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Research Article

Multi-Regression Modeling of Harvest Income in Smallholder Long Coriander Production: Insights from Battambang, Cambodia

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Abstract

The target of this study is to promote Long Coriander production; the most widely recognized leafy vegetable in Southeast Asia and Cambodia. As a substitute for regular coriander, it is valued for its taste and health benefits. The market price for Long Coriander seeds typically goes up and down depending on the season, similar to other fluctuations observed in other agricultural products. In an effort to fulfill the study's expectations, researchers intend to identify the key factors affecting the profitability of Long Coriander production for smallholders in Battambang, Cambodia. Using multi-regression models, the analysis will determine the statistical significance of specific cost categories and their influence on incomes from both single and annual harvests of Long Coriander. Two regression analyses will be applied: ordinary least squares (OLS) and stepwise regression. Understanding the factors influencing Long Coriander harvest income is crucial for developing targeted strategies to improve the livelihoods of rural producers. With the knowledge gained from this study, smallholders will be able to make strategies that will maximize profitability and maintain the long-term sustainability of Long Coriander production within the context of agriculture. Additionally, the study also defines variables that can be controlled by producers, besides the variables that have a significant effect by chance.

Keywords

Multi-Regression Modeling, Harvest Income, Smallholder, Long Coriander Production, Chi Rona, Agriculture, Cambodia

1. Introduction

Long Coriander, recognized for its distinctive flavor, is considered an essential ingredient in Cambodian cuisine. Based on the farmers, this is called *Chi Rona* in Khmer, also known as *Chi Banla*, *Chi Baraing*, or *Chi Pa-la* [5, 23]. Similarly, Long Coriander is also known by several alternative names in other countries, such as "Puerto Rican coriander, Black Benny, Saw leaf herb, Mexican coriander, Saw tooth coriander, Spiny coriander, Fitweed" [23]. The Caribbean Islands are considered to be the birthplace of this plant. Many areas of Southeast Asia, including Indonesia, Malaysia, and Indochina, are currently experiencing introduction of this plant [7, 22]. The Coriander classification belongs to the

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Plantae kingdom. Within this kingdom, it falls under the family of *Apiaceae*. The specific genus for Long Coriander is *Eryngium*, and the species is *E. foetidum*. Combining the genus and species gives us the binomial name *Eryngium foetidum* [23]. Despite the difference in appearance between Long Coriander and other corianders, their long, tough stems share a similar scent. This suggests Long Coriander as a potential substitute for coriander [14]. Interestingly, discovered in Asia, Long Coriander rapidly gained popularity there as an alternative to Mediterranean remedies. Although previously unknown, Long Coriander has become a popular houseplant for summer [10]. Seeds for growing Long Coriander at home can now be found at seed suppliers, Asian and Latin markets, and online seed retailers [22]. The fragrant leaves, with long are a characteristic of Long Coriander, a popular leafy vegetable that is commonly eaten (Figure 1). The plant's evergreen stems reach 15-20 cm in height and have long fibrous roots. Arranged in a rosette pattern, the leaves possess long-serrated margins [7, 15]. Long Coriander's flowers are cylindrical and have rounded apices, measuring about 1.2 cm long and 0.5 cm wide. This plant flowers continuously throughout the year in Southeast Asia.

Figure 1. *Harvest of Long Coriander (Source: Authors, 2024).*

The Long Coriander fruits are oval-shaped, about 1.5 millimeters in length and covered in small spheres [21]. The basic cultivation process of Long Coriander traditionally involves planting seeds. Farmers typically sow 3-5 kilograms of seed per square meter directly onto a 1,600 square meter plot. Soaking the seeds for two nights before sowing is recommended. Following the soaking, farmers mix 6 tablespoons of seeds with a specific amount of ashes. This mixture is then directly scattered onto the prepared soil surface. Adequate moisture in the soil is essential for seed germination, so thorough watering is necessary 15 days after sowing [21, 22].

