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The economic aspects of chilli production in Central Java

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Abstract

This study analyses the economic aspects of chilli in Central Java where chilli is massively and intensively cultivated. Data for this study is compiled during 2009-2011 in three chilli producing districts: Brebes, Magelang and Rembang. Analyses is conducted using qualitative and quantitative approaches. The results indicate that many important findings related to economic aspects of chilli. There are various ranges of economic aspects across regions. The main findings is that chilli provided positive net returns, has relatively high economic risk and intensive use of chemicals. The policies related to improvement of chilli cultivation need to be formulated based on local specific constraints.

Abstrak

Penelitian ini menganalisis aspek ekonomi cabai di Jawa Tengah di mana cabai secara massal dan intensif dibudidayakan. Data untuk penelitian ini dikumpulkan selama 2009-2011 di tiga kabupaten, yaitu Brebes, Magelang dan Rembang. Analisis dilakukan dengan menggunakan pendekatan kualitatif dan kuantitatif. Hasil penelitian menunjukkan bahwa banyak temuan penting terkait dengan aspek ekonomi cabai. Ada berbagai rentang aspek manfaat ekonomi di daerah. Temuan utama adalah bahwa cabai memiliki pengembalian bersih positif, memiliki risiko ekonomi yang relatif tinggi dan penggunaan intensif bahan kimia. Kebijakan yang terkait dengan perbaikan budidaya cabai perlu dirumuskan berdasarkan kendala spesifik lokal.

Introduction

Chilli is one of the commercial vegetables that have been cultivated in Indonesia over past decades. This commodity has high economic value, because it is needed for daily dietary as well as for raw material of food and pharmaceutical industries. Chilli can be marketed in fresh, dried of powder forms.

Chilli is grown widely in Indonesia. In 2007, chilli was cultivated in over 190,000 ha in Indonesia with production of over a million ton, which accounts for about 5 percent of the total world market share. Chilli-planted area is the highest among other vegetables, despite the production of cabbage is the highest. But, the per hectare production averages for the Indonesia are low by regional and international standards. There is still scope for more use of high yielding (hybrid) cultivars and better management to increase national production without encroaching on grain production areas (Johnson, Weinberger, & Wu, 2008).

There are 33 provinces in Indonesia that produce over 20 types of vegetables, but the most important chilli growing islands in Indonesia are Java and Sumatra. Over 85% of all vegetables are grown on the islands of Java and Sumatra. The major vegetable producing provinces are: West Java, Central Java, East Java, and North Sumatra, these four provinces accounted for over 70% of all vegetable production. In Central Java itself, chilli was cultivated in 2007, on over 18,225 ha in Central Java, which has also a largest share of chilli acreage in the country.

Commonly, price fluctuation of vegetables, including chilli, is higher than that of fruits, paddy and other secondary crops. This means that the imbalance of supply volume and consumer needs frequently occurred on vegetables. High fluctuation in price of chilli does not provide beneficial circumstance for vegetables agribusiness, since it has adverse effect on the decision for investment as a result of uncertainty in return. The fluctuation in price often makes more loss for farmers than traders/collectors, because farmers are not capable of managing sale to obtain better price. Price fluctuation also triggers asymmetric market information, and this results in high marketing margin as traders take advantage from this situation as they can provide misleading price information to the farmers. The price received by the farmers and price transmission from consumer's area to producer's region is low. Thus, it is understandable that the share of market price for traders is almost 50% of the total chilli price. This condition is not conducive for efforts to develop agribusiness and to increase produce's quality competitiveness characterized by the ability to respond to effective market dynamics.

In spite of high fluctuation in price, farmers still motivate to grow chilli. The need of chilli is increasing fast in line with the increase of income and/or the number of population as seen on the demand trend that tended to increase from 2.45 kg/capita in 1988 to 2.88 kg/capita in 1990, and 3.16 kg/capita in 1992 (Bank of Indonesia, 2007).

Although the needs tends to increase, the chilli demand for daily needs has been fluctuated which is caused by the retail price in the market. The fluctuation is either caused by some factors that influence the demand side, or by other factors, which influence the supply side. It could be explained that the price equilibrium exists when the supply of chilli is lower that its demand. This will cause the price to be very high. On the contrary, if the supply of chilli is greater that its demand, the price will be very low.

