THE IMPACT OF FARMER GROUP MEMBERSHIP ON REVENUES, COSTS, AND INCOME GENERATED FROM CAYENNE PEPPER FARMING IN INDONESIA

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ABSTRACT

Cayenne pepper, a national strategic commodity, has fluctuating prices and production risks. As a result, the income of cayenne pepper farmers fluctuates. Farmer groups that function as learning classes, work platforms, and production units for farmers make few of the many efforts to deal with this issue. This study aims to (1) analyze the revenue, cost structure, and income of cayenne pepper farming among farmer group members and non-farmer group members in Indonesia, and (2) analyze the impact of farmer group membership on revenue and cost structure, and cayenne pepper farming income. The data used were secondary data from the 2014 Horticultural Crop Household Survey, with a total of 18.049 households. Data processing was performed qualitatively and quantitatively. Qualitative data analysis was performed using descriptive and quantitative methods using propensity score matching (PSM). The study results showed that farmers who are farmer group members have higher revenues, costs, and incomes than farmers who are not. Farmer groups membership impact on higher costs as well as significant positive effect towards farmer's revenueion and income.

Keywords: *cayenne pepper, farmer group, farmer's income, propensity score matching*

BACKGROUND

Cayenne pepper (*Capsicum frutescens L.*) is an essential commodity for national development in Indonesia. Cayenne peppers significantly contributed to inflation in Indonesia, the largest contribution was in December 2021 (BPS, 2022). In 2022, cayenne pepper production reached 1.54 million tons, and the demand for cayenne pepper from consumption in the national household sector reached 569.65 thousand tons. Household sector contributed to 75.77% of the total Indonesia's consumption of cayenne pepper in 2022 (BPS, 2023). Factors influencing cayenne pepper farming in Indonesia include land area, production costs, and rainfall. Climate also plays a role, with cayenne pepper primarily planted during the dry season and harvested mid-year, causing price increases at the beginning and end of the year (Ba'isyah et al., 2024). Maintaining the stability of cayenne pepper production is vital in determining the continuity of national development.

The fluctuating supply and demand of cayenne pepper in Indonesia results in market price instability. The price of cayenne pepper can soar high and fall sharply over a short period. Therefore, cayenne pepper is classified as a volatile food source (Mandarsari et al., 2020; Muflikh et al., 2021). The instability of cayenne pepper prices is an important issue affecting cayenne pepper value chain actors in Indonesia, especially farmers (Muflikh et al., 2021). Price instability

of cayenne peppers is influenced by high volatility at producer and extreme volatility at consumer levels, with spillover effects between the two, impacting market stabilization efforts (Mandarsari et al., 2020). Hence, an appropriate strategy is needed to maintain the stability of cayenne pepper stocks to maintain price stability.

Cayenne peppers have fluctuating production characteristics and prices. Fluctuations in the price of cayenne pepper in 2021 have a coefficient of variation (CV) of 31% (BPS, 2022). Price fluctuations of cayenne pepper in the market indicate that cayenne pepper farmers deal with selling price risk (Himawan & Puryantoro, 2019). Cayenne pepper marketing in Indonesia has long and complex channels (Muflikh et al., 2021). Production limitations are also a risk factor for cayenne pepper farmers. According to BPS (2022), Cayenne pepper production in Indonesia in 2021 has a coefficient of variation (CV) of 11%, indicating that cayenne pepper production fluctuates. Therefore, in addition to facing risks regarding the selling price of cayenne pepper, farmers also deal with production risks (Amin & Prihantini, 2021).

The input variables influence cayenne pepper production in the form of land area, seeds, organic fertilizer, inorganic fertilizer, pesticides, and number of workers (Sari et al., 2019). Cayenne pepper farmers require a significant amount of capital to provide sufficient production inputs. Meanwhile, agriculture in Indonesia is dominated by small-scale businesses with land holdings <0.50 ha (small farmers). The number of smallholder farming households in Indonesia increased by 10.95% from 2013 to 2018 (BPS, 2019). According to recommendations for farming businesses, most farmers need more capital to meet their input needs. One way to obtain farming inputs is by requesting production input assistance from the government. The production inputs distributed by the government include seeds, fertilizers, pesticides, and several agricultural tools and machines (Aslidayanti, 2019). Receiving government assistance requires the formation of legal farming groups (poktan) (Government Regulation, 2020). Membership in a farmer group can make it easier for cayenne pepper farmers to obtain subsidies for farming inputs.