As a result of its unique flavor, Long Coriander is recognized as an essential ingredient in many cuisines. Central America and the Far East, especially in Southeast Asian countries are the main area where Long Coriander is used. In Thailand, Malaysia, and Singapore are also commonly used as a topping for soups, noodles, and curries, sometimes even as a substitute for regular coriander. Since coriander roots are unavailable in these regions, Long Coriander can also be used in Thai curry pastes. While Vietnamese cuisine emphasizes fresh herbs in general, Long Coriander finds its place there as well [17, 23].

Beyond its unique flavor, In South American like Peru, Colombia, and Ecuador, the plant is valued for its medicinal properties, particularly in treating digestive and gynecological issues like bloating, diarrhea, and upset stomachs. Studies suggest that Long Coriander might also be beneficial for various female reproductive issues, including menstrual regulation, cramp relief, fertility enhancement, childbirth assistance, and even acting as an aphrodisiac [8, 15, 22]. Besides, the potential health benefits of Long Coriander have been highlighted by scientific studies. This flavorful plant is not only a delight for the taste buds but also a rich source of many nutrients. It boasts a high content of minerals, vitamins, carotenoids, antioxidants, and phytosterols. Fresh Long Coriander leaves are comprised of 87% moisture, 6.5% carbohydrates, 3.3% protein, 0.6% fat, 1.7% ash, 0.06% phosphorus, and 0.02% iron (Figure 2). Additionally, Long Coriander is a significant source of vitamins, containing 10,460 IU of vitamin A, 60 mg of vitamin B2, 0.8 mg of vitamin B1, and 150–200 mg of vitamin C per 100 grams [8, 17, 23].

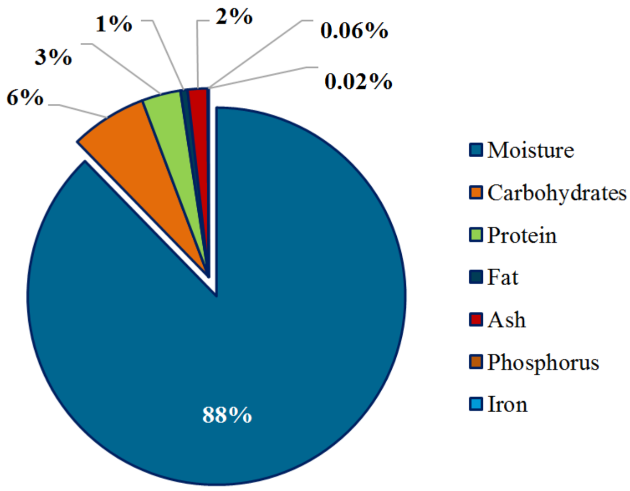

Figure 2. *Composition of Fresh Long Coriander Leaves [1, 17].*

The market price for Long Coriander seeds is typically 100,000 riels (approx. $24.29) per kg; however, producers can usually purchase them for a discounted rate of 90,000 riels (approx. $21.86) per kg. The price of Long Coriander crop always fluctuates, just like the others in the market. Producers pay the lowest price, between 1,500 and 2,500 riels (approx. $0.36 to $0.61) per kg, while market sellers start at 3,500 to 4,000 riels (approx. $0.85 to $0.97). During the off-season, Long Coriander crop prices for producers selling to brokers range from 3,500 to 5,000 riels (approx. $0.85 to $1.21), while market sellers offer them between 7,000 and 9,000 riels (approx. $1.70 to $2.19) per kg (According to the producers, 2024). The high profitability of Long Coriander suggests it to be a very promising agricultural product for producers in Cambodia [22].

Apart from its potential as a leafy green vegetable, the study on Long Coriander investigates its market and profitability by testing each variable to observe statistical significance and factors that adversely affect Long Coriander output for producers in the Battambang land area of Cambodia. Ordinary least squares (OLS) and stepwise regression analysis are employed to conduct this analysis. By demonstrating the Long Coriander output, relationship between costs, potential earnings, both regression analyses can help producers understand the factors influencing output and encourage them to continue cultivating this kind of crop. The insights gained from this study can also further inspire research on crop production.