Farm level economic analysis of chilli is important because the fact that Indonesia's chilli productivity level (about 5 t/ha) is still very low, compared to other countries in Asia (Mustafa, Ali, & Kuswanti, 2006). Major problems and constraints include poor crop management techniques, widespread use of low quality seed, high production costs, inadequate marketing infrastructure, and farmers' lack of knowledge of improved production practices or of integrated technology packages (Basuki, Adiyoga, & Gunadi, 2009; Vos, 1994). In addition, the constraints that prevent farmers from achieving potential yields are pests and diseases, cultural practices, bureaucratic problems related to land and seed permits, small land holdings, lack of market information, post-harvest losses due to poor infrastructure, institutional factors, such as lack of an industrial policy for horticulture, and lack of credit, despite the fact that farmers use high level of inputs (Darmawan & Pasandaran, 2000).

Vegetable sector produces, including chilli, provide more income and employment than cereal and staple crops sectors (Ali, 2008; Johnson et al., 2008; Weinberger & Genova-II, 2005; Weinberger & Lumpkin, 2007). Findings related to chilli production will be meaningful, and policy related to improvement in economic production of chilli can be provided, as reported in a five-country case study in tropical Asia, that emphasized the importance of public policy, credit, infrastructure, and innovative extension methods for the effective diffusion of vegetable sector technologies, especially those related to seed (Everaarts & Putter, 2009).

This study is to analyse economic aspects of chilli production in Central Java, the largest area of chilli cultivation in Indonesia. The specific objectives are: to assess factors affecting the economics of chilli production in the community; to assess the uses of material and labour inputs in chilli production; to assess the cost and return of chilli production.

The scope of this study is limited to selected information and findings from a group level consultation and out of a household level survey across chilli growing farmers in the three districts in Central Java during 2009-2011.

The next chapters will be a review of literatures related to the economics of chilli production, which have been done both in Indonesia and other countries. Chapter following the literature review is methodology of survey. In this part, techniques, methods and tools were discussed. Some formulations of analysis were also provided to make it easy to understand. Results and discussions, which follow part of methodology, provide overviews of chilli production in Central Java, particularly in the location of study. Details on the economic aspects of chilli production were analysed and compared across sites. For comparison purpose, the economic aspects of rice production were provided in the separate chapter, following the results and discussions of chilli. In the last chapter, conclusion and policy implication, brief findings on the economic aspects of chilli were provided, and suggestion and recommendation for better cultivation of chilli were suggested.

Economic analysis of farming is important because it provides economic factor affecting the performance of farms. Factors determining production and income can be identified and valuable suggestions can be provided for policy makers and researchers to follow up. Various studies on economics of vegetable producing have been conducted.

Vegetable farming commonly is labour and input intensive. In Bangladesh, factor share of labour and fertilizer in vegetable production is around 48% and 24% respectively (Ali & Hau, 2001). Weinberger and Genova-II (2005) found that fraction of hired labour employed in the vegetable farming is high. In terms of profitability, a study on eggplant production in India shows that eggplant farming is profitable, where farmers can get profit around 40 percent of the price of eggplant (Baral et al., 2006). In chilli production Rajur, Patil, and Basavaraj (2008) reports that benefit cost ratio is 1.73, meaning that chilli is also profitable.

In Indonesia, an economic analysis of chilli farming by Mustafa et al. (2006) shows that benefit cost ratio is greater than 2, meaning that chilli is more profitable. In rice, the benefit ratio is only 0.5, meaning that farmers gained negative profit or loss.[1]

The factor share of chemicals was highest because of its peculiar production system that required large amount of initial investment on its basic infrastructural development; and the labour share was around 20 percent. Fertilizer was the next important input; and seeds played the major role in productivity, despite lowest factor share, i.e., only one percent or less. This means that more use of labour and such fertilizers diminish the yield of chilli.

Different level of education determines the level of efficiency. The variation in the efficiency of production is very high meaning that not all farmers are able to apply chilli production technology appropriately. This is consistent to the finding of Mustafa et al. (2006) that the variation of yield in chilli production is high.

