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The Household Economic Evaluation of Chinese Cabbage Production in the Rainy Season at Lowland Area, Cambodia.

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Abstract: Vegetable production has the highest gross farm margins and return to labor among Cambodia's five top crops, followed by cassava, maize, dry season rice, and wet season rice. The production cost and benefits of the vegetable is vital to understanding the economic viability of a farming system. This information provides the vegetable producers of basis decision making to understand the overall profitability of a farm. The better farming production type will be of great benefit to vegetable producers. This will lead to a better market connection and stable production margin. Chinese cabbage)*Brassica Pekinensis L. Rupr.*(is a popular leafy vegetable of Cambodian farmers and consumers among many kinds of vegetables for their daily food security and income generation. The main object of this research was to "Evaluate the household economic of Chinese cabbage production in the rainy season at lowland area, Cambodia". The research site was conducted in 4 provinces at lowland area of Cambodia including: Kandal, Kampong Cham, Kampong Chhnang, and Svay Rieng Provinces. The research was conducted with 120 Chinese cabbage producers among 3 different production types including: open field (OF), net house (NH), and plastic house (PH) growing conditions. The purposive sampling method was used to select the target provinces and identify total sample size due to there was no exact population on Chinese cabbage producers; and the quota sampling method was used to identify the sample size in each target province and each production type. The collected data was normalized and analyze with Minitab 24.0 to examine all the results. The results of this research during the rainy season were revealed as follows: 1) The production cost of farmer's Chinese cabbage under NH was higher than the production cost of Chinese cabbage under PH and OF growing conditions accounted for 129% and 207%; respectively. 2) The production income of Chinese cabbage under OF condition was lower than the production income of farmer's Chinese cabbage under NH and PH growing conditions accounted for 356% and 377%; respectively. 3) The farmer's production under the plastic house condition could earn net profitable 16,408.27$/ha with ROI=230.25% and EF=330.25% much more than the production under the net house 13,042.68$/ha with ROI=141.88% and EF=241.88%; and the production under open field condition 3.727.47$/ha with ROI=40.88 and EF=140.88% respectively. Consequently, the Chinese cabbage producers should grow their vegetable under the net house or plastic house conditions to increase their productivity during rainy season with more potential market and price to generate their incomes and daily livelihood as the conditions indicated the high enormous profits, return on investment (ROI), and economics efficiency (EF) for vegetable producers.

Index Terms - Chinese cabbage, economic efficiency, return on investment, growing conditions, rainy season.

I. INTRODUCTION

Agriculture plays an important mainstay in Cambodia economic growth, enhances food security, reduces poverty and fosters rural development. In 2021, the share of agriculture in Cambodia's gross domestic product (GDP) was 22.85 %, including the contributions of fishery at approximately 5.5 percent, livestock at 2.6 %, forestry at 1.6 %, and crops at about 13 percent [1]. A wide variety of vegetables was cultivated across the country, including leafy, stem, and fruit-bearing, root, bulb, and tuberous, leguminous green vegetables, etc. Fruit-bearing vegetables were planted on 35,000 ha; leafy and stem vegetables on almost 6,000 ha. Vegetables are increasingly recognized as essential for food and nutrition security. Vegetable production is a key component of farm diversification strategies to provide a promising economic opportunity for reducing rural poverty and unemployment in developing countries [2]. Among Cambodia's five top crops, vegetable production has the highest gross farm margins and return to labor, followed by cassava, maize, dry season rice, and wet season rice [3]. Even vegetable production results in a higher profitability, but less than 1.5% of the total cultivated land is in vegetables and the trend for expansion is low [3,4].

Although the major occupation of the Cambodians is agriculture, the country is a net agricultural importer with vegetable imports worth approximately USD 200 million annually [5]. The heavy reliance on neighboring countries on vegetables is associated with the highly seasonal productions of Cambodian producers lasting for around only three months from late December to late March. The period is appropriate for vegetable production as the weather is relatively mild and dry [6]. Moreover, farmers are free from rice production and some of them opt to produce vegetables for additional income, causing the volume of vegetables to reach a peak while the price falls to the lowest one [7]. After the period, water becomes scarce and the soil becomes too dry whereas the wet season faces the problem of too much rainfall, causing waterlogging, high pests, and diseases [6]. The discontinuous supply of vegetables at stable volume has caused vegetable value chain to break and loss of competitiveness to the neighboring

countries, namely Vietnam and Thailand. It is reported that local capacity for vegetable production could supply approximately 45% of the market demand and 70% is in the peak period of the production [8].

