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# Agricultural Input Uses and Rice Productivity Assessment: A Case Study in Battambang and Svay Rieng Provinces, Cambodia

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**ABSTRACT**

**Purpose of the Study:** The study aims to 1) assess the use of farming inputs and rice productivity in Battambang and Svay Rieng provinces, Cambodia; 2) identify the factors influencing rice productivity; and 3) predict rice productivity based on farming inputs. It seeks to provide insights into optimizing rice production and improving farmers' livelihoods.

**Methodology:** A survey was conducted across 7 villages, 2 communes, and 2 districts in Battambang and Svay Rieng provinces, with 148 samples collected. Data were analyzed using quantitative and qualitative methods, including frequency analysis, descriptive statistics, cross-tabulation, chi-square tests, one-sample t-tests, and p-value probability.

**Main Findings:** The study revealed that the average number of family members involved in farming was 2 (70%), and land sizes ranged from 2-4 hectares (40%). DAP was the most commonly used chemical fertilizer (66%). Land size significantly affected rice productivity (93%), followed by seed quality (86% yield increase) and pesticide use (91% yield increase). Chemical fertilizers had a near-total impact on productivity. The study recommends reducing chemical fertilizers in favor of organic alternatives for safer and higher-quality rice production.

**Novelty/Originality of This Study:** This study provides a detailed analysis of farming inputs and their impact on rice productivity in Cambodia, emphasizing the role of land size, seed quality, and chemical inputs. It highlights the need for sustainable practices, such as organic fertilizers, and calls for stronger government and NGO support in agricultural policy and technical assistance. Future research could explore the impact of Good Agricultural Practices (GAP) on rice yield and quality.



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## 1. INTRODUCTION

Rice is a globally significant staple crop, central not only to diets but also to the socio-economic fabric of agrarian societies. In Cambodia, rice cultivation is the backbone of rural livelihoods, with over 70% of the population relying on agriculture as a primary source of income [1], [2]. Among Cambodian farmers, smallholders dominate the agricultural landscape, cultivating modest plots under rain-fed lowland ecosystems that account for nearly 90% of Southeast Asia's rice-growing area [3]. Despite Cambodia's natural endowments including fertile floodplains, monsoon rains, and major rivers like the Mekong and Tonle Sap its rice farmers face chronic vulnerabilities stemming from systemic socio-economic constraints.One of the most persistent challenges is the high dependency on agricultural inputs such as fertilizers, improved seeds, and pesticides. As noted by Sok [4], these inputs are often financially inaccessible to farmers due to limited access to formal credit and fluctuating input costs. Consequently, many smallholders either reduce input use, thereby compromising productivity, or rely on informal credit, leading to cycles of debt and economic fragility. These pressures are exacerbated by environmental shocks like floods and droughts, which disproportionately impact those without safety nets or diversified income sources [5].

From the perspective of agricultural sociology, farming is not merely a technical or economic activity but one deeply embedded within social systems, cultural norms, and institutional dynamics [6], [7]. In rural Cambodia, cultural values tied to land, tradition, and community decision-making often shape agricultural behavior as much as economic rationality. For instance, many farmers continue to follow ancestral practices in crop rotation, irrigation, and harvest timing, even when newer methods might offer higher yields [8], [9]. Moreover, social hierarchies and gender roles influence who has access to training, credit, and decision-making authority on farms, often marginalizing women and ethnic minorities in rural development strategies. Government policies have made some strides through the "Rectangular Strategy" and various rural development programs aimed at increasing productivity and export potential [10]. However, these top-down efforts frequently overlook the lived realities of smallholder farmers. Agricultural extension services remain underfunded, and outreach workers are few, limiting the dissemination of sustainable farming practices [11]. Furthermore, education and training remain key gaps in the system. As Sok & Kham [12] emphasize, the lack of access to modern agricultural knowledge in rural areas prevents farmers from adopting resource-efficient and climate-resilient practices [13], [14].