Among vegetables, chilli shows the second highest in terms of variation in yield. Coefficient variation of chilli is 26.4, while that of rice is only 1.7. High variability in production generally leads to high, unstable prices. Variability in producers' price is higher in chilli and also higher for vegetables as a group, than producers' price variability of rice (Darmawan & Pasandaran, 2000). At least, there are four factors affecting the high fluctuation in price of chilli and other vegetables.

First, production is highly concentrated in certain location. In this case, 82 percent of chilli is produced in 7 provinces. Thus is there is anomaly in production, there will be a shock in production that market equilibrium. Second, there is no synchronization in the planting season of chilli. Commonly, chilli is planted at relatively the same time in all producing areas. Third, the demand for chilli (and other vegetables) is very sensitive to the freshness of product. Chilli is not durable, and farmers cannot manage the supply, and they have to sell the product as soon as possible after harvesting. Last, the facility of good storing of chilli and other vegetables has not been available, and consequently, it is difficult to manage the supply of chilli.This is not the case for rice, and indication that chilli farming is riskier than rice farming.

Research Method

This survey illustrates the economic aspects of chilli production and cultivation in Central Java province of Indonesia. The assessment is based on farmers' group level survey carried out during 2009-2011 in three communities in Magelang, Brebes and Rembang districts of Central Java province. Each district selected here was an intensive chilli production area and each site represents a distinct variation of production characteristic and agro-ecology settings of chilli farming practice in the region.

This baseline survey collected both secondary and primary data. Secondary data were collected from agricultural offices and statistical offices at provincial and district level. Data on chilli-planted area and production during last three years were recorded. Primary data were collected at farm level, based on community level in the village and individual level.

The survey adopted framework of integration of qualitative and quantitative survey to meet the above objectives. The qualitative survey approach used for collection of social and institutional issues involved in chilli farming and the information at the community or group level average in the village. The quantitative approach used for collection individual information on socio-economic of farmers' household and farming. The later approach was expected to provide information of quantitative information more accurate.

The districts include Magelang, Brebes and Rembang. Those districts are expected to be representative for chilli producing area in Central Java as those are three largest chilli producers in the province. One to two communities at village level were selected to be surveyed. One of the criteria for selection was that the community is close to the field trial of chilli in each district. It is expected that farmers in the community will be induced by the existence of field trial for which new agricultural technology is being assessed at field level.

[1] In the 1980s, the BC ration of rice was 1.59 (Darmawan and Pasandaran, 2000)

Farmers actively growing chilli in the community at village level were considered as sample of survey. About 50 farmers in each district were selected. Chilli farming analysed here was based on the sample plot level. Farmers where asked to provided information on chilli farming by selecting one main plot of chilli. The chilli farming was mostly operated in dry season which was considered good season for chilli. But, in Magelang and Rembang, a few of sample plots were planted in the transaction between dry and wet seasons.

Farm characteristics of chilli farms having continuous parameter values were based on 0.1ha. The parameters include nursery area, material inputs, labour input, yield, measured in terms of physical unit and monetary values evaluated at current prevailing price.

Results were analysed and presented by each districts. Every variable was compared across districts. Mean value and standard deviation (SD) of quantitative variables were provided, and statistical comparison on mean value was tested using T-test procedure, evaluated at 90 percent of confidence interval. Mean value and SD were respectively calculated using:

$$\bar{X} = \frac{\sum_{i=1}^{N} X_i}{N} \tag{1}$$

$$SD = \sqrt{\frac{\left(X_i - \bar{X}\right)^2}{N-1}} \tag{2}$$

where X_i is the variable of i[th] to be analysed, *N* is the number of samples.
Statistical *t*-test was calculated using

$$t_{test} = \frac{x_{ij} - x_{ik}}{SD_{jk}}, \text{ for } k \neq j \tag{3}$$

where sub-scrip k and j refers to the different district, and SD_{jk} is the standard deviation of obtained from x_j and x_k. If the value of *t*-test is greater than the value t-table at 90% confident interval, the mean of such variables from different district is significantly different.

