Comparative Risk and Income Analysis of Cultivation of Cayenne Pepper and Large Chilli in East Lombok District

[*1]Fitri Puji Purnamasari., [2]Muhamad Siddik., [3]IGL Parta Tanaya, [4]Suparmin

[1]Student of Master Programme in Agribusiness, Master of Agribusiness Study Programme, Faculty of Agriculture, Mataram University

[2]Main supervisor, Master of Agribusiness Study Programme, Faculty of Agriculture, Mataram University

[3,4]Co-supervisor, Master of Agribusiness Study Programme, Faculty of Agriculture, Mataram University

[*]Corresponding Author

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ABSTRACT

This study aims to analyse the production, income differences and farming risks of cayenne pepper and large chilli in East Lombok Regency. The research used descriptive quantitative methods and data collection using survey techniques. The research location was determined by *multistage purposive sampling* based on the altitude of the place and the highest production of cayenne pepper and large chilli. Respondent farmers were determined as many as 60 people selected by quota sampling. Selection of respondents using *random sampling* method. Production and farm income were analysed descriptively quantitatively. Risk measurement uses variance, standard deviation and coefficient of variation. Differences in income and risk of cayenne pepper and large chilli farming were analysed statistically with the Z test. The average production of cayenne pepper in East Lombok Regency was found to be 3,962 kg/ha and 6,044 kg/ha respectively in the rainy season and dry season. While the average production of large chilli in the rainy season and dry season was 3,297 kg/ha and 4,546 kg/ha. The average income of cayenne pepper farming is in the rainy season of Rp. 106 million/ha and the dry season of Rp. 11 million/ha is high and significantly different compared to the income of large chilli farming in the rainy season of Rp. 30 million/ha and the dry season of Rp. 15 million/ha. Production risk in cayenne pepper and large chilli farms is in the low category with a coefficient of variation (CVq) smaller than 0.50; however, the risk of cayenne pepper production is lower (CVq =0.33) than the risk of large chilli production and significantly different from the risk of large chilli production (CVq=0.40). While at price risk, cayenne pepper farming is at high risk (CVp = 0.54), while in large chillies the risk is lower (CVp = 0.39) and significantly different. The benefits of the research are (1) Farmers, as a material consideration in dealing with the risks in the cayenne pepper and large chilli farms carried out. (2) Government and related agencies, as information material for policy making related to risk issues in cayenne pepper and large chilli farms. (3) Other researchers, as a material consideration and information for similar research.

Keywords: descriptive, survey, coefficient of variation

INTRODUCTION

Chilli is one of the horticultural commodities that gets a lot of attention because it has a high economic value and is needed by all levels of society to add a spicy flavour to food. In general, chillies have many nutrients and vitamins, including calories, protein, fat, kabohidarat, calcium, vitamins A, B1, and vitamin C. They also contain lasparaginase and capsaicin. Chillies also contain lasparaginase and capsaicin which act as anti-cancer substances (Swatika, *et.al*., 2017).

Chilli farming is one of the activities in agriculture that aims to meet people's needs for chilli. The key to the success of chilli cultivation is to use chilli seeds from superior varieties (Syukur *et al.*, 2015). Chilli plants can grow both in the lowlands and highlands, with an altitude of 0.5 - 1,300 meters above sea level (Ariyanto, *et. al*, 2019). Three classifications of altitude areas based on the classification of I Made Sandy (1977) are lowlands = <100 masl, medium or midlands = 100 - 500 masl, and highlands = >500 masl.

West Nusa Tenggara Province is a chilli production centre in Indonesia, especially East Lombok Regency. This area has an altitude from lowlands to highlands (Susilowati and Gunawan, 2020). The altitude of the place can affect humidity, temperature, sunlight, the presence of pests and diseases, so that it can affect the growth or cultivation of chilli plants which can ultimately affect production, income and farming risks.

In addition to altitude, seasonal factors determine the success of chilli farming. In the rainy season, chilli production usually decreases dramatically so that the price increases sharply; conversely, in the dry season chilli production increases, but the price decreases dramatically (Siddik, *et.al*, 2022). Therefore, chilli farming is not only faced with production risk but also price risk.