The contrast between Battambang and Svay Rieng provinces underscores these disparities. Battambang, located in the fertile northwest, has long been a rice production hub, benefiting from better soil quality and agricultural infrastructure [15], [16]. Svay Rieng, by contrast, suffers from nutrient-depleted soils and a reliance on chemical fertilizers that has led to declining productivity over time [17]. Yet in both regions, farmers are deeply reliant on external inputs, and yields remain inconsistent without adequate technical guidance and institutional support [18], [19].

Although numerous studies in Cambodia have investigated the link between input use and rice yield, they often treat farming as a technical issue and neglect the broader social and economic factors that shape input decisions [20], [21]. Most fail to explore how access to education, credit, and markets interacts with farmers' behavior and productivity. Furthermore, previous research has been overwhelmingly quantitative, measuring yields without examining their implications for household resilience, poverty alleviation, or food security.This study addresses these critical gaps by taking a more holistic approach. It considers how social systems such as kinship networks, cultural practices, and gender roles as well as institutional factors like credit access and extension services, mediate the relationship between input use and rice productivity. The study is particularly urgent given Cambodia's growing exposure to climate change and the increasing commercialization of agriculture, which threaten to widen inequalities among rural producers [22], [23].

This study aims to 1) assess the farming input uses and rice productivity in Battambang and Svay Rieng provinces, Cambodia; 2) determine the factors that affect rice productivity; and 3) predict rice productivity based on farming inputs. In addition, A gap analysis between this study and previous research on agricultural input uses and rice productivity in Cambodia reveals several critical areas of focus. While previous studies have primarily examined the direct relationship between input usage (such as fertilizers, seeds, and pesticides) and rice yields, they often overlook the socio-economic factors that influence farmers' access to and utilization of these inputs. This study aims to fill that gap by integrating the role of education, credit access, and market dynamics in shaping agricultural input decisions. Additionally, while earlier research has largely focused on quantitative yield outcomes, this study will explore the broader impacts of input use on farmers' livelihoods, resilience to climate change, and overall socio-economic stability, providing a more comprehensive understanding of the challenges farmers face in maintaining productivity.

## 2. RESEARCH METHOD

The methodological approach used to investigate the relationship between farming inputs and rice productivity in Battambang and Svay Rieng provinces of Cambodia. The study combines both quantitative and qualitative methods to obtain a comprehensive understanding of the socio-economic and agronomic factors influencing rice yields. The following sections detail the type of research, research subjects, data collection instruments and techniques, data analysis methods, and the overall research procedure.

The type of research in this study we used a descriptive survey research design with elements of correlational analysis. Survey research is well-suited for studies involving large populations and aims to describe patterns of behavior, attitudes, or characteristics by collecting data directly from respondents [24], [25]. The use of both quantitative and qualitative approaches allows for triangulation of data, enhancing the reliability and depth of findings. The quantitative aspect focuses on numerical relationships between input use and productivity, while the qualitative component explores farmers' experiences and decision-making processes.

The research subject was conducted in two provinces Battambang in the northwest and Svay Rieng in the southeast representing contrasting agro-ecological zones in Cambodia. A total of 148 smallholder rice farmers were selected as respondents from 7 villages, 2 communes, and 2 districts. The sample included both male and female household heads who are directly involved in rice cultivation during both the dry and rainy seasons. A stratified purposive sampling method was used to ensure representation from diverse farming environments and socio-economic backgrounds, as suggested by Neuman [26]. The selection criteria included landholding size, frequency of rice cultivation, and engagement in seasonal farming practices.

In this research data collection instruments and techniques both primary data and secondary data. Primary data were collected through structured and semi-structured interviews. The questionnaire included both closed-ended and open-ended questions, divided into key sections: demographic information, farming practices, input usage (fertilizers, seeds, pesticides, labor, water), land size, credit access, rice yield per hectare, and extension service contact.Interviews were conducted face-to-face, ensuring clear communication, particularly in remote areas with low literacy rates. The structured components enabled quantitative analysis, while open-ended responses provided qualitative insights into challenges, strategies, and perceptions related to input use and productivity [27]. Secondary data from local agricultural offices and commune councils were also collected to verify patterns of input availability, seasonal calendars, and climatic conditions in the selected regions. After collected data this stusy we used data analysis incorporated both quantitative statistical techniques and qualitative content analysis. Quantitative data were analyzed using frequency distributions and descriptive statistics to summarize demographic and farming characteristics, Cross-tabulations and Chi-square tests to explore associations between categorical variables such as fertilizer use and yield categories, One-sample t-tests to determine whether the average rice yields in the sample significantly differ from national or provincial benchmarks, and *P-value* analysis to assess the significance of observed differences and associations, with a standard alpha level of 0.05.Qualitative data from open-ended responses were thematically analyzed, identifying patterns related to decision-making, perceived constraints, and strategies for coping with input scarcity or climate variability [28], [29].