Factor shares are the ratio of cists of factor inputs used in a production process to the total value of output. Factor share is a fundamental concept in economics that plays a critical role in research concerning production structure, costs and return analysis (Kikuchi, 1991). The share of each cost item in the total cost was estimated in percent. In this analysis, the factor shares for labour, seed, fertilizer, manure, irrigation, pesticide, and others (including staking, mulching, land, and interest rate) were computed. In estimating these shares, the cost of labour used to apply an input was excluded and was aggregated into the labour cost. Consider a production function of producing Q using material inputs X, labour input L, and land A, formulated as:

$$Q = f(X, L, A) \tag{4}$$

then, the factor shares of material inputs (S_X), labour (S_L) and land (S_A) can be respectively formulated as:

$$S_X = \frac{P_x X}{P_q Q} * 100 \tag{5a}$$

$$S_L = \frac{wL}{P_q Q} * 100 \tag{5b}$$

$$S_A = \frac{rA}{P_q Q} * 100 \tag{5c}$$

where P_x is the price of material inputs, P_q is the price of output, and r is current rental cost of land. Return to the management (S_M) is calculated using

$$S_M = 100 - (S_X + S_L + S_A) \quad (6)$$

Return to the management could be positive or negative. Higher value of this value represents better farm management.

Gross revenue was estimated as outputs from a piece of land in a season multiplied by their respective market prices. Net return is obtained from the gross revenue which is deducted by total cost. In this case, family labour is not included. Real net revenue is obtained from real return which is deducted by imputed family labour. Family labour devoted into production practices was imputed using prevailing average wage rate. This paper follows analysis of economic farming which was applied in livestock farming by Kumar, Dey, and Barik (2008).

Risk in chilli production was quantified by estimating the coefficient of variation (CV) of the per 0.1ha basis. A measure of dispersion that can be used in such cases is the CV, which is a measure of dispersion in relation to the mean. It is obtained by dividing the standard deviation by the mean, and is customarily expressed as a percentage, that is

$$CV = \frac{SD}{\overline{X}} * 100\% \quad (7)$$

For comparison purposes, the CVs were estimated separately for each region.

Results and Discussion

Gender involvement

Recently, gender issues are important in the process of development, including agricultural development. The roles and contributions of females in agricultural activities are substantial. In chilli farming, females were commonly specialized in nursery preparation, transplanting, and weeding (Table 1). These activities needed carefulness and accuracy but did not need more power. Males were specialized in activities which needed more power, such as land preparation, pesticide application and irrigation. On average, the involvement of females in chilli farming activities was around 40%. The highest involvement of females was in Brebes, which accounted for more than 50%. This finding suggests that female has participated in chilli farming. If there are workshops or training in chilli production practices, females should not be ignored.

Table 1. Gender involvement in chilli farming

Activities	Percentage of involvement					
	Magelang		Brebes		Rembang	
	Male	Female	Male	Female	Male	Female
Nursery	0	100	10	90	100	0
Land preparation	100	0	100	0	100	0
Mulching	100	0	N/A	N/A	50	50
Transplanting	50	50	0	100	25	75
Fertilizer application	50	50	25	75	50	50
Spraying	100	0	100	0	100	0
Irrigation	100	0	95	5	80	20
Weeding and uprooting	100	0	0	100	50	50
Harvesting and sorting	50	50	10	90	80	20
Marketing	50	50	50	50	20	80
Total average	70	30	43	57	65	35

Note: in Brebes, there was no mulching in chilli farming

Factors affecting chilli production

Specific factors affecting farmers' crop production decisions may vary by crop type, production location, and season. Based on group discussions in each of the three communities, we have summarizes factors that affect farmers' decisions to grow chilli in the region (Table 2). Some factors are common across the locations, but there are some important differences as well.

Table 2. Major techno-institutional factors affecting adoption of chilli

No	Magelang	Brebes	Rembang
A. Factors that encourage adoption of chilli			
1	Availability of water	Easy to sell	Availability of water
2	Availability of pesticides	Availability of pesticides	Availability of pesticides
3	Availability of new high yielding varieties of chilli	Availability of new high yielding varieties of chill	Availability of new high yielding varieties of chill
4		Support from extension office	Support from agricultural office
5	Proximity to vegetable market	Proximity to vegetable market	
B. Factors that discourage adoption of chilli			
1	Pests and diseases attack	Pests and diseases attack	Pests and diseases attack
2	High price fluctuation	High price fluctuation	High price fluctuation
3		Lack of water for irrigation	Cost of pumping water
4	More profitability from competing crops (tobacco and paddy)	More profitability from competing crops (shallot and paddy)	More profitability from competing crops (melon and paddy)

Note: Farmers listed these factors as during the focus group discussions in each of the three communities surveyed in 2008.