Chinese cabbage *(Brassica Pekinensis L. Rupr.)* is annually grown as a salad crop. It is indigenous to China and eastern Asia, where it has been in cultivation since the fifth century. Two more or less distinct species of Chinese cabbage are grown. The leaves are long, dark green, and oblong or oval, and they do not form a solid head. It is also called Chinese mustard [9]. Chinese cabbage *(Brassica Pekinensis L. Rupr.)* is a popular leafy vegetable of Cambodian producers and consumers among many kinds of vegetables for their daily food security and income generation [10]. Determining the Cost of Production (CoP) is vital to understanding the economic viability of a farming system. The CoP is defined as being the total cost to produce a unit of a given product. This information provides the basis to understanding the overall profitability of a farm and where changes need to be made to increase it. Profitability is calculated by determining all costs related with production and then deducting them from the price received. The CoP will be used for decision making tasks on farm [11].

Hence, "The household economic evaluation of Chinese cabbage production in the rainy season at lowland area, Cambodia" is essential in determining the better farming production types, which will be of great benefit to vegetable producers in terms of productivity and profitability. This will lead to a better market connection and production margin which is stable in income generation and daily livelihood.

II. RESEARCH METHODOLOGY

2.1 Observation Site

The research was conducted in 4 lowland provinces of Cambodia including: Kandal, Kampong Cham, Kampong Chhnang, and Svay Rieng Provinces (fig.1). The research was observed from August to November 2022 with 120 Chinese cabbage producers in the 3 different production types (40 producers in each condition) including: Open Field (OF), Net House (NH), and Plastic House (PH) growing conditions.