The research procedures followed a systematic procedure as outlined below: Preliminary phase from literature review and conceptual framework development and selection of study areas and identification of target communities. For instrument design and validation as development of the questionnaire in English and translation into Khmer, Pre-testing the instrument in a pilot village to ensure clarity and relevance, and Refinement of questions based on pilot feedback. For data collection such as Fieldwork conducted over two months during the dry season to capture retrospective and current information on both rainy and dry season practices and Researchers worked in pairs, supported by local facilitators, to improve cultural sensitivity and accuracy in translation. Data enntry and cleaning we implement for quantitative data entered into SPSS and Excel spreadsheets and qualitative data transcribed and coded for R-program analysis. To produce the results in data analysis and interpretation as following Statistical analyses conducted using SPSS and R-program and Integration of qualitative insights to contextualize statistical trends [30]. In addition, for Eethical considerations we toke informed consent obtained from all participants, anonymity and confidentiality maintained throughout data collection and reporting, and local authorities were consulted and permissions were secured prior to fieldwork [31].

## 3. RESULTS AND DISCUSSION

### 3.1. Assessment of the Farming Input Uses and Rice Productivity in Battambang and Svay Rieng Provinces

The results found that the average number of farmer family members involved in agricultural production was 2 people, or 70%. Analysis by the one-sample t-test has illustrated that the land size of farmers in each family used in rice production every year showed that the biggest land size from 2-4 ha is 40%, followed by from 4-6 ha is 34%, and from 0.5-2 ha is 9%, while the land size greater than 6 ha is only 8%. This could be explained that the biggest land size farmers per family used for rice production was 2-4 ha, as well as 4-6 ha. Based on this result, it can be seen that most farmers in Battambang and Svay Rieng have their land, and every family uses their land for rice productivity. Instead, if farmers have their personal land for agriculture, they do not waste money renting other farmers' land to produce rice and ensure sustainable rice production in their families, as they grow rice for food and income. Similar to [32], which explained that land for agriculture could justifiably be viewed as the most important natural asset and the most important resource for the enhancement of peasant production, it also mentioned land as the most fundamental productive resource in the rural economy. [33], [34] have stated that it has not been possible to increase production as land for cultivation is becoming increasingly scarce. This, according to Chinaware, is aggravated by the fact that most lands have lost their productive capacity in a situation where the cost of bringing new lands under cultivation is also high and rising [35].

#### 3.1.1. Impact of Social Inequality on Access to Agricultural Inputs

Social inequality significantly affects farmers' access to key agricultural inputs like land, chemical fertilizers, and technology. Although most farming families in Batambang and Svay Rieng own land-reducing rental costs and promoting sustainable rice production-land ownership remains unequal. The majority farm on 2-4 ha (40%) or 4-6 ha (34%), while a smaller group operates on less than 2 ha (9%) or more than 6 ha (8%). This disparity influences access to inputs, as farmers with smaller landholdings may lack the resources or incentive to invest in fertilizers, improved seeds, or machinery, limiting their productivity and income [36].

#### 3.1.2. Social Implications of Reliance on Fertilizers and Technology

Dependence on chemical fertilizers and modern technologies can widen social and economic divides. Wealthier or better-informed farmers can afford and effectively use these inputs, while poorer farmers may struggle due to high costs, limited knowledge, or market access. Overuse of fertilizers can also lead to environmental degradation, which disproportionately affects smallholders who rely more heavily on natural soil fertility. Moreover, technological advancement often excludes those without training or literacy, reinforcing existing inequalities[37], [38].