Theoretically, the courage of armers to face farming risks determines farm productivity and income. If farmers behave risk *aversion*, then the use of resources (land, labour and other means of production) is not done optimally, resulting in lower productivity and farm income than can be generated. However, if farmers behave as *risk takers*, then the utilisation of resources will be done optimally to obtain maximum productivity and income, but with the possibility of greater risk of loss (Ellis, 1988).

The type of chilli that is widely cultivated in NTB, especially East Lombok Regency, apart from cayenne pepper is large chilli (East Lombok in Figures, 2021). This study aims to analyse the production and risk differences of cayenne and large chilli farms in East Lombok Regency.

RESEARCH METHODOLOGY

This research is a descriptive quantitative study with the unit of analysis is the farming of cayenne pepper and large chillies cultivated in East Lombok Regency in 2022 The research location was determined by *multistage purposive sampling* based on the altitude of the place and the largest production of cayenne pepper and large chillies, so Pringgasela Village, Pringgasela Subdistrict, represents the highland area (> 500 mpdl), Kalijaga Tengah village of Aikmel sub-district represents the medium altitude (200-500 mpdl) and Jorewaru village of Jerowaru sub-district represents the low altitude (> 200 mpdl). Furthermore, in each village two farmer groups were selected whose members grow cayenne pepper and large chilli. The farmer groups are Mele Maju V Farmer Group and Tempasan Bersatu Farmer Group in Pringgasela Village, Pringgasela Sub-district. Kelompok Tani Kompak Giat and Kelompok Tani Sumber Rezeki in Kalijaga Tengah Village, Aikmel Sub-district; and Kelompok Tani Mule Jati and Kelompok Tani Sekilat Baru in Jerowaru Village, Jerowaru Sub-district.

The object of the research is farmers who cultivate cayenne pepper and farmers who cultivate large chillies in the rainy season and dry season in 2022. In 2 farmer groups in each sample village, 20 respondent farmers are determined, namely 10 farmers who cultivate cayenne pepper and 10 farmers who cultivate large chillies, so that the total number of respondents is 60 farmers. The selection of respondent farmers was carried out by *random sampling* selected from members of the 6 sample farmer groups.

The types of data collected include quantitative data and qualitative data; and the sources are primary data and secondary data. Primary data collection was carried out using the observation method and survey method equipped with a list of questions that had been prepared previously related to this research. Furthermore, the data collected was analysed sequentially following the order of the research objectives.

Production Analysis of Cayenne Pepper and Large Chillies

To calculate the amount of production of cayenne pepper and large chilli farming production is calculated

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using the following formula:

$$Qj = \sum_{k=1}^{m} Q_k$$

Description:

Q	=	Production of each type of chilli (Kg/Ha
J	=	Type of chilli (Cayenne pepper, large chilli)
M	=	Number of times each type of chilli is harvested
K	=	The kth harvest (k=1,2,3, ...m) of each chilli type

Analysis of Differences in Income of Raw Chilli and Large Chilli Farms

Farm income is the difference between the value of production and all production costs. Production value is the result of multiplying production by production price. Production, production value and farm income for each type of chilli were analysed using the following formula:

TC	=	VC + FC	
∏j	=	$\sum_{k=1}^{m} (Pk\ x\ Q_k)$	- TC
Where:			
Q	=	Production of each type of chilli (Kg/Ha)	
π	=	Farm income for each type of chilli (Rp.000) Price of each type of chilli (Rp/Kg)	
P TC VC	=	Total Cost or total cost of each type of chilli (Rp) Variable Cost or variable cost (Rp)	
FC /J	=	Fix Cost or fixed cost (Rp)	
m	=	Type of chilli (Cayenne pepper, large chilli) Number of times each type of chilli is harvested	
k	=	The kth harvest (k=1,2,3,..... m) of each chilli type	

To compare the farming income of cayenne pepper and large chilli using the Z test, with the formula:

$$Z\text{-count} = \frac{\pi 1 - \pi 2}{\sqrt{\frac{\sigma 1^2}{n1} + \frac{\sigma 2^2}{n2}}}$$

The hypothesis formulation and decision-making criteria are as follows:

Ho: μ1 = μ2, means there is no difference between cayenne pepper farming income and large chilli farming income.