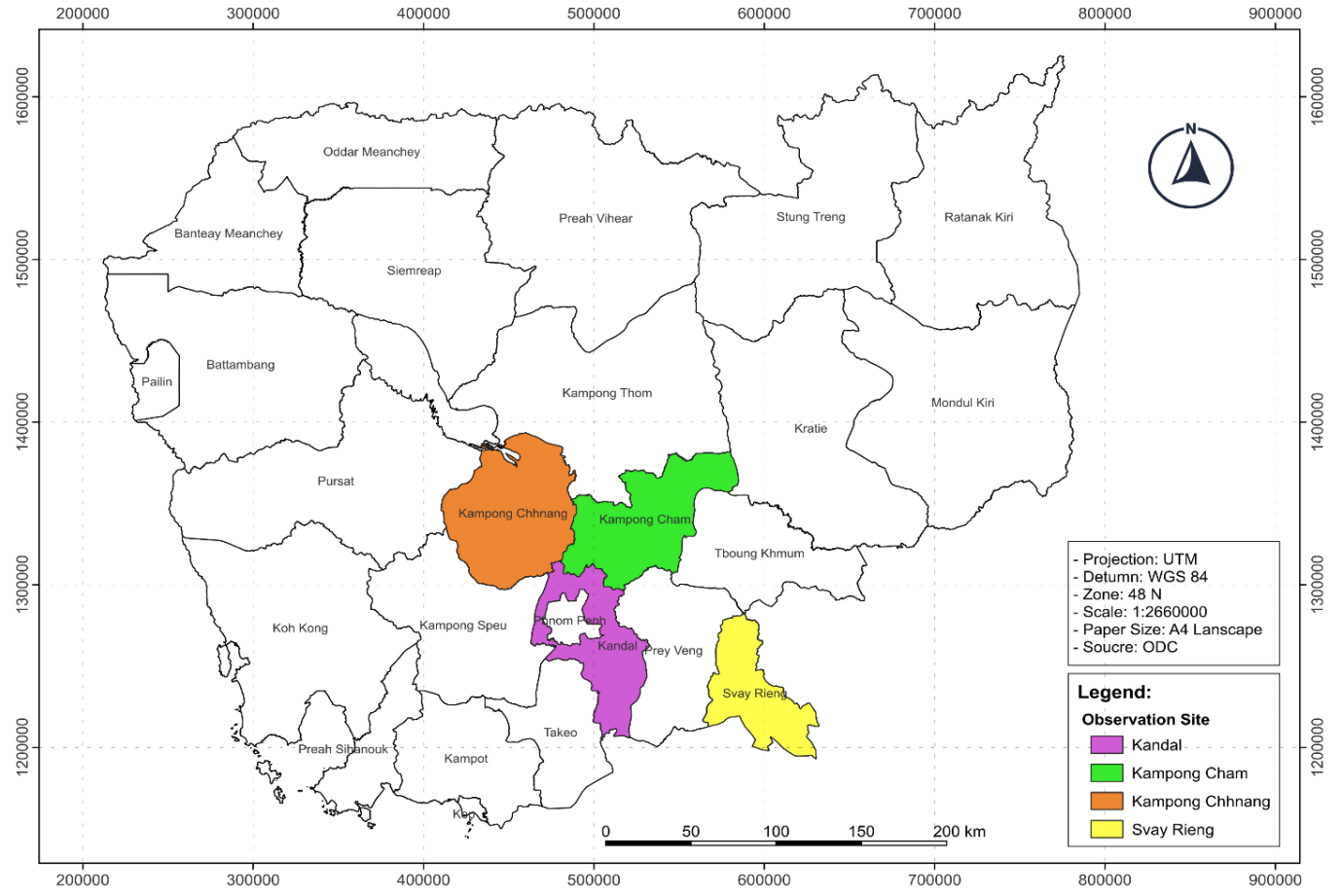

Fig. 1: Map of target provinces.

2.2 Data Collection

The purposive sampling method was used to select the target provinces and determine the total sample size, since there is no exact population on Chinese cabbage producers; and the quota sampling method was used to determine the sample size in each target province and each production type. The semie structure interview and key individual interview were used with Chinese cabbage producers to collect the data including: the household demographics, farm size, fix cost, variable cost, and income at the farm gate of the Chinese cabbage production.

2.3 Data Analyses

The collected data was normalized and analysed with Minitab 24.0 to examine the frequency, percentage, and mean comparisons; while the Ms. Excel program was used to analyse the return on investment (ROI) and the economic efficiency (EF) of the Chinese cabbage production. The equations are as follows:

$\text{ROI}\ (\%) = (\text{Outputs} - \text{Inputs}) \div \text{Inputs} * 100$ [12].

$\text{EF}\ (\%) = \text{Amount Returned} \div \text{Amount Invested} * 100$ [13]

III. RESULTS AND DISCUSSION

Table 1. The production cost of Chinese cabbage per cycle

Item	Production cost in a cycle per family ($)			Production cost in a cycle per hectare ($)		
Growing Condition	OF	NH	PH	OF	NH	PH
Variable Cost	454.47	213.87	114.48	3,757.89	4,687.31	3,270.99
Fix Cost	47.47	143.17	101.84	554.82	4,249.84	3,659.31
Total Cost	501.94	357.04	216.32	4,312.71	8,937.15	6,930.30

As the above result (table 1), it found that the most production cost per cycle of Chinese cabbage was 8,937.15 $/ha for NH condition, followed by 6,930.30 $/ha and 4,312.71 $/ha for PH and OF conditions; respectively. This would be interpreted that the production cost of Chinese cabbage under NH was higher than the production cost of Chinese cabbage under PH and OF growing conditions accounted for 130% and 210%; respectively. The cost of Chinese cabbage production per cycle as reported in a research project on "Chinese Cabbage Production Under Net House Condition in Takeo Province" by the Agricultural and Rural Development Bank (ARDB) was 121.78$/240m^2 (approximately 5,074.17 $/ha) [14]. Another study (Duong Ngoc Thanh, et al., 2023) also reported that the cost of Chinese cabbage production was 7.95 million VDN/1,000m^2 (approximately 3,275 $/ha) and 9.78 million VDN/1,000m^2 (approximately 4,028.80 $/ha) for in-side the net house and out-side the net house in Vietnam; respectively [15]. These results were lower than the finding in the table 1 for both OF and NH growing conditions. This would be translated that the Cambodia farmer's expenditure including depreciation of fix cost and variable cost such as the expense on inputs, net or plastic house structure, labor, and so on were more expensive than the previous years as of the economic inflation and more expensive than the other countries as they could produce by their own countries.

Table 2. The production income of Chinese cabbage per cycle

Item	Income per production cycle ($/family)			Income per production cycle ($//ha)		
Growing Condition	OF	NH	PH	OF	NH	PH
Rainy Season	594.47	970.74	845.12	6,075.86	21,617.34	22,887.43
Dry Season	1,015.40	844.90	881.47	9,057.73	20,905.50	23,949.25