Indonesia's number of farmer groups has experienced a positive trend. As of December 2020, there were 646,293 farmer groups in Indonesia with 15,688,685 members. The number of farmer groups in 2020 increased by 21.65% in 2016 (BPPSDMP, 2020). Farmer groups function as forums for learning, cooperation, and exchanging information to solve problems in farming (Constitution of the Republic of Indonesia, 2013). Farmer groups have the potential to help overcome various problems in the agricultural sector, including cayenne pepper farming. Farmer groups serve as invaluable resources and active participants in shaping the future of agriculture. Farmer groups are essential in farming management, such as tasks division, fostering innovation, and enhanced farming processes despite challenges like weather and inadequate facilities (Aremu, 2019; Gumelar et al., 2023; Nelvi et al., 2023). Farmer groups enhances resource access, providing inputs, equipment, and better crop prices through collective marketing, ultimately improving livelihoods (Othman et al., 2020). By working together to solve problems and maximize their potential, farmer groups become crucial of long-term agricultural progress and overall rural improvement.

The fluctuating production and market prices of cayenne pepper create substantial difficulties for Indonesian farmers. Farmer groups offer promise as a remedy, therefore this study tried to discover empirical evidence of the differences in cayenne pepper farming between farmers joining farmer groups and those who are not associated with it. This research seeks to (1) analyze

the revenue, cost structure, and income of cayenne pepper farming among farmer group members and non-farmer group members in Indonesia, and (2) analyze the impact of farmer group membership on revenue, cost structure, and income.

RESEARCH METHODS

This study used secondary dataset from Indonesia's 2014 Horticultural Crop Business Household Survey conducted by Statistics Indonesia (BPS). It focused on cross-sectional data from cayenne pepper farms, comparing those organized into farmer groups with those that are not. The number of data processed was 18,049. The obtained data were processed both qualitatively and quantitatively. Qualitative analysis used descriptive statistical methods to explain the general picture of the characteristics of cayenne pepper farming actors, both members of farmer groups and those who are not, and quantitative analysis used farming performance analysis and Propensity Score Matching (PSM). Farming revenue should cover the costs of production and management. To determine farming income, it's essential to first understand both the costs and the revenues. The farming revenue is written in the form of a mathematical equation as follows (Soekartawi, 1995).

$$TR = Y \ x \ Py$$

Information:
TR   : Farming total revenue (Rp)
Y   : Farming production (Kg)
Py   : Farming selling price (Rp)

The costs used in this study are economic costs, namely, costs that include cash costs and calculated (non-cash) costs. Cash costs of farming are the amount of money used to purchase goods and services to run the farming business, whereas the calculated costs are the resources used, but their use is not calculated or paid for using cash (Hernanto, 2018). The formula used to obtain the total cost is as follows.

$$TC = \ BT + BD$$

Information:
TC   : Farming total costs (Rp)
BT   : Farming cash costs (Rp)
BD   : Farming calculated costs (Rp)

The analysis of farming income shows the remuneration obtained from production factors used in farming production, and (Soekartawi et al., 1986) the calculation used in this research is shown in Table 1.

Table 1. Farming Income Analysis

No.	Description	Calculation
1	Cash revenue	Price x harvest sold (Kg)
2	Calculated revenue	Price x harvest consumed or storaged (Kg)
3	Gross farm income	Total revenues (cash and calculated revenues)
4	Cash costs	a. Production facilities costs b. Non-family labor costs c. Rental costs d. Loan interest, taxes, and levies
5	Calculated costs	a. Family labor costs b. Depreciation costs c. Own land rental costs
6	Total farm expense	Cash costs (non interest) / Calculated costs (non family labor costs)
7	Income from cash costs	(1)-(4)
8	Net farm income	(3)-(6)
9	Net farm earning	(8)-loan interest

Source: Soekartawi et al. (1986)

As generally assumed, farmers join groups because they anticipate advantages generated from the membership. Theoretically, even a minor benefit could encourage participation. However, these potential benefits are intangible and could not be directly measured. Instead, we observed actual farmer group membership and used statistical methods to infer these unobservable benefits variables based on measurable factors.

