally employed ordinary least squares (OLS) regression analysis to examine the relationship between rice production and output as well as identify the most significant variables. Stepwise regression, a variable selection method, was used to identify the most significant predictors of rice yield from a wider range of potential factors, enhancing model efficiency and interpretability. The findings revealed that rice harvest yield was the most crucial factor affecting production, with higher yields leading to increased income. Herbicides could potentially enhance production; however, their negative impacts on the environment and human health need careful consideration. Additionally, the study highlighted a positive correlation between satisfaction with the harvest process and higher yields, emphasizing the importance of farmer morale in achieving successful outcomes. Based on the analysis, significant factors affecting rice production function with total output include rice harvesting yields, herbicides used for rice cultivation, and the rice harvest itself. Factors affecting rice production costs include the cost of herbicides, land preparation costs, the percentage of rice yield for sale and food, and the total cost of rice harvested. Overall, the study provided valuable insights for farmers in Preah Vihear Province, enabling them to develop strategies for enhancing rice production, improving incomes, and contributing to the region's economic growth. The following are some recommendations for farmers and policymakers to consider enhancing rice production in Preah Vihear province to mitigate the impact of significant factors affecting domestic rice production:

1) Proper soil preparation is crucial for cultivating healthy rice plants and maximizing yields. Techniques such as plowing and other methods can help create optimal growing conditions for rice crops.
2) To optimize profits, it's crucial to closely monitor fertilizer and herbicide expenses, ensuring they align with the yield of the rice crops. Investigating organic alternatives and more affordable options can help reduce expenses and environmental harm.
3) Invest in training and innovative education to stay updated on best practices through workshops and training programs that empower rice farmers to make informed decisions and adopt more efficient and sustainable methods.

4) Diversifying crop production can make farmers less vulnerable to market ups and downs and environmental problems that can affect rice crops.
5) Promoting organic methods and reducing the use of chemicals in farming practices can lead to sustainable agriculture.
6) By investing in research into local agricultural challenges, like making rice that resists pests and finding organic alternatives to herbicides, farmers can benefit from new and helpful ideas.
7) Improving infrastructure like roads and markets can help farmers get their crops to customers more efficiently, boosting their income and making the market less unpredictable.

ABBREVIATIONS:

Approx.: Approximately
GDP: Gross Domestic Product
H.H.: Household
Ha: Hectare
OLS: Ordinary Least Squares
Riels (KHR): The official currency of Cambodia
Root MSE: Root Mean Squared Error
STATA: Statistical software for data science
UNESCO: United Nations Educational, Scientific and Cultural Organization

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
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.

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