2. Methodology

2.1. Data Sources and Descriptions

Descriptive Statistics of Inputs for Long Coriander Production Cost-Value Analysis

The demographic information (Table 1) in the descriptive statistics of inputs for Long Coriander production cost-value revealed distinct inputs (costs) that were defined by *"material_1-10"* variables. Each of them referred to various materials needed for Long Coriander production. Notably, plant veil cover *("material_1")* stood out as having had the highest cost of 3,135.5 riels (approx. $762.99). Subsequently, the irrigation supply pipe *("material_4")* had a cost of 1,577.3 riels (approx. $383.82). Compared to the other costs associated with the other variables, they appeared reasonable for producers to have expended on cultivation.

Table 1. *Descriptive Statistics of Inputs for Long Coriander Production Cost-Value Analysis.*

Variable	Definition	Obs.	Value	
			*1000 Riels	Dollars
material_1	Plant Veil Cover	50	3,135.5	762.99
material_2	Plant Stake	50	952.9	231.88
material_3	Bamboo Plant Stake	50	206.8	50.32
material_4	Irrigation Supply Pipe	50	1,577.3	383.82
material_5	Rope	50	94.2	22.93
material_6	Nail	50	8.1	1.98
material_8	Biocide (Herbicide)	50	156.9	38.18
material_9	Chemical Fertilizer	50	235.2	57.24
material_10	Water Pump Motor/Engine	50	556.7	135.47
labor_1	Labor of Excavation	50	74.8	18.20
labor_2	Labor of Plowing	50	168.5	41.01
labor_3	Labor of Harvesting	50	946.6	230.35
Exp_1	Energy Resource	50	78.6	19.12

Note: The riel is the currency of Cambodia.

Labor and land preparation inputs (costs) were also listed by *"labor_1-3"* variables, and each of them refers to the labor of the different types of work required to cultivate long coriander (1, 2, and 3). These labors involved labor for excavation (74.8 riels), plowing (168.5 riels), and harvesting (946.6 riels). Each labor cost was equivalent to a total cost of approx. $289.56. *"Exp_1"* is the last variable; it represented the energy resources (liters) used in its production, with a cost of 78.6

riels (approx. $19.12).

Descriptive Statistics of Inputs and Outputs for Long Coriander Production Regression Analysis

In the regression analysis conducted to examine Long Coriander production, descriptive statistics were used to summarize the input (costs) and output (income) data. These statistics helped understand the unique characteristics of the information and build a model that considers various cost variables impacting the income generated from Long Coriander production. The demographic information (Table 2) primarily relied on *"material_7,"* which represented the cost of seeds used for cultivation. These seeds cost 598 riels (approx. $145.56). Significantly, the cost of other materials was the highest cost at 5,975 riels (approx. $1,454.31) compared to the other categories. Conversely, the other costs seemed lower: total labor costs *("Labor_total")*, transportation costs *("Exp_2")*, energy resource & water pump/engine costs *("material_energyEngin")*, and chemical fertilizer & biocide (herbicide) costs *("material_cheFerti")*. Considering all potential costs, the market price of the crop was 3,42 riels ($0.83) per kg, represented by *"Y_price."* Accordingly, the income from a single harvest *("Income_1stHarvest")* earned 3,958 riels (approx. $963.40). This represented the income earned by selling crops harvested in one season. The final variable is known as total annual income *("Income_Year Harvest")*. It referred to the total income earned throughout a year or during a 12-month period. As a result, it earned 21,900 riels (approx. $5,330.58). Seed rate per rai (kg) determines the amount of seed (3.96 kg) needed to plant one rai of land, represented by the variable *"cul_Seed"*. The variables *"total_land"* and *"cul_area"* refer to the total land (rai) with a value of 7.14 (rai) and cultivate land with a value of 1.24 (rai), respectively. They provide data on land use and the size of the cultivating operation. The number of plants per year *("Y_N_plantYear")* has a value of 2.66, and the number of harvests per year *("Y_Harvest_year")* has a value of 5.46. They refer to the total number of cultivating plants in a year along with the number of harvests that can be collected within a year. Moreover, harvest yield per rai (kg) or *"Y_harvest"* represents the yield per rai of cultivated land, with a value of 1,146 kg.