Ha: μ1 ≠ μ2, means there is a difference between cayenne pepper farming income and large chilli farming income.

Risk Analysis of Raw Chilli and Large Chilli Farms

To analyse the risk of farming can be done in several ways such as variance, standard deviation and coefficient of variation (Anderson *et al.*, 1977). Production variance and price variance as a measure of production risk and price risk are based on the experience of farmers doing chilli farming activities before (Fariyanti, 2008).

μ_i	=	$q_{ih}Q_{ih} + q_{ir}Q_{ir} + q_{in}Q_{in}$,
σ_i^2	=	$q_{ih}\,[Q_{ih} - \mu_i]^2 + q_{ir}\,[Q_{ir} - \mu_i]^2 + q_{in}\,[Q_{in} - \mu_i]^2$
θ_i	=	$q_{ih}P_{ih} + q_{ir}P_{ir} + q_{in}P_{in}$,
φ_i^2	=	$q_{ih}\,[P_{ih} - \theta_i]^2 + q_{ir}\,[P_{ir} - \theta_i]^2 + q_{in}\,[P_{in} - \theta_i]^2$

Where:

Q	=	Production of each type of chilli (Kg/Are)
μ_i	=	Expected production of each type of chilli (kg)
σ_i^2	=	Variance or production risk of each type of chilli
P	=	Price of each type of chilli (Rp/Kg)
θ_i	=	Expected price of each type of chilli (Rp/Kg)
φ_i^2	=	Price variance or risk of each type of chilli
i	=	The i-th sample or respondent
q	=	Production opportunity or price opportunity for each type of chilli (%)
h,r,n	=	Shows the probability of high (h), normal (r) & low (n) production or price of each type of chilli.

Furthermore, to analyse the level of production risk and price risk of each type of chilli, the coefficient of variation is used, using the formula:

CVqj	=	$\frac{\sigma j}{\bar{Q}j}$
CVpj	=	$\frac{\varphi j}{\bar{H}j}$
CVqj	=	Coefficient of variation of production of each type of chilli
σ_i	=	Standard deviation of production of each type of chilli
CVpj	=	Coefficient of variation of the price of each type of chilli pepper
Θ_j	=	Standard deviation of the price of each type of chilli
J	=	Type of chilli (1 = cayenne pepper, 2 = large chilli)

If the coefficient of variation CVqj or CVpj is greater than 0.5, the production risk or price risk is high; if it is less than or equal to 0.5, it is low risk.

To compare the production risk of cayenne pepper and large chilli farms using the Z test with the formula:

$$\text{Z-count} = \frac{Rq1 - Rq2}{\sqrt{\frac{\sigma 1^2}{n1} + \frac{\sigma 2^2}{n2}}}$$

Hypothesis formulation and decision-making criteria are as follows:

Ho: $Rq_1 = Rq_2$, means that there is no difference in production risk between cayenne pepper farming and large chilli farming income.

Ha: $Rq_1 \neq Rq_2$, means that there is a difference in production risk between cayenne pepper farming and large chilli farming income.

To compare the price risk of cayenne pepper and large chilli farms using the Z test with the formula:

$$\text{Z-count} = \frac{Rp1 - Rp2}{\sqrt{\frac{\varphi 1^2}{n1} + \frac{\varphi 2^2}{n2}}}$$

The hypothesis formulation and decision-making criteria are as follows:

Ho: $Rp_1 = Rp_2$, means that there is no difference in price risk between cayenne pepper farming and large chilli farming income.

Ha: $Rp_1 \neq RP_2$, means there is a difference in price risk between cayenne pepper farming and large chilli farming income.