$$G_i^* = \beta Z_i + \varepsilon_i, G_i = 1 \mid G_i * > 0 \mid$$

G_i was employed to denote farmer group participation, where 1 signified membership and 0 indicated non-membership. The model included an error term, ε_i, assumed to be normally distributed with a mean of zero and variance of σ². A vector of observable variables, Z_i, was incorporated to capture factors influencing the decision to join a farmer group, with their corresponding coefficients represented by β. F was the cumulative distribution function for ε_i. The likelihood of a farmer joining a group was defined as follows.

$$P_r(G_i = 1) = P_r(G_i^* > 0) = P_r(\varepsilon_i > -Z_i\beta) = 1 - F(-Z_i\beta)$$

This study examines the differences in total costs, total revenues, and income between cayenne pepper farmers who are members of farmer groups and those who are not. Following established methodologies (Abdul-Rahaman & Abdulai, 2018; Baga et al., 2023; Olagunju et al., 2021), this study employed Propensity Score Matching (PSM) to address potential selection bias. PSM is a technique that creates comparable groups by matching treated and untreated units based on similar characteristics. Its core principle involves estimating the average treatment effect by comparing matched pairs. In this study, PSM was utilized to assess the impact of farmer group membership on cayenne pepper production. As highlighted by previous research by Mojo et al. (2017), applying PSM requires careful consideration of underlying assumptions.

The unconfoundedness assumed that once observable covariates are controlled, whether a farmer joined a group were independent of the treatment assignment. This assumption indicated that participating in a farmer group depends on observable characteristics. Additionally, it was assumed that for any given set of observable characteristics, there was a possibility for a farmer to both join or not join a group. Lastly, the study ensured that after matching, farmers in the group (treated) and non-group (untreated) had similar observable characteristics. This confirms that farmer group membership was independent of unit characteristics after conditioning on Z.

PSM method involves multiple steps (Farida et al., 2016; Prasada et al., 2022). The first step was the division of the observation group; the data were divided into treatment and control groups. This method describes the relationship between the dependent and independent variables, which are categorical, continuous, or a combination of both. The types of variables used are based on demographic and socioeconomic groups (Baga et al., 2023; Khandker et al., 2010; Mojo et al., 2017; Olagunju et al., 2021). This study employed several demographic and farm-related factors, including age, education, gender, land area, and others, as detailed in Tabel 2 to investigate variable that impact on cayenne pepper farming performance.

Table 2. Variable Impact of Farmer Group Membership on Cayenne Pepper Farming Performance

Code	Variable	Unit
Total costs	Total cost outcome	Rp/ha
Revenue	Total revenue outcome	Rp/ha
Price	Price outcome	Rp/ha
Income	Cayenne pepper farming income outcome	Rp/ha
Farmers group	Membership of farmer groups	1 (yes) and (0) no
Age	Farmer age	Year
Education	Farmer education level	1 (completed primary school) and 0 (not completed primary school)
Gender	Farmer gender	1 (male) and (0) female
Location	Location of cayenne pepper farming	1 (Java island) and (0) (outside Java island)
Land area	Land area of cayenne pepper farming	Ha
Land status	Land ownership status	(1) own dan (0) not own
Partnership	Farmer partnership	1 (yes) and (0) no
Assistance	Business assistance	1 (yes) and (0) no
Seed	Seed source	1 (purchase), 0 (not purchase)
Credit	Use of credit for farming	1 (yes) and (0) no
Tools machinery	Use of agricultural tools and machinery for farming	1 (yes) and (0) no

The second step is to choose a matching algorithm, namely, to compare observations from the treatment and control groups based on their propensity values with an appropriate matching method. In this study, the matching method was Nearest Neighbor Matching (NNM). The third step was to look at the overlap and joint support between the treatment and control groups when compared by looking at both distributions. Mathematically, the propensity score matching can be calculated using the formula:

$$ATT = \varepsilon(R1|G = 1) - \varepsilon(R0|G = 0)$$

$$ATT = \varepsilon\{R1|G = 1, p(Z)\} - \varepsilon\{R0|G = 0, p(Z)\}$$

The average treatment effect for the treated group (ATT) represents the overall policy impact on respondents. The study utilized a treatment group indicator (G=1) and a control group (G =0) to differentiate between those joined farmer group membership and who are not. Outcome values for control and treatment groups were denoted as R0 and R1, respectively. The propensity score, p(Z), was calculated using a logit model. Observation values that were too high and too low were removed from the equation. Differences in outcome variables were obtained from the differences in the averages of the treatment and control groups. The treatment provided is reflected in the treatment of the treated individuals (Rosenbaum & Rubin, 1984).