Table 2. *Descriptive Statistics of Inputs and Outputs for Long Coriander Production Regression Analysis.*

Variable	Definition	Obs.	Value	
			*1000 Riels	Dollars
material_7	Cost of Seed	50	598	145.56
material_Other Cost	Cost of Other Materials	50	5,975	1,454.31
material_cheFerti	Cost of Chemical Fertilizer & Biocide (Herbicide)	50	392	95.44
material_energyEngin	Cost of Energy Resource & Water Pump/Engine	50	635	154.63
Exp_2	Cost of Transportation	50	4.95	1.20
Labor_total	Total Cost of Labors	50	1,190	289.64
Income_1stHarvest	Income from a Single Harvest	50	3,958	963.40
Income_Year Harvest	Total Annual Income	50	21,900	5,330.58
cul_Seed	Seed Rate Per Rai (Kg)	50	3.96	
Y_price	Price Per Riel (Kg)	50	3,422	
total_land	Total of Land (Rai)	50	7.14	
cul_area	Cultivate Land (Rai)	50	1.24	
Y_N_plantYear	Number of Plants Per Year	50	2.66	
Y_Harvest_year	Number of Harvests Per Year	50	5.46	
Y_harvest	Harvest Yield Per Rai (Kg)	50	1,146	

Note: The riel is the currency of Cambodia

Descriptive Statistics of Average Single and Annual Harvest Income for Long Coriander Production

The following Table 3 presented descriptive statistics on average single harvest and annual harvest income for Long

Coriander production. This table helped readers gain a deeper understanding of the data presented in the previous tables. It included rich data on potential variables, groups, number of observations, and standard deviation.

Table 3. Descriptive Statistics of Average Single and Annual Harvest Income for Long Coriander Production.

Variable	Group	Average of Single Harvest Income				Average of Annual Harvest Income			
		Obs.	*1000 Riels	Dollars	SD	Obs.	*1000 Riels	Dollars	SD
total_land	> 7.14	11	3733	933	1771	11	21128	5282	11025
	≤ 7.14	39	4022	1005	1380	39	22109	5527	9236
cul_Seed	> 3.96	27	3850	963	1607	27	22278	5570	10575
	≤ 3.96	23	4084	1021	1290	23	21442	5360	8391
cul_area	> 1.24	13	4026	1006	1382	13	23885	5971	8575
	≤ 1.24	37	3934	984	1504	37	21194	5298	9879
Y_N_plantYear	> 2.66	25	3722	930	1153	25	20252	5063	7529
	≤ 2.66	25	4194	1049	1705	25	23534	5884	11125
Y_Harvest_year	> 5.46	28	4384	1096	1582	28	26761	6690	9585
	≤ 5.46	22	3415	854	1098	22	26761	6690	9585
Y_price	> 3422	41	4284	1071	1381	41	24029	6007	9156
	≤ 3422	9	2475	619	704	9	12163	3041	3024
Y_harvest	> 1146	20	5253	1313	1329	20	28938	7234	10309
	≤ 1146	30	3095	774	720	30	17197	4299	5226

Note: The riel is the currency of Cambodia

2.2. Data Collection

The research took place in Battambang province, located in northwestern Cambodia and part of the Tonle Sap Lake region. This area is famous for its vast farmlands, which produce a significant amount of rice and other grains. These crops serve as a primary food source for Cambodian farmers. This third-largest city in Cambodia has a total population of 987,400 [3]. Additionally, Cambodia is located in Southeast Asia, at the southern tip of the Indochina Peninsula. The climate there is tropical monsoon [26, 20] with two distinct seasons: a wet season from May to October and a dry season from November to April. Importantly, the Mekong River flows through Cambodia's flat plains, and Tonle Sap Lake is surrounded by plateaus and cultivated hillsides [2-6].