Chilli farmers' constraints and concerns

During our individual household survey, over 97% of chilli growers reported viral diseases as their top concern in chilli farming, as indicated by its lowest rank number (Table 3). Fungal disease and bacterial disease also were reported as major problems by 96% and 92%of the households, respectively. The high fluctuation of price was reported as the highest ranking factor (1.03) by 66% of households. The information from the participatory rural assessment was consistent with that of the household survey.

Table 3. Major chilli production constraints and problems as expressed by farmers' problem ranking index

Major concerns and constraints of production	Average rank value for each of the major concerns											
	Magelang (N=49)			Brebes (N=60)			Rembang (N=51)			Overall Sample (N=160)		
	n	Mean rank	S D	n	Mean rank	S D	n	Mean rank	S D	n	Mean rank	S D
1. Virus diseases	44	1.61^{BR}	.54	60	1.03	.18	51	1.12	.43	155	1.23	.46
2. Fungal diseases	44	1.43^{B}	.50	60	1.17	.56	49	2.59^{MB}	.54	153	1.70	.82
3. Bacterial diseases	36	2.94^{BR}	.33	60	1.10	.40	51	2.31^{B}	.62	147	1.97	.90
4. Lack of information on pest management	10	2.10	.32	4	3.00^{M}	.00	45	2.93^{M}	.50	59	2.80	.55
5. High price fluctuation	40	1.03	.16	15	1.07	.26	50	1.02	.14	105	1.03	.17
6. Exploitation by traders	13	1.92	.64	6	1.67	.52	46	2.15	.42	65	2.06	.50
7. Other diseases	4	3.75^{B}	.50	17	1.06	.24	1	2.00	.	22	1.59	1.10

N = total sample of household survey in each communities/districts;
n = Number of responded for each factors.
Mean Rank = Weightage Average Rank in index: 1 = most important concern. SD = Standard Deviation value. Significant different of mean across sites is indicated by superscript M, B and R; wherein, ^{M}= Magelang, ^{B}= Brebes, ^{R}= Rembang. Mean comparison is tested at 95 % of confidence interval.

During the survey, we also noticed that to minimize yield loss farmers try to adopt a variety of chilli that is resistant to a particular pest and disease. In Magelang, farmers usually grow hybrids. In Brebes, farmers usually grow open-pollinated or local varieties. In Rembang, 50% of chilli varieties cultivated are hybrids, and also large number of Open Pollinated varieties. Chilli farming practice in Rembang is also less intensive than that of the other two sites.

Relative risk and return of chilli and other crops

In simple notion, risk in farming is the possibility of adversity or loss from uncertain events, and it refers to "uncertainty that negatively affects an individual's welfare"; it could be due to production risk, marketing risk, financial risk, or institutional risk (Harwood, Heifner, Coble, Perry, & Somwaru, 1999). In economics interpretation, risk is however defined and differentiated from events that are "purely uncertainty". When the probability of loss associated with an event is known then such occurrence in economics is called as of risk, but when probability of the event is not known then it is simply refereed as uncertainty[2] , or uncertain event (Hardaker & Lien, 2007). In this study, however, our aim is not to define risk beforehand but to assess farmers' subjective perceptions of overall risk which is combination of several types of risks associated with crop cultivation. Using participatory framework of assessment, the risk estimated in this study is the farmers' group level perceived and relative risk not the individual farmer's level absolute risk factor. In reality, each farmer may have a different degree of risk aversion factor, assessment of which requires a large-scale risk focused study, which was beyond scope of our filed study. Hence, risk for a crop mentioned in this paper should be considered as "perceived risk" of a group of farmers for cultivation of the particular crop.