#### 3.1.3. Gender, Generational, and Regional Differences

Gender disparities persist in access to land, credit, and training. Women, despite their involvement in agriculture, often have limited land rights or decision-making power. Similarly, younger generations may lack land inheritance or motivation to engage in farming due to poor returns and limited support. Regionally, variations in infrastructure and institutional presence (e.g., extension services) lead to unequal access to knowledge and inputs, with remote areas often being underserved [39].

#### 3.1.4. Role of Public Policies and Institutional Support

Public interventions like fertilizer subsidies or Good Agricultural Practices training are critical to addressing these inequalities. Subsidies help smallholders afford inputs, while Good Agricultural Practices programs can promote sustainable farming and build farmers' knowledge. However, the effectiveness of these programs depends on equitable access, transparency, and regional outreach. Without careful targeting, such interventions may inadvertently benefit wealthier farmers more than the intended poor or marginalized groups [40], [41].

#### 3.1.5. Impacts and Limitations of The Research

The study highlights important trends in land use and access but has limitations. It focuses on average landholding sizes without fully exploring deeper causes of inequality or the broader social dimensions (e.g., class or ethnicity) [42], [43]. Additionally, reliance on land size as the primary metric may oversimplify the complexity of agricultural livelihoods. Future research should include qualitative data on farmers' experiences, policy access, and social dynamics to build a more comprehensive understanding of inequality in agriculture [44], [45].

The quantity of rice seed that farmers preferred to use per hectare was about 200 kg, or 63%. About the price of rice seed per kg, the highest price of rice seed was 1,600-2,000 riels per kg, or 75%, while the lowest price was 2,000-2,500 riels per kg, or 25%. Based on this result, it can be discussed that in rice productivity, farmers need rice seed to cultivate; however, it is noted that generally, farmers use rice seed of about 150-200 kg to grow per hectare both in Batambang and Svay Rieng. As agreed to Latour et al., [46], rice was established by Direct Seeded Rice using manual broadcasting by 100% of the farmers, with an average seeding rate of 181 kg/ha. In their survey study conducted in Batambang and Takeo provinces of Cambodia, they also found that 97% of farmers were practicing Direct Seeded Rice using a similar seed rate. The majority of the farmers used their own saved seeds or seeds purchased from neighboring farmers (82-83%) for planting rice in both dry and wet seasons, and only 8-13% bought seeds from a seed company. These results are similar to the previous findings. However Messina and Kapenga [47], Mugabe et al., [48] have reported a similar situation in Vietnam, where 81% of farmers use their own saved seeds for rice sowing and only < 5% buy certified seeds.

The types of fertilizer farmers use to grow their rice every year show that the most chemical fertilizer is 87%, while the most natural fertilizer is only 13%. In addition, due to the results, it could be explained that the most common fertilizer farmers use to grow rice is chemical fertilizer, which they prefer over natural fertilizer because it is easier and improves growth very quickly. As agree to Ngouy and Prichet [49], Paphavasit and Meekumsri [50], Parsons and Munroe [51], Peou et al., [52] reported that 95% of farmers used fertilizer on rice in the wet season. Urea (82%) was the most commonly used fertilizer, followed by diammonium phosphate, 52%), ammonium phosphate (27%), NPK fertilizers (12%), and muriate of potash (8%). Overall, 91% of farmers applied N, 86% applied P, and only 30% applied K. In the dry season, only 53% of farmers planted rice, and among them, 96% used fertilizer. Urea (75%) was the most commonly used fertilizer in the dry season, followed by diammonium phosphate (42%), NPK fertilizers (32%), ammonium phosphate (30%), and muriate of potash (9%). Overall, 96% of farmers applied N, 94% applied P, and 35% applied K [53]-[55].