RESULT AND DISCUSSION

Analysis of Costs, Revenues, and Income from Cayenne Pepper Farming in Indonesia

There are significant differences in the average revenues, costs, and income of cayenne pepper farming in Indonesia between farmers who are members of farmer groups and those who are not. The average income, total costs, and farming income of the group of farmers who are members of the farmer group are greater than those of the group of farmers who are not.

Table 3. Cost Structure for Cayenne Pepper Farming in Indonesia per Hectare in Thousand Rupiah

Cost component	Cayenne Pepper Farmers		Farmer groups members		Not farmer groups members	
	Mean	%	Mean	%	Mean	%
Cash costs	32,488.23	87.72	33,742.16	87.48	32,259.73	87.76
Seed	1,729.49	5.32	1,566.13	4.64	1,759.25	5.45
Fertilizer	4,475.51	13.78	4,656.10	13.80	4,442.60	13.77
ZPT	174.58	0.54	215.14	0.64	167.19	0.52
ZPB	335.94	1.03	502.53	1.49	305.58	0.95
Pesticide	1,533.81	4.72	1,738.21	5.15	1,496.57	4.64
Fuel oil	323.38	1.00	303.58	0.90	326.99	1.01
Electricity	36.04	0.11	54.75	0.16	32.63	0.10
Protection net	66.90	0.21	120.80	0.36	57.08	0.18
Mulch	775.23	2.39	842.25	2.50	763.02	2.37
Labor	20,218.16	62.23	20,751.18	61.50	20,121.03	62.37
Agricultural Services	592.56	1.82	530.53	1.57	603.87	1.87
Land lease	725.34	2.23	693.50	2.06	731.14	2.27
Equipment Rental	76.12	0.23	84.51	0.25	74.59	0.23
Loans with interest	154.12	0.47	243.59	0.72	137.81	0.43
Indirect taxes	355.86	1.10	369.48	1.10	353.37	1.10
Retribution	36.10	0.11	47.59	0.14	34.00	0.11
Other	879.10	271	1,022.27	3.03	853.01	2.64

Non-Cash Costs	4,548.58	12.28	4,829.78	12.52	4,497.33	12.24
Own land	3,668.55	80.65	3,855.24	79.82	3,634.52	80.82
Own equipment	647.90	14.24	737.81	15.28	631.52	14.04
Depreciation of capital goods	232.13	5.10	236.74	4.90	231.29	5.14
Total Costs	37,036.81	100	38,571.94	100	36,757.06	100

Table 3 shows that the average cost by cayenne pepper farmers in Indonesia is Rp 5,315,700. Descriptive results show that farmers who are members of farmer groups spend an average of Rp 5,546,000, and farmers who are not members of farmer groups spend an average of Rp 5,273,900. The expenses by farmer group members align with the more significant percentage of farmers who receive credit. The costs by farmers include cash and noncash costs. Cash costs consist of seeds, fertilizer, growth regulators (ZPT), fruit stimulants (ZPB), pesticides, fuel, electricity, protection netting, mulch, labor, agricultural services, land rental, machine tool rental, loans, taxes, levies, and other costs, such as containers, polybags, stakes, ropes, and water. Non-cash costs consist of costs when renting one's own land, machine tools, and investment depreciation costs. The cost structure of cayenne pepper farmers in Indonesia per hectare is shown in Table 3.

The percentage of cash costs by cayenne pepper farmers in Indonesia was greater than the percentage of non-cash costs (Table 3). Cayenne pepper farmers who are members of farmer groups have cash costs of 87.48% and non-cash costs of 12.52%. Meanwhile, cayenne pepper farmers who were not members of farmer groups had a cash cost percentage of 87.76% and a non-cash cost percentage of 12.24%. The most significant cash cost components in cayenne pepper farming in Indonesia (in order of the largest) are the costs of labor, fertilizer, seeds, and pesticides. This aligns with previous studies (Jono, 2023) showing that the most significant cash costs of cayenne pepper farming are labor, fertilizer, pesticides, and seeds.