RESULTS AND DISCUSSION

Production and Prices of Cayenne and Large Chillies

Production is the total yield of chilli from the first harvest to the last harvest based on the planting area and converted in hectares in the rainy season and dry season. While the price is the value of production per kilogram of chilli received by farmers from the first harvest to the last harvest and averaged during the harvest process in the rainy season and dry season. The average production and farming prices of cayenne pepper and large chilli in East Lombok Regency can be seen in Table 1.

Table 1. Average Production and Farm Price of Raw Chilli and Large Chilli in Lombok Timur District, 2022/2023

		Cayenne Pepper		Large Chillies	
No.	Harvest To	Production (Kg)	Price (IDR)	Production (Kg)	Price (IDR)
A.	Rainy Season	(0.12 ha)		(0.16 ha)	
1	1st harvest	22	41.400	19	23.733
2	2nd harvest	36	45.467	36	24.600
3	3rd harvest	53	44.467	53	28.067
4	4th harvest	58	41.667	77	23.467
5	5th harvest	75	42.133	93	23.267
6	6th harvest	78	38.533	95	25.000
7	7th harvest	55	42.100	64	24.800
8	8th harvest	40	39.933	42	21.533
9	9th harvest	25	31.200	32	14.933
10	10th harvest	22	21.800	12	8.267
11	11th harvest	9	17.000	2	1.933
12	12th harvest	2	9.000	1	2.133
Total/LLG		475	39.612	528	23.244
Conversion/Ha		3.962	39.612	3.297	23.244
B.	Dry Season	(0.18 ha)		(0.17 ha)	
1	1st harvest	41	10.867	25	12.733
2	2nd harvest	72	9.867	38	15.000
3	3rd harvest	111	8.800	56	13.200
4	4th harvest	140	9.633	91	14.600
5	5th harvest	152	12.333	121	16.000
6	6th harvest	156	10.933	129	15.733
7	7th harvest	118	8.667	120	14.933
8	8th harvest	91	9.467	84	15.333
9	9th harvest	74	8.267	53	13.067
10	10th harvest	45	5.667	31	11.067
11	11th harvest	45	2.600	14	2.067
12	12th harvest	31	1.800	9	2.200
13	13th harvest	12	10.002	-	-
Total/LLG		1.088	9.290	773	14.373
Conversion/Ha		6.044	9.290	4.546	14.373

Source: Primary Data Processed (2023)

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Based on Table 1, the average amount of production in the rainy season and dry season of cayenne pepper is 475 kg/LLG or 3,962 kg/ha and, 088 kg/LLG or 6,044 kg/ha, respectively. While the amount of production in the rainy season and dry season of large chillies was 528 kg/LLG or 3,297 kg/ha and 773 kg/LLG or 4,546 kg/ha. The average price of cayenne pepper received by farmers in the rainy season is Rp. 39,612 /kg and in the dry season it is Rp. 9,783 /kg. While the average price of large chillies in the rainy season was Rp. 23,244 /kg and in the dry season was Rp. 14,373 /kg.

Differences in Income of Raw Chilli and Large Chilli Farms

The highest income in the rainy season was obtained by cayenne pepper farming, which reached Rp. 106 million/ha and large chilli farming at Rp. 30 million/ha. In the dry season, the highest income is obtained by cayenne pepper farming, which is Rp. 70 million/ha, then large chilli farming is Rp. 15 million/ha (Table 2).

Table 2: Average Income of Raw Chilli and Large Chilli Farms (Rp/Ha) in the Rainy Season and Dry Season in East Lombok Regency, 2022/2023

No.	Component	Cayenne Pepper		Large Chillies	
		M. Rain	M. Drought	M. Rain	M. Drought
1	Production (Kg)	3.962	6.044	3.297	4.546
2	Price (Rp/Kg)	39.612	9.290	23.244	14,373
3	Production Value (Rp.000/Ha)	156.942	56.150	76.635	65.339
4	Production Costs (Rp.000/Ha)	50.143	44.327	45.994	49.988
5	UT Income (IDR 000)	106.798	11.823	30.640	15.351

Source: Primary Data Processed (2023)

When the farm income of each type of chilli above is compared between the rainy season and the dry season, the biggest difference is found in cayenne pepper farming, which reaches Rp. 94 million/ha; then large chilli at Rp. 15 million/ha. that cayenne pepper farming may have a high income risk, while large chilli farming has a low income risk.