The farmers who currently use herbicides in their rice productivity the most are 91%, while some farmers do not use them at all, at only 9%. The types of herbicides farmers currently use in their rice productivity are: the most common chemical herbicide is 91%, while some farmers use natural herbicides at only 9%. Based on this result, it can be discussed that very farmers wanted to get higher rice yields after harvesting. To achieve this, farmers needed to use herbicides to control all kinds of weeds. Similar to Sopheak and Dunne [56], it is stated that an effective herbicide for desiccation of live vegetation (cover crop, previous crop, rice, or weeds) before planting is necessary to establish a growth advantage of the crop over weeds. The herbicide must provide a complete shoot kill and prevent regrowth of the previous crop or weeds. It should be capable of controlling all emerging plant species present, but should have no residual activity on the crop being planted.

The water resources that farmers use in rice productivity the most are rainwater 87%, while some farmers use water from rivers, lakes, and canals at only 13%. The fuel that farmers use in rice productivity the most from 50-75 Litres is 66%, while some farmers use fuel from 25-50 Litres is only 34%. The amount of money that farmers used to pay for fuel in rice productivity per year was the highest at 240,000-480,000 Riels, while some farmers paid only 43%. Based on the results, it can be concluded that in rice production in both Batambang and Svay Rieng, farmers exactly need water resources and irrigation from rainwater, rivers, canals, or lakes to grow rice; however, without water, farmers cannot grow rice, whether in the wet or dry seasons. Similar to Tan et al., [57] presented, the use of wastewater in agriculture is growing due to water scarcity, population growth, and urbanization, which all lead to the generation of yet more wastewater in urban areas. With the increasing scarcity of freshwater resources that are available to agriculture, the use of urban wastewater in agriculture will increase, especially in arid and semi-arid countries [58].

### 3.2. Determining The Factors That Affect Rice Productivity

The results found that the amount of farmers' land size used in rice productivity by each family almost affects rice productivity at 93%, while some farmers say farmers' land size does not at only 7%. Most farmers think that the quality of rice seed affects rice productivity by 80%, while some farmers say it is affected by only 20% [59]. In the below Chi-Square test (Table 1), it is indicated by non-significant (*n/s*) that there is no relationship because the sign or *p-value* = 0.247 is greater than 0.05, which implies a Null Hypothesis that can be rejected. So, there is a relationship between the quality and quantity of rice seed that farmers use, which directly affects rice productivity. That means if farmers use high-quality rice seeds to grow, they will receive higher rice yields after harvesting.

$H_0$: There is no relationship between the rice yields and the quality of rice seed farmers' use in rice productivity (Null Hypothesis).

$H_1$: There is a relationship between the rice yields and the quality of rice seed farmers in rice productivity (alternative hypothesis).

Table 1. Testing To Determine The Factors That Affect Rice Productivity

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 5.414[a] | 4 | .247 |
| Likelihood Ratio | 4.887 | 4 | .299 |
| Linear-by-Linear Association | 1.066 | 1 | .302 |
| N of Valid Cases | 148 | | |

*a. 5 cells (50.0%) have an expected count of less than 5. The minimum expected count is .20.*

The quality of rice seeds used in rice productivity has shown that the quality of rice seeds is almost affected by rice productivity by increasing rice yields by about 86%, while some farmers do not think that the quality of rice seeds is affected by rice yield by only 14%. It could be explained that the quality of rice seed affected the rice yield. meaning that if farmers use quality rice seed to grow, they will get a higher rice yield [60].

The pesticides that farmers use to improve rice productivity show that pesticides almost completely affect rice productivity by increasing rice yield by 100%, while farmers use pesticides to control all kinds of pests and insects by reducing damage to rice during growing until it has been harvested. The pesticides that affected rice productivity that farmers used show that pesticides are the most affected in increasing rice yields by about 91%, while some farmers did not think that using pesticides had not affected on rice yield by only 9%. This could be explained by the fact that using pesticides affected the rice yield. meaning that if farmers do not use pesticides when growing rice, they will get a low rice yield [61].

Herbicides almost completely affect rice productivity by increasing rice yield by 100%, while farmers use pesticides to control all kinds of weeds or grass by reducing damage to rice during growing until it has been harvested. The herbicides that farmers used affected rice productivity the most. It shows that most herbicides affected rice productivity by increasing rice yields by about 98%, while some farmers did not think that using herbicides affected rice yield by only 2%. This could be explained by the fact that the use of herbicides had a significant impact on rice yield, meaning that if farmers do not use pesticides during rice growing, they will get a low rice yield [62].