The data for this study was gathered using quantitative methods. Nearly 50 households were interviewed in the province of Battambang, Cambodia. The structured questionnaire was used to collect information from six villages, as stated in (Table 4). The study also applied the non-random purposive sampling method, which concentrated on farmers who cultivate Long Coriander crop. This study investigated production costs and income (both single harvest and annual) from Long Coriander cultivation using ordinary least squares (OLS) and stepwise regression analysis.

Table 4. Selected site and sampling method.

Province	District	Commune	Village	Household Population	*Purposive sample selection in Non-Random Sampling*	
					Sample size	% of Sample size
Battambang	Thma Koul	Ta Meun	Samraong	245	11	22

Province	District	Commune	Village	Household Population	Purposive sample selection in Non-Random Sampling	
					Sample size	% of Sample size
			Ta Sei	694	8	16
			Ang Cheung	412	6	12
			Krasang	352	10	20
			Tumpung Tboung	448	6	12
		Ta Pung	Ang Tboung	441	9	18
01 Province	01 District	02 Communes	06 Villages	2592	50	100

Direct observation involved visiting the area to understand the general situation, demographics, and existing farming systems. Researchers observed living conditions and existing Long Coriander plantings to identify the agricultural practices in the area and estimated how planting patterns differed between villages.

Key informant meetings Interviews were conducted with local authorities, such as district chiefs, commune chiefs, and village heads. These meetings aimed to gather general information about the materials, the total land used for Long Coriander planting, connections with middlemen, and market demand (price per kg).

Survey-structured questionnaires were used to conduct in-depth interviews with farmers who plant the Long Coriander crop. These interviews covered various aspects of labor and land preparation, including organic fertilizer, energy resources, transportation costs, excavation costs, seed, chemical fertilizer, plowing costs, and harvesting costs. The additional study based on the analysis focused on examining the statistical significance of each variable and how they influence Long Coriander production, both for single harvest and annual income. Two models were employed: ordinary least squares (OLS) and stepwise regression.

2.3. Model and Data Analysis

STATA software was used to conduct the statistical analysis for this study, employing ordinary least squares (OLS) and stepwise regression models to analyze the relationship between single harvest income and annual harvest income of Long Coriander production. OLS was implemented to estimate the basic linear model and identify the most significant variables affecting income. Stepwise regression was used to select potential variables and determine the most relevant factors influencing income [13, 12, 25, 19].

The collected data was initially entered into Microsoft Excel for coding and grouping variables. It was then transferred to STATA for data cleaning, regression analysis, and further modeling. Within STATA, multiple regression models were employed to estimate the relationship between single harvest income $(lnIncom_{1st.havest})$ and annual harvest income $(lnIncom_{year.havest})$, considering a set of cost variables representing both inputs and outputs of Long Coriander production. These included cost of seed, total cost of other materials, cost of chemical fertilizer & biocide, cost of energy resource & water pump or engine, total land area (rai), seed rate per rai (kg), cultivated land area (rai), price per riel (kg), number of plants per year, transportation cost, number of harvests per year, harvest yield per rai (kg), and total cost of labor. The results of the econometric analysis are presented in the following tables and constructed models.

$$lnIncom_{\mathbf{1st.havest}} = \beta_0 + \beta_1.lnm7 + \beta_2.lnm_{othercost} + \beta_3 lnm_{cheFerti} + \beta_4.lnm_{energyEng} + \beta_5.lnTota\_land + \beta_6.lnCul\_seed + \beta_7 lnCul\_area + \beta_8.lnY\_Price + \beta_9.lnY\_NplanYear + \beta_{10}.lnTranspo + \beta_{11}.lnY\_havesYear + \beta_{12} lnY\_havest + \beta_{13}.lnLabor\_total + \varepsilon_i$$

$$lnIncom_{\mathbf{year.havest}} = \beta_0 + \beta_1.lnm7 + \beta_2.lnm_{othercost} + \beta_3 lnm_{cheFerti} + \beta_4.lnm\_energyEng + \beta_5.lnTota\_land\ \beta_6.lnCul\_seed + \beta_7 lnCul\_area + \beta_8.lnY\_Price + \beta_9.lnY\_NplanYear + \beta_{10}.lnTranspo + \beta_{11}.lnY\_havesYear + \beta_{12} lnY\_havest + \beta_{13}.lnLabor\_total + \varepsilon_i$$