As in the table 2, the results in the rainy season revealed the most production income per cycle of Chinese cabbage was 22,887.43 $/ha for PH condition, followed by 21,617.34 $/ha and 6,075.86 $/ha for PH and OF growing conditions; respectively. This would be presented that the production income of Chinese cabbage under OF condition was lower than the production income of farmer's Chinese cabbage under NH and PH growing conditions accounted for 356% and 377%; respectively. The production income of farmer's Chinese cabbage under OF condition in the rainy season was much lower than the one in the dry season, while the production income under the NH and PH growing conditions were almost the same for both rainy season and dry season since there were more stable productivity and price. There was a study by Duong Ngoc Thanh, et al., 2023 reported that the revenue of Chinese cabbage production was 10.36 million VDN/1,000m^2 (approximately 4,273.60 $/ha) and 16.33 million VDN/1,000m^2 (approximately 6,736.20 $/ha) for out-side the net house and in-side the net house in Vietnam; respectively [15]. These results were still much lower than the finding in the above table. Furthermore, the revenue of Chinese cabbage production in the net house compared to that outside the net house was 1.6 times higher [15]. This result was still lower than the finding in the above table for both OF and NH growing conditions. The reason was because of the Chinese cabbage unit price in Vietnam was lower than the unit price in Cambodia with accounted for 0.27 $/kg and 0.30 $/kg only for out-side the net house and in-side the net house vegetable respectively in Vietnam.

Table 3. The production profitability of Chinese cabbage per cycle

Net profit in a production cycle per family						
Growing Condition	OF		NH		PH	
Variable	Net profit ($)	N)%(	Net profit ($)	N)%(	Net profit ($)	N)%(
Rainy Season	298.03	72.50	629.72	97.50	645.77	97.50
Dry Season	657.27	82.50	487.86	100.00	665.15	100.00
Net profit in a production cycle per hectare						
Rainy Season	3,727.18	72.50	13,042.68	97.50	16,408.27	97.50
Dry Season	6,290.10	82.50	11,968.35	100.00	17,063.86	100.00

Return on investment and economic efficiency in a production cycle per hectare						
Growing Condition	OF		NH		PH	
Variable	ROI (%)	EF (%)	ROI (%)	EF (%)	ROI (%)	EF (%)
Rainy Season	40.88	140.88	141.88	241.88	230.25	330.25
Dry Season	110.02	210.02	133.92	233.92	245.57	345.57

As the analytical results of production cost and income, the better net profit (table 3) was 16,408.27 $/ha for PH condition, followed by 13,042.68 $/ha and 3,727.18 $/ha for NH and OF growing conditions; respectively. With these results, it would be illustrated that the net profit of Chinese cabbage production under OF condition was lower than the net profit of Chinese cabbage production under NH and PH growing conditions accounted for 350% and 440%; respectively. In the meanwhile, the better return on investment (ROI) and economic efficiency (EF) were: 1) ROI: 230.25% for PH condition, followed by 141.88% and 40.88% for NH and OF conditions respectively; and 2) EF: 330.25% for PH condition in comparing with 241.88% and 140.88% for NH and OF conditions respectively. The profit was considered the most important factor in analyzing the financial efficiency of the Chinese cabbage growing conditions. The economics analytical results could be presented with the positive improvement on the net profits of the Chinese cabbage production; and make well increase of 250% and 340% for NH and PH in comparing with OF growing condition; respectively. The Agricultural and Rural Development Bank (ARDB) reported in the research project on "Chinese Cabbage Production Under Net House Condition in Takeo Province" that the net profit of Chinese cabbage production was 623.43$/240m2 (approximately 25,976.04 $/ha) [14]. This result was still 1.6 times and 2 times higher profit for PH and NH growing conditions since the result found at the rainy season with lower productivity. There was another study reported that the average profit of households in the net house was 2.7 times higher than that of the household outside the net house [15]. Similarly, the finding result was higher 3.5 times and 4.4 times for NH and PH in comparing with OF growing condition; respectively. In addition, a report from the National Institute of Statistics showed that Cambodia harvested area of vegetable was about 57.300 ha in 2019 [16], this would be translated into approximately contribution of $534 million and $727 million with the application of NH and PH growing conditions at least during the wet season.

IV. CONCLUSIONS

The net house (NH) or plastic house (PH) growing conditions indicated high enormous profits, return on investment, and economic efficiency for long term vegetable producers. Consequently, the vegetable producers should grow their vegetables under the net house (NH) or plastic house (PH) to increase the productivity with more potential output price at rainy season to generate their daily incomes and livelihoods. The government should promote more vegetable production under the net house (NH) or plastic house (PH) growing conditions with less production cost and better outputs price viz: 1) Encourage private sector to invest on locally made of inputs, structure and accessory; 2) Promote agricultural loan with lower interest rate and favorable condition; and 3) Coordinate with contracted buyers and farmers to ensure better stable price.

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