Chemical fertilizers, which farmers use to improve rice productivity, show that chemical fertilizer almost affects rice productivity by increasing rice yield by 100%, while farmers use chemical fertilizers to improve rice growing at very fast rates and with higher yields. The chemical fertilizer most affected rice productivity by increasing rice yields is about 95%, while some farmers did not think that using chemical fertilizer would affect rice yields by only 5%. This could be explained by the fact that the use of chemical fertilizer had a significant impact on rice yield. means that farmers use chemical fertilizers to improve the growing rice in a short time and get a higher rice yield [63].

Natural fertilizer almost affected rice productivity by increasing rice yield by 100%; meanwhile, farmers used natural fertilizer to improve rice growth, during very fast and high yields. Furthermore, rice yields are derived from natural fertilizer, which people can consume safely and of high quality. The price of selling rice yield per kg after harvesting, which farmers sell rice yields, showed that the most price-affected rice productivity is from 800-1,100 Riel/kg, followed by 500-800 Riel/kg, which is 24%, and from 1,100-1,400 Riel/Kg is 14%, while some farmers sell their rice yield at 1,400-1,700 Riel/kg, which is 5%. Meanwhile, most farmers sell their rice yield at an agreed price of 500-800 Riel/kg, which is a bit low compared to the price of inputs for rice productivity [64].

### 3.3. Predicting Rice Productivity Based on Farming Inputs

Analysis by the Chi-Square test (Table 2) has indicated the quantity of rice yields that farmers get after harvesting per hectare. It shows that the amount of rice yields farmers generally get from 2,000-4,000 kg/ha is about 84%, while some farmers get higher rice yields from 4,000-6,000 kg/ha, which is only 16%. This could be explained by the fact that most farmers get rice yields of 2,000-4,000 kg/ha, while some farmers get higher rice yields of 4,000-6,000 kg/ha. it is indicated by a perfectly significant (***) that there is a strong relationship because the sign or *p-value* = 0.000 is less than 0.01, which implies a Null Hypothesis that can be rejected. The season, during which farmers always like to grow rice, has a strong relationship with the quality of rice yields.

$H_0$: There is no relationship between the seasons and the quantity of rice yields with which farmers cultivate rice productivity (Null Hypothesis).

$H_1$: There is a relationship between the seasons and the quality of rice yields with which farmers cultivate rice productivity (alternative hypothesis).

Table 2. Test of Rice Productivity Based On Farming Inputs

Chi-Square Tests

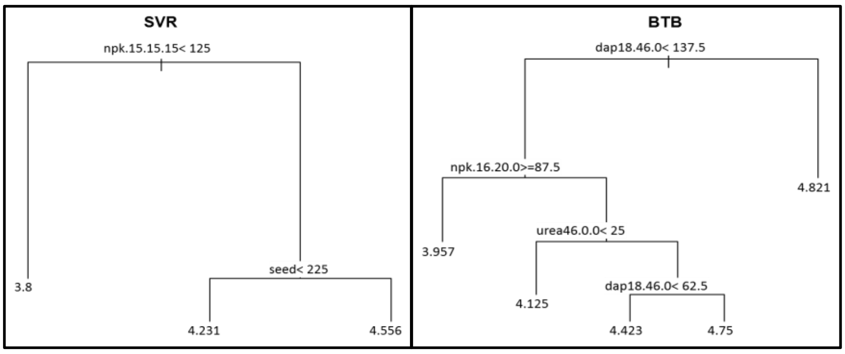
| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 30.313[a] | 1 | .000 | | |
| Continuity Correction | 28.459 | 1 | .000 | | |
| Likelihood Ratio | 30.943 | 1 | .000 | | |
| Fisher's Exact Test | | | | .000 | .000 |
| Linear-by-Linear Association | 30.108 | 1 | .000 | | |
| N of Valid Cases | 148 | | | | |