3. Results and Discussion

The study applied two model analyses, both ordinary least squares (OLS) and stepwise regression. These methods were used to examine the statistical significance of each variable and to analyze the Long Coriander production outputs for encouraging Cambodian farmers to plant this crop. The logarithmic form of the variables was applied. According to Table 5, the results of the logarithmic regression analysis of single harvest income include the cost of the seed used for cultivation as well as other costs. Notably, the cost of chemical fertilizer and biocide, represented by the variable *"lnm_cheFerti"*, was found to be a statistically significant predictor of single harvest income in the stepwise result, ($p < 0.05$, 5% significance level). It has a measurable effect on the amount of income generated from a single harvest. With this relationship between chemical fertilizer and biocide costs and single harvest income, producers can make informed decisions about the amount of fertilizer to use on Long Coriander crops. By analyzing the costs that lead to a higher income from each harvest, their profits can be potentially maximized. Likewise, total of land (rai), or *"lnTota_land"* was also found statistically significant at the 5% level in both OLS and stepwise models. In this case, producers with larger total land tend to have a higher number of harvests per year compared to producers with smaller total land. This suggests that producers with more land may also have more resources, which could contribute to their higher income from cultivation [16].

Table 5. *The Results of Logarithmic Regression Analysis of Single Harvest Income.*

Variable	Definition	OLS Model			Stepwise Model		
		Coefficient	T-value	P>T	Coefficient	T-value	P>T
lnm7	Logarithm of Seed	7.16E-08	0.440	0.663	-	-	-
lnm_othercost	Logarithm Total Cost of Other Materials	-3.32E-08	-0.350	0.726	-	-	-
lnm_cheFerti	Logarithm Cost of Chemical Fertilizer & Biocide	-1.83E-07	-1.620	0.114	0.000	-2.650	0.011**
lnm_energyEng	Logarithm Cost of Energy Resource & Water Pump/Engine	3.17E-08	0.290	0.770	-	-	-
lnTota_land	Logarithm of Total of Land (Rai)	1.45E-07	2.040	0.048**	0.000	2.370	0.022**
lnCul_seed	Logarithm of Seed Rate Per Rai (Kg)	-4.25E-08	-0.170	0.864	-	-	-
lnCul_area	Logarithm of Cultivate Land (Rai)	-2.14E-07	-1.170	0.248	-	-	-
lnY_Price	Logarithm of Price Per Riel (Kg)	1.000001	2.60E+06	0.000***	1.000	3100000	0.000***
lnY_NplanYear	Logarithm of Number of Plants Per Year	5.91E-08	0.240	0.809	-	-	-
lnTranspo	Logarithm of Transportation Cost	-5.88E-08	-0.430	0.668	-	-	-
lnY_havesYear	Logarithm Number of Harvests Per Year	3.28E-07	0.780	0.438	-	-	-
lnY_havest	Logarithm Harvest Yield Per Rai (Kg)	0.9999999	4.60E+06	0.000***	1.000	5500000	0.000***
lnLabor_total	Logarithm of Total Cost of Labor	4.87E-08	0.400	0.694	-	-	-
_cons	Constants	-5.96E-06	-1.440	0.159	-	-	-
No.of obs	Number of Observations	50.0			50.0		
R2	R-squared	1.00			1.00		
Adj R2	Adj R-squared	1.00			1.00		