The seasonal income of the above farms is calculated on average per year, so the cayenne pepper farm income is an average of Rp. 70.43 million/ha and large chilli averages Rp. 28.30 million/ha. To confirm the difference in the income of the two chilli farms, a Z test was conducted. The test results can be seen in Table 3.

Table 3 Results of Z-Test Analysis of Income of Raw Chilli Farming with Large Chilli in East Lombok Regency

	Raw Chilli Income (IDR/Ha)	*Large Chilli Income (Rp/Ha)*
Mean	70.437.465	28.303.526
Known Variance	3.35033E+15	4.36049E+14
Observations	30	30
Hypothesised Mean Difference	0	
Z	3,750	
P(Z<=Z) One-Tail	8,82666E-05	
Z Critical One-Tail	1,644853627	
P(Z<=Z) Two-Tail	0,000176533	
Z Critical Two-Tail	1,959963985	

Source: Primary Data Processed Year (2023)

Based on the results of the Z test in Table 3, it shows that the income of cayenne pepper farming in East Lombok Regency is higher and significantly different from that of large chilli farming.

Risk Analysis of Raw Chilli and Large Chilli Farms

Production Risk

Production risk is a risk that arises from the uncertainty of the amount of yield obtained from a farm.

Table 4. Production Risk of Raw Chilli and Large Chilli Farms in Lombok Timur

No.	Description	Cayenne Pepper	Large Chillies
1	Production Variace	2.608.146	2.080.977
2	Standard Deviation of Production	1.423	1.324
3	Coefficient of variation of production	0,33	0,40

Source: Primary Data Analysis (2023)

Table 4 shows the results of the analysis that the coefficient of variation of production (CVq) of both types of chilli is quite high, but the highest is large chilli (0.40) and the lowest is cayenne pepper (0.33). This means that the production risk of chilli farming in East Lombok Regency is quite risky, but those in the low risk category (CVq, <0.50) are cayenne pepper farms and large chillies are in the low production risk category.

The test results with the z test of the difference in production risk of cayenne pepper and large chilli with a probability value = 0.1809 with a real level = 0.05 so that H0 is accepted and H1 is rejected, meaning that it also shows that the production risk of cayenne pepper is smaller than that of large chilli so that the production risk of cayenne pepper and large chilli shows no difference (Table 5).

Table 5. Comparative Test Results (Z Test) Production Risk of Raw Chilli and Large Chilli Farms in East Lombok Regency

	Risk of Cayenne Pepper Production	Risk of Large Chilli Production
Mean	2.608.146	2.080.976
Known Variance	7.79491E+12	2.23658E+12
Observations	30	30
Hypothesised Mean Difference	0	
Z	0,91	
P(Z<=z) one-tail	0,18	
z Critical one-tail	1,64	
P(Z<=z) two-tail	0,36	
z Critical two-tail	1,95	

Source: Primary Data Processed Year (2023)

Price Risk

Price risk is also analysed in the same way as production risk, but the results of the analysis are contradictory. Table 6 shows that the coefficient of price variation (CVp) of cayenne pepper farming is actually the highest (0.46) compared to large chilli (0.39).

Table 6. Price Risk of Raw Chilli and Large Chilli in East Lombok

No.	Description	Cayenne Pepper	Large Chillies
1	Price Variace	202.971.691	74.068.467
2	Price Standard Deviation	12.755	7.736
3	Price Coefficient of Variation	0,54	0,39

Source: Primary Data Analysis (2023).

The results of this analysis show that cayenne pepper farming in East Lombok Regency is categorised as having a high price risk (CVp>0.5), while large chilli has a low coefficient of variation, still below 0.50. The results of this study are consistent with the results of previous research (Siddik *et.al*., 2022), that the price risk of chilli in the production centres of cayenne pepper, large chilli and curly chilli on Lombok Island is in the high-risk category.