Negative factors of chilli farming listed in Table 1, and constraints summarized in Table 4, are closely related to risk associated with chilli cultivation. The increasing incidence of diseases and pests, high fluctuation of market prices, and inadequate access to water in the dry season some of the major factors farmers worry about most when deciding how much acreage to allocate for chilli. During our survey, almost all farmers noted that growing chilli is risky compared to cultivation of other vegetables and paddy. But, many of them also said that they would like to grow chilli, at least on small plot area (around 0.1 ha) largely because of high profits from chilli than that of other vegetables, if they are lucky to get good market prices and good yield. This suggests that different farmers perceive different level of risk across the vegetables (and paddy), and the perceived risk level vary across the farmers. We also observed that a typical farmer allocates only a modest amount of land to chilli cultivation (0.1 to 0.2 ha per household). Over 2/3[rd] of Chilli cultivation is also an intensive farming practice with high level of inputs as noted earlier (Ali, 2006). Therefore, in this study, we have tried to assess this farmer's perceive risk in index value and in relative term.

Table 4. Expected returns and risk and trade-off associated with selected crops

No.	Crops	Profit obtained	Risk level	Working capital need	Remarks: underlined factors related to risk
1	Chilli	6	9-10	9	Price and diseases (Anthracnose)
2	Rice	3	2-4	2-3	(Tungro virus; rat, plant hoppers)
3	Tobacco	8	9-10	8	Bad weather causing low quality
4	Watermelon	6	9-10	7-8	Price and diseases, can not grow
5	Tomato	4	9-10	3-4	Price and fruit borer, wilt
6	Cucumber	5	1-2	3-4	Lower price and pest (caterpillars)
7	Bitter gourd	7	5	1-2	Pests (fruit fly)
8	Chinese Cabbage	2-3	2-3	1	
9	Peanut	2-3	2-3	1	
10	Cabbage	3-4	5-6	4-5	Price and pest: caterpillar
11	Yard-long bean	7	2-4	1-2	Price and pests: aphids, fruit borer

Index 1 = lowest scale value, and Index 10 = Highest scale value
For example: Capital (1 means low requirement of operating capital 10 = high capital requirement); Profitability (1 = low expected profit, 10 = high expected profit); Risk (1 = low perceived risk, 10 = high perceived risk).
Range of index numbers: For some crops, as expected earlier, the farmers' group could not come to a consensus for an exact index number, but preferred to use a range. This may be due to the high variability of these factors in the community as such, or to variations in the perceptions of individual farmers in the group).

The results in Table 4 shows that farmers perceive that the relative profitability of chilli cultivation is on average four times higher than that of paddy cultivation, but the overall perceived risk (i.e., subjective risk and also relative risk) associated with chilli cultivation is also four times higher than that of paddy cultivation (Figure 4.1). The high level of farmers' perceived risk factor for chilli cultivation is largely from probability of loss associated with Anthracnose attack (it attacks would lead to 100 percent crop failure), as well high fluctuation of chilli prices at the local markets. A working capital requirement for chilli cultivation, in relative terms, was 4 to 5 times higher than that of paddy cultivation, consistent with that of previous findings of (Ali, 2006). We also noticed that those farmers who already have enough disposable capital on hand (or who have better access to low-cost credit locally) prefer to grow chilli on larger areas (0.2 ha or more), and others would decide crop acreage as per the availability of the disposal capital on hand.

[2] Thus, the loss caused by excess rain (or pest attack, price fluctuation) in farming is considered as risk (since year-to-year occurrence probability can be guessed objectively, but the loss caused by earthquake (or volcano eruption) is considered as uncertainty since we cannot assign any probability value for loss associated with these events.

Unlike the production of paddy and other cereals, an average farmer, usually do not intend to borrow capital from outside credit institutions to grow chilli; in fact, the formal credit institutions such as bank and cooperative also do not easily provide farm-loan for chilli cultivation, except modest level of credit provided by the chill collectors (and chilli traders at the local market). The chilli collector also later would purchase chilli from the farmers who had borrowed capital earlier. All of these arrangements are due to variation of return from chilli farming in the region, and so the perceived risk level of an average farmer. Among 11 commonly cultivated vegetables and cereals, farmers noted that a relatively moderate level of operating capital for yard-long bean but potentially almost the same return as that of chilli. The low expected risk and high-expected profit from yard-long bean could also account for the recent rapid expansion of yard-long bean acreage in Central Java. The results on risk-return trade-off of vegetables in Figure 1 were conceptually the same as risk-return trade-off of financial stocks. One of the reason for a typical farmer to diversify acreage for different crops is to reduce his perceive risk, or to minimize probability of loss on cultivation of a particular crop. The results suggest advantage of crop diversification over growing a single crop due to so wide variation on return and risk across the crops cultivated in a location.