Note: *10% Significance Level; **5% Significance Level; ***1% Significance Level

The impact of prices on agricultural markets is multifaceted. It can directly influence producers' income, and changes in market prices have a broader impact on global economic conditions [24]. Additionally, inflation undoubtedly leads to rising costs and the total price level rises. In this scenario, the variable *"lnY_Price"* represents the price per riel (kg), found the lowest significance level at 1% in both OLS and stepwise models, providing the strongest evidence among the variables considered that aligns with the impacts of prices on Long Coriander production. The final variable *(" lnY_havest")* of single harvest income is determined by the harvest yield per rai, which is measured in kilograms (kg) per unit of land area, found a significance level of 1% suggests the possibility of a real effect, which is the same as the earlier variable. However, relying solely on income from a single harvest is not enough evidence to assess the true impact. More data in Table 6 from multiple harvests would strengthen the analysis results. Obviously, every step in producing crops needs a starting point. Due to the significant amount of equipment required to supply and support this cultivation process, it became costly. Since these initial costs provide for significant reductions in costs for subsequent cultivation, by having existing equipment and supplies on hand, following harvests will become progressively more profitable [5].

Similar to Table 5, which displayed the results of the logarithmic regression analysis for single harvest income, the following Table 6 demonstrates the results for the same analysis applied to total annual income. Remarkably, every variable with statistical significance in OLS and stepwise models remains equally significant, as indicated by the star symbols that are placed following the corresponding values in the table. Each model examined the effect of the same variable on annual income. The initial variables *"lnm_cheFerti"* and *"lnCul_seed"* represent the costs of chemical fertilizer and biocide, as well as the amount of seed needed to plant one rai of land (seed rate per rai, kg). The costs and the amount of seed discovered had the highest significance level of 10%. According to Long Coriander producers in Battambang, when chemical fertilizer and biocide or the plant seed share raw materials or production processes, a cost increase could affect income. When producers tend to buy them, the price increases due to supplier strategies. However, it is not necessarily proven by a 10% significance level that the cost directly causes the change, while other factors may be influenced as well. Additionally, another variable, *"lnm_energyEng"* of the cost of energy resource and water pump or engine also influences the annual income, and it suggests strong evidence for a real effect with a 5% significance level. As the cost of electricity, gasoline, or other powering fuels increases, higher operational costs are directly incurred. The annual income of producers in general is significantly influenced by the type of energy resource used and the water pump or engine used [18]. Finding ways to save energy and cut costs seems necessary. The following significant variables in terms of *"lnCul_area"* (cultivated land per rai), *"lnY_Price"* (price per riel (kg), and *"lnY_havesYear"* (number of harvests per year) are presumably significant at the 5% level in influencing annual income. In these circumstances, the influence on single harvest income mirrors the effect on annual harvest income; despite this, multiple harvests would increase income as the annual income rapidly rose while supplies and equipment remained affordable [9].

The key influence factors related to the said variables of cultivated land, price, and number of harvests per year are essential not only for producing Long Coriander but also for raising livestock and overall food production. Effectively managing it in accordance with government policies and the market might help producers optimize costs and income. In addition, some cultivated land is rented for growing crops, and market prices significantly impact profitability. More harvests lead to more opportunities to sell produce and generate income. However, the number of harvests producers can achieve in a year is influenced by factors like planting time and climate [27, 11]. This core variability, leading to significant fluctuations in annual income, is a defining characteristic of the agricultural sector.

Table 6. *The Results of Logarithmic Regression Analysis of Total Annual Income.*