When the difference in price risk of cayenne pepper and large chilli is tested statistically with the Z test with a probability value = 0.0034 smaller than the real level of 0.05 so that H0 is rejected and H1 is accepted, meaning that there is a real difference in the price risk of cayenne pepper and large chilli farming (significant). (Table 7).

Table 7. Comparative Test Results (Z Test) Price Risk of Raw Chilli and Large Chilli Farms in East Lombok Regency

	Price Risk of Cayenne Pepper	Price Risk of Large Chillies
Mean	202.971.690	74.068.467
Known Variance	6.28763E+16	5.28407E+15
Observations	30	30
Hypothesised Mean Difference	0	
Z	2,70	
P(Z<=z) one-tail	0,0034	
z Critical one-tail	1,6448	
P(Z<=z) two-tail	0,0068	
z Critical two-tail	1,9599	

Source: Primary Data Processed Year (2023)

Price Risk

Price risk is also analysed in the same way as production risk, but the results of the analysis are contradictory. Table 8 shows that the coefficient of price variation (CVp) of cayenne pepper farming is actually the highest (0.46) compared to large chilli (0.39).

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When the difference in price risk of cayenne pepper and large chilli is tested statistically with the Z test with a probability value = 0.0034 smaller than the real level of 0.05 so that H0 is rejected and H1 is accepted, meaning that there is a real difference in the price risk of cayenne pepper and large chilli farming (significant). (Table 10).

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Table 10: Comparative Test Results (Z Test) Price Risk of Raw Chilli and Large Chilli Farms in Lombok Timur Regency

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Known Variance	6.28763E+16	5.28407E+15
Observations	30	30
Hypothesised Mean Difference	0	
Z	2,70	
P(Z<=z) one-tail	0,0034	
z Critical one-tail	1,6448	
P(Z<=z) two-tail	0,0068	
z Critical two-tail	1,9599	

Source: Primary Data Processed Year (2023)

At the farm level, price risk is an important issue in farming activities. The price fluctuations experienced by farmers every time they produce indicate the existence of price risk. Limited facilities and infrastructure, as well as access to market information, weaken farmers' bargaining position. Abundant harvests at the same time as farmers in other areas can cause selling prices to fall and farmers' incomes to decline. Another risk is poor sales techniques, where farmers sell through collective traders with an indirect payment system. Apart from output prices, price risk can also be seen in input prices. High fluctuations in input prices are also a risk for farmers, as they will have an impact on production costs and farmers' income.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The average production of cayenne pepper in the wet season and dry season was 3,962 kg/ha and 6,044 kg/ha respectively. While the average production of large chillies in the rainy season and dry season is 3,297 kg/ha and 4,546 kg/ha. The average price of cayenne pepper received by farmers in the rainy season is Rp. 39,612 /kg and in the dry season it is Rp. 9,290 /kg. While the average price of large chillies in the rainy season was Rp. 23,244 /kg and in the dry season was Rp. 14,373 /kg.

The average income of cayenne pepper farming is higher and significantly different than the income of large chillies. In the rainy season it is Rp. 106 million/ha and the dry season is Rp. 11 million/ha. While the income of large chilli farms in the rainy season is Rp.30 million/ha and the dry season is Rp.15 million/ha.

Production risk in cayenne pepper and large chilli farms is in the low category with a coefficient of variation of 0.33 and 0.40 (CVq <0.50), meaning that the production risk of cayenne pepper and large chilli does not show significant differences. While at the risk of price, cayenne pepper farming is at high risk and the highest (CVp = 0.54) compared to large chillies (CVp = 0.39) so that it shows a significant difference.

RECOMMENDATIONS

Cayenne pepper and large chilli farmers are expected to not only do chilli farming or farmers can plant with various other types of crops in one land area, so as to increase income and avoid risk. And not only that, farmers must also be more willing to take risks, namely by planting in the rainy season and increasing their planting area.

It is expected that the extension service conducts training to farmers related to how to deal with production

risks in the rainy season and price risks in the dry season so that farmers are ready and brave to take these risks, especially at the risk of production in the rainy season so that they can bring more profit.

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