*a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 23.91.*
*b. Computed only for a 2x2 table*

Comparing the chemical and natural fertilizers with which farmers grow rice every year. It shows that the most fertilizers applied to rice yields are chemical fertilizers (about 78%), followed by natural fertilizers (about 21%), while some farmers mix chemical and natural fertilizers (only 1%). This could be explained by the fact that most farmers use chemical fertilizers to grow rice, and they get higher rice yields than with natural fertilizers. Only a few mixed fertilizers. The rainy season rice yield per hectare, what farmers grow during the rainy season. It shows that the most generally rainy season rice yields are about 2,000-4,000 kg/ha, or 70%, while some farmers get rice yields of about 4,000-6,000 kg/ha after harvesting per hectare, or only 30%. This could be explained by the fact that most rainy season rice is higher than 2,000-4,000 kg/ha, and some farmers get 4,000-6,000 kg/ha. It shows that the most generally high dry season rice yields are about 2,000-4,000 kg, or 86%, while some farmers get rice yields of about 4,000-6,000 kg after harvesting per hectare, or only 14%. This could be explained by the fact that most dry-season rice yields are higher at 2,000-4,000 kg/ha, and some farmers get 4,000-6,000 kg/ha [65].

The coefficient of determination describing the correlation between rice productivity and the predicted value was 0.566. Pesticide level appeared to have the highest influence on rice production, followed by natural fertilizer and chemical fertilizer factors, respectively (Figure 1). With regard to productivity prediction, high rice productivity of 5 tons/ha was correlated with a pesticide cost of >= $13,000. The medium volume of rice production, 4.276, was discovered. Furthermore, the lowest level of rice production, 3,800 kg/ha, was discovered when chemical fertilizer was used less than 125 kg/ha. If farmers use rice seeds less than 225 kg/ha, they will probably get rice production of 4,231-4,556 kg/ha in Svay Rieng province (Figure 1). In contrast, the rice productivity in Battambang province requires farmers to use more chemical fertilizers if they want to get higher rice production, as follows: If rice production was 4,821 kg/ha, they applied DAP 18:46:00 less than 137.5 kg/ha, while N.P.K. 16:20.00 was about 87.5 kg/ha and rice yield was 3,957 kg/ha. If they applied UREA 46.0.0 less than 25 kg/ha, rice yield was 4,125 kg/ha, and if they applied DAP 18.46.0 less than 62.5 kg/ha, they would get rice production of 4,423-4,750 kg/ha [66], [67].

- The coefficient of determination describing the correlation between rice productivity in Svay Rieng and the predicted value was 0.572.
- The coefficient of determination describing the correlation between rice productivity in Battambang and the predicted value was 0.481.




Svay Rieng Province Battambang Province

Figure 1. Showing The Prediction of Rice Productivity Based On Farming Inputs In Svay Rieng And Battambang Province

## 4. CONCLUSION

The study confirms that chemical fertilizers significantly influence rice productivity, with 84% of farmers reporting yields between 2,000-4,000 kg/ha. During the rainy season, 70% achieve this yield range, increasing to 86% in the dry season. To improve rice quality and ensure food safety, farmers are encouraged to shift toward organic and natural fertilizers. Government agencies and NGOs should enhance their support by promoting sustainable farming practices and offering technical assistance.

Future research should focus on Conduct field trials comparing chemical, organic, and integrated fertilizer systems to evaluate differences in rice yield, soil health, cost-effectiveness, and environmental impact, Assess the long-term productivity, soil fertility, and economic outcomes for farmers transitioning from chemical to organic/natural fertilizers over multiple growing seasons, Investigate the social, economic, and institutional barriers that prevent widespread adoption of Good Agricultural Practices (GAP) and identify effective incentives to promote uptake, Study how seasonal climate variability (rainy vs. dry) affects the efficacy of different fertilizer regimes and develop region-specific recommendations, Examine how different fertilization practices influence the nutritional value and potential chemical residues in rice, with implications for public health, and Analyze the effectiveness of current agricultural policies and NGO interventions in promoting sustainable rice farming and identify areas for policy innovation.

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