Variable	**Definition**	**OLS Model**			**Stepwise Model**		
		Coefficient	**T-value**	**P>T**	**Coefficient**	**T-value**	**P>T**
lnm7	Logarithm of Seed	2.95E-07	1.250	0.221	-	-	-
lnm_othercost	Logarithm Cost of Other Materials (1-6)	1.41E-07	1.030	0.311	-	-	-
lnm_cheFerti	Logarithm Cost of Chemical Fertilizer & Biocide	0.000	1.760	0.086*	0.00000028	1.920	0.062*
lnm_energyEng	Logarithm Cost of Energy Resource & Water Pump/Engine	3.58E-07	2.290	0.028**	0.00000028	2.130	0.039**
lnTota_land	Logarithm of Total of Land (Rai)	5.55E-08	0.540	0.593	-	-	-
lnCul_seed	Logarithm of Seed Rate Per Rai (Kg)	-7.38E-07	-2.050	0.048*	-	-	-
lnCul_area	Logarithm of Cultivate Land (Rai)	-8.03E-07	-3.020	0.005***	-6.31E-07	-3.030	0.004***
lnY_Price	Logarithm of Price Per Riel (Kg)	1.000	1800000	0.000***	1.000000	1900000.0	0.000***
lnY_NplanYear	Logarithm of Number of Plants Per Year	-1.27E-07	-0.360	0.721	-	-	-
lnY_havesYear	Logarithm Number of Harvests Per Year	1.000001	1600000	0.000***	1.000001	1700000.0	0.000***
lnY_havest	Logarithm Harvest Yield Per Rai (Kg)	1.000	3200000	0.000	1.000000	3500000.0	0.000

Variable	Definition	OLS Model			Stepwise Model		
		Coefficient	T-value	P>T	Coefficient	T-value	P>T
lnTranspo	Logarithm of Transportation Cost	1.44E-07	0.720	0.474	-	-	-
lnLabor_total	Logarithm of Total Cost of Labor	-1.9E-07	-1.060	0.295	-	-	-
_cons	Constants	-0.0000137	-2.260	0.030	-0.00000972	-1.910	0.063
No.of obs	Number of Observations	50.0			50.0		
R2	R-squared	1.00			1.00		
Adj R2	Adj R-squared	1.00			1.00		

Note: *10% Significance Level; **5% Significance Level; ***1% Significance Level

4. Conclusions and Recommendations

This study examines the profitability of cultivating Long Coriander for producers in Battambang province, Cambodia. The researchers used two regression analyses, Ordinary Least Squares (OLS) and Stepwise Regression, to identify the statistical significance of various costs and their influence on incomes from both single and annual harvests of Long Coriander. Important factors significantly impacting the potential income from a single harvest of Long Coriander include the cost of chemical fertilizers and biocides, total land area, price per kilogram, and harvest yield per rai. Similarly, factors influencing annual harvest income include the cost of chemical fertilizers and biocides, seeding rate per rai, cost of energy for water pumps or engines, cultivated land area, price per kilogram, and frequency of harvests per year. Based on these findings, the following recommendations would be beneficial for Long Coriander producers and smallholders to research potential income. These recommendations consider enhancing income while preventing significant impacts on harvest yields.

1) The Department of Agriculture should continuously monitor the impact of the agricultural market. Critical areas for assessment include price controls, demand and supply patterns, producers' involvement in markets, and the effectiveness of agricultural policies. By staying informed on these aspects, producers and smallholders can gain a better understanding of how agricultural markets function and make informed choices that will increase economic growth and reduce suffering in the market.
2) Market awareness is crucial and required for agricultural producers. Understanding market conditions and customer preferences enables producers to make informed decisions about crops, harvest times, and sales channels. Gaining this understanding results in higher earnings, lower risks, and being able to adapt to changes in the market while sustaining competitiveness.

The study demonstrates that Long Coriander cultivation can significantly increase income for rural regions. Ultimately, further studies could also provide a deeper understanding of the economic viability of Long Coriander production in Cambodia.

Abbreviations

Approx.	Approximately
Kg	Kilogram
OLS	Ordinary Least Squares
Rai	A Unit of Measurement of Land Area in Cambodia, Equal to 1,600 Square Meters (Approximately 0.40 Acres)
Riels (KHR)	The Official Currency of Cambodia
USD (US Dollar)	The Currency of the United States

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Author Contributions

Siek Darith: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Resources, Software, Writing – original draft, Writing – review & editing

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Conflicts of Interest

The authors declare no conflicts of interest.

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