Monetary value of input, or costs of inputs

In total, the value of fertilizers was around Rp237,000.00. The highest value of fertilizer was KCl, which accounted for about Rp53,000.00 (Table 5). This was sensible since the price of KCl was higher than those of other fertilizers. The value of SP36 (phosphate) and NPK (composite fertilizers containing Nitrogen, Phosphate and Potassium) quite similar, which was around Rp42,000.00.

The value of pesticides, including surfactant, was around Rp325,000.00 (Table 6). Of the total value, insecticide value was around Rp237,000.00, or around 73%, even though the level of insecticide use was much lower than that of fungicides. This was because insecticides were commonly more expensive that fungicides. In total, the value of insecticides was around 20%. Note that pesticide level in Brebes was the highest. Overall, each site has a massive campaign in use of pesticides, particularly during the Green Revolution (Mariyono, 2015).

Total value of mulching and support was around was Rp274,000.00 (Table 7). Of the total value, plastic mulching was valued around 56 percent. In Magelang, the portion is higher because almost farmers there apply plastic mulching technology. The value of bamboo stick in Magelang was also higher than in Rembang, because the density of stick was higher.

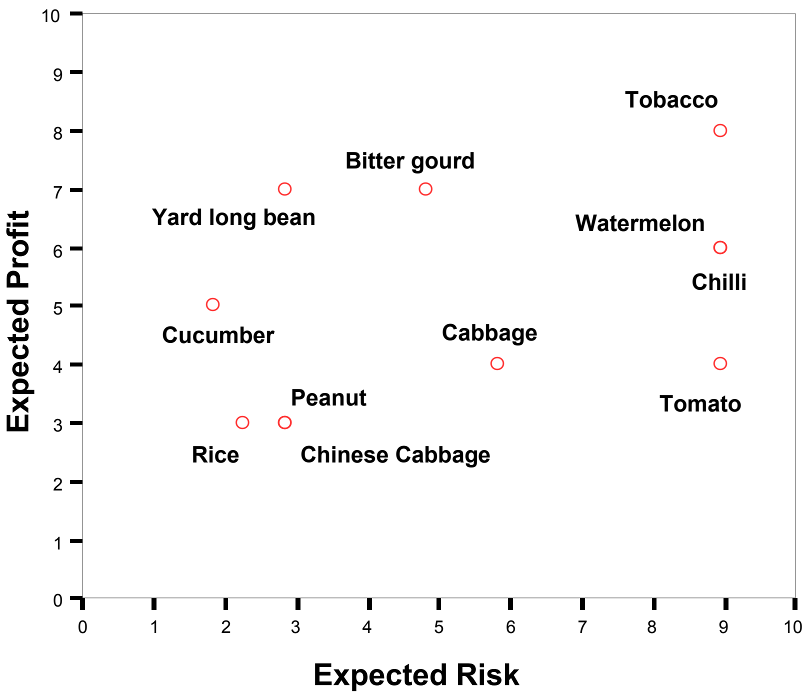

Figure 1. Trade-off on risk and return, selected vegetables

Table 5. Value of material input in the main plot

Fertilizers	Value of fertilizers (Rp)							
	Magelang		Brebes		Rembang		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Organic	23316 ^{B}	40145	5521	19742	34914 ^{B}	50933	20340	40008
Urea	28509	61883	55219 ^{MR}	32504	17271	7903	34943	42847
SP36	48235 ^{R}	41675	71297 ^{MR}	54920	2825	7212	42409	49878
KCl	56224	38299	75048 ^{R}	128159	23613	23703	52888	84722
NPK	41883	81115	55690	138968	25810	16810	41937	96933
ZA	40377 ^{B}	28275	26288 ^{R}	29282	7635	15915	24657	28447
Liquid	20944 ^{B}	46084	1771	13717	1393	4846	7522	28256
Others	6286	13421	22517 ^{MR}	35949	6810	9508	12539	24950
Total	265774		313351		120271		237235	

Note: Significant different of mean across sites is indicated by superscript M, B and R.
Mean comparison is tested at 90 % of confidence interval.