The non-cash costs of cayenne pepper farming in Indonesia are 12.28% and 12.52% for the group of farmers who are members of the farmer group and 12.24% for the group of farmers who are not. The most significant non-cash cost component in Indonesian cayenne pepper farming is renting one's own land, which is 80.65% of the total non-cash costs of cayenne pepper farming in Indonesia. Non-cash land rental costs were more significant than cash land rental costs (Table 3). This can encourage farmers to use their land, because working on their own land is more economically profitable (Hendrisetiawan, 2022).

Table 4. Revenue from Cayenne Pepper Farming in Indonesia per Hectare in Thousand Rupiah

Revenue Component	Cayenne Pepper Farmers		Farmer groups members		Not farmer groups members	
	Mean	**%**	**Mean**	**%**	**Mean**	**%**
Cash revenues	64011.74	99.64	67995.27	99.53	63285.85	99.66
Non-cash revenues	233.75	0.36	321.93	0.47	217.68	0.34
Total revenues	64245.49	100	68317.20	100	63503.53	100

Table 4 shows that Indonesia's average income of cayenne pepper farmers is Rp 64,011,740. If we look at farmer group membership, farmers who are members of farmer groups receive an average income of Rp 67,995,270. In contrast, farmers not members of farmer groups receive an

average income of Rp 63,285,850. Then, a comparison of the revenues of farmer group members and non-farmer group members per hectare can be seen in Table 4. The average total income of farmer group members is Rp 68,317,200 per hectare, while that of non-farmer group members is Rp 63,503,530. The average cash revenue of farmer group members is Rp 67,995,270 per hectare, which is 99.53% of the total revenues of farmer group members. Meanwhile, non-members of farmer groups have an average cash revenue of Rp 63,285,550 per hectare, and 99.66% of the total revenues are from non-member farmer groups. Based on this, the average income from cayenne pepper farming in Indonesia among farmers who are members of farming groups is greater than that of farmers who are not. Income is obtained by subtracting costs from revenues. The average income of cayenne pepper farmers in Indonesia was Rp 27,208,680. If we look at the membership of the farmer group, the average income of the group of farmers who are members of the farmer group is Rp 29,745,260 and the income of the group of farmers who are not members of the farmer group is Rp 26,746,480 (Table 5). The average income of farmers who are members of farmer groups is greater than that of those who are not.

Table 5. Cayenne Pepper Farming Income in Indonesia per Hectare in Thousand Rupiah

Component	Cayenne Pepper Farmers	Farmer Groups Members	Not Farmer Groups Members
Cash costs	32,488.23	33,742.16	32,259.73
Non-cash costs	4,548.58	4,829.78	4,497.33
Total farm expenses	37,036.81	38,571.94	36,757.06
Cash revenues	64,011.74	67,995.27	63,285.85
Non-cash revenues	233.75	321.93	217.68
Gross farm income	64,245.49	68,317.20	63,503.53
Net farm earnings	27,208.68	29,745.26	26,746.48
R/C on cash costs	1.98	2.02	1.97
R/C on total cost	1.73	1.77	1.73

In Table 5, we observe the income from cayenne pepper farming in Indonesia and compare the income of members of farmer groups and those who are not. It can be concluded that cayenne pepper farming is worth running, judging from the R/C ratio values above 1. In addition, members of farmer groups have higher incomes than those who are not members of farmer groups.

The Impact of Farmer Group Membership on Cayenne Pepper Farming Income in Indonesia

The revenue obtained from farming is reused as production capital in the subsequent period. Table 6 shows that farmer group membership significantly affects revenue from cayenne pepper farming in Indonesia. Based on data processing with the PSM model, the results of the t-statistic value are positive and significant at the real level $\alpha = 5\%$, namely 2.48 (T-stat> 1.96). Farmers who are members of farmer groups receive Rp 11,622,040, and farmers who are not members of farmer groups receive Rp 10,110,290; therefore, the difference between the treated and control groups is Rp 1,511,750. Based on these results, farmer group membership increases farming revenue.