Table 6. Value of pesticides

	Value of pesticides (Rp)							
	Magelang		Brebes		Rembang		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Insecticides	165577 ^{R}	117085	461121 ^{MR}	353425	43448	44848	237477	289247
Fungicides	27284	29254	143047 ^{MR}	156057	14839	18724	66728	113783
Surfactants	1423	5333	28635 ^{MR}	96951	1196	7139	11555	60734
Others	9704	24168	17710 ^{R}	30374	515	2276	9777	23907
Total	203988		650513		59998		325537	

Note: Significant different of mean across sites is indicated by superscript M, B and R.
Mean comparison is tested at 90 % of confidence interval.

Table 7. Value of mulching and other materials

	Value of mulching and support (Rp)							
	Magelang		Brebes		Rembang		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Mulching	355867 ^{BR}	180116	0	0	145386	176468	155326	202771
Stick	210232 ^{BR}	206984	0	0	28856	51401	73582	149010
Rope	17103 ^{BR}	12000	0	0	660	2242	5448	10270
Irrigation	6378	44643	56042 ^{M}	81636	38703 ^{M}	27977	35305	61193
Tools	5238	15361	1667	12116	8127 ^{MB}	8729	4820	12529

Note: Significant different of mean across sites is indicated by superscript M, B and R.
Mean comparison is tested at 90 % of confidence interval.

Table 8. Labour costs

Activities	Labour costs (Rp)							
	Magelang		Brebes		Rembang		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Land preparation	215587 ^{R}	202901	454500 ^{MR}	169792	63944	33653	256843	225132
Transplanting	17690	24937	73754 ^{MR}	41456	32841	38511	43544	43347
Fertilizer application	2986	8555	25510 ^{MR}	30298	14000 ^{M}	19647	14944	23887
Pesticide application	19476	60681	19885	70640	2451	17504	14203	55898
Weeding	1854	8394	118260 ^{MR}	48707	7531	22182	47316	64033
Bed maintenance	272	1905	70393 ^{MR}	42437	0	0	26481	42821
Watering plants	255	1786	1354	8225	2941	21004	1523	12882
Harvesting	67355 ^{R}	74671	159252 ^{MR}	78437	16337	69485	85990	95760
Transport	3605	6390	44327 ^{MR}	64485	5755	11431	19561	44357
Others	0	0	4625 ^{MR}	6156	1595	5750	2243	5319

Note: Significant different of mean across sites is indicated by superscript M, B and R.
Mean comparison is tested at 90 % of confidence interval.

Labour cost here was calculated from the number of hired labour multiplied by wage rate.[3] Thus cost, higher labour costs did not necessarily mean more labour devoted in the activities. The activities that needed more family labour would be less costly than those with more hired labour. Land preparation, which was carried out by hired labour, need more costs (Table 8). In Brebes where the portion of family labour was low, costs for almost activities were significantly higher than that of in Magelang in Rembang, except for watering and spraying which were mostly carried out by family members in all three sites.

Productivity and gross return

On average, the productivity of chilli was 5600kg/ha (Table 9). The highest productivity was in Brebes, which was 7040kg/ha. This was significantly higher than in Magelang and Rembang. In addition, the productivity of chilli in Magelang was significantly higher than that in Rembang. In terms of monetary value of chilli, the value was around Rp3.4 million. As the productivity of chilli in Brebes was the highest, the monetary value of chilli in Brebes was also the highest. But, it was statistically equal to that in Magelang, and significantly higher than that in Rembang. Yield lost to harvesting process was around 3 kg on average, and in Brebes, the yield lost was the highest. This loss was very low, which accounted for less than 1 percent.

Table 9. Production, value and yield lost to harvesting process

Particulars	Quantity							
	Magelang		Brebres		Rembang		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total production (kg)	573^{R}	329	704^{MR}	269	378	131	560	289
Value production (Rp000)	3860^{R}	2454	4392^{R}	2885	1913	873	3439	2508
Production loss	3.08	4.51	4.55^{R}	9.50	0.83	1.08	2.91	6.51

Note: Significant different of mean across sites is indicated by superscript M, B and R.
Mean comparison is tested at 90 % of confidence interval.