Table 6. Cayenne Pepper Farming Income in Indonesia Per Hectare in Thousand Rupiah

Variable	Sample	Farmer Groups Members	Not Farmer Groups Members	Difference	S.E.	t-stat
Revenue	Unmatched	11,622.04	10,335.83	1,286.21	401.73	3.2***
	ATT	11,622.04	10,110.29	1,511.75	608.68	2.48**
Total cost	Unmatched	5,545.53	5,273.86	271.67	115.85	2.34**
	ATT	5,545.53	5,432.12	113.42	173.13	0.66
Income	Unmatched	6,076.50	5,061.97	1,014.54	338.28	3***
	ATT	6,076.50	4,678.17	1,398.33	515.93	2.71***

Note: * α=10%, |t| ≥ 1,65
        ** α=5%, |t| ≥ 1,96
        *** α=1%, |t| ≥ 2,58

These results align with several previous studies that show that farmers who are members of farmer groups receive higher revenue than farmers who are not (Prasetyo et al., 2023). The increase in revenue from cayenne pepper farming can be attributed to farming inputs used in production activities. Farmers who are members of farmer groups have a more comprehensive range of access to meet production input needs that were previously unaffordable for several reasons, such as a lack of capital and information. This increases the production input, which can be observed from the higher production costs. Additionally, increased revenue can be caused by the technology used to make the production process more efficient and effective. This statement is consistent with the results of previous research that farmer membership and participation in associations can facilitate access to higher quality inputs, such as pesticides, superior variety seeds, irrigation facilities, and fertilizer (Olagunju et al., 2021; Wossen et al., 2017). Membership in farmer groups facilitates access so that there is an increase in farming inputs, farming productivity, and the amount of production, and farmer income will ultimately increase. (Olagunju et al., 2021)

The results of this study indicate that while farmer group membership has a positive influence on farming costs, this effect is not statistically significant. This is evident in the t-statistic value of 0.66 for the ATT of the cost variable, which does not meet the significance threshold (Table 6). Cayenne pepper farmers who are members of farmer groups have an average total costs of Rp 5,545,533, compared to Rp 5,432,120 for non-members. Thus, member farmers, on average, spend Rp 113,420 more than non-member farmers. The largest components of total cayenne pepper farming costs are labor wages, fertilizers, and pesticides (Khan et al., 2017; Subastian & Yuliawati, 2024). These findings align with those of Wossen et al. (2017) and Olagunju et al. (2021) which showed that farmer group members production costs are higher than farmers who are not member. This is attributed to an increased use of inputs in farming activities. Based on these results, it can be concluded that farmer group membership positively impacts the production costs of cayenne pepper farming. Consequently, farmers can leverage farmer organizations such as groups to optimize the use of agricultural inputs

Farmers' income influences the use and selection of farming inputs. The greater the farmer's income, the greater the choice to use better inputs or adopt new technology to increase the productivity of the farming business. The results show that farmer group membership significantly positively influences farming income at the actual level of α=5%, namely 2.71 (T-stat>1.96). This

aligns with several studies that show that group membership increases farming income and improves farmers' social welfare (Hoken & Su, 2018; Kumar et al., 2018; Michalek et al., 2018). In this study, cayenne pepper farmers who were members of farmer groups had an average income seen from ATT income, namely Rp 6,076,509, and farmers who were not members of farmer groups had an average income of Rp 4,678,170. The average difference in income between farmers who are members of the farmer group and those who are not members of the farmer group is Rp 1,398,330. Based on the results of this research, farmer group membership has a significant positive impact on the production costs by cayenne pepper farming.

CONCLUSION AND SUGGESTION

Based on research results, it can be concluded that the average cayenne pepper farming income of farmer groups in Indonesia is higher than the average cayenne pepper farming income of non-farmer group members. Membership among farmer groups has a positive and significant impact on increasing revenue from cayenne pepper farming in Indonesia. The total costs for farmer group members are greater, but not significant, because of the additional input. Membership in farmer groups has a positive and significant impact on increasing the income from cayenne pepper farming in Indonesia. Therefore, there is a need for government regulations that promote partnerships among agricultural stakeholders and for the expansion of agricultural extension services. Farming actors should utilize agricultural institutions, such as farmer groups, to increase farming production, especially regarding access to inputs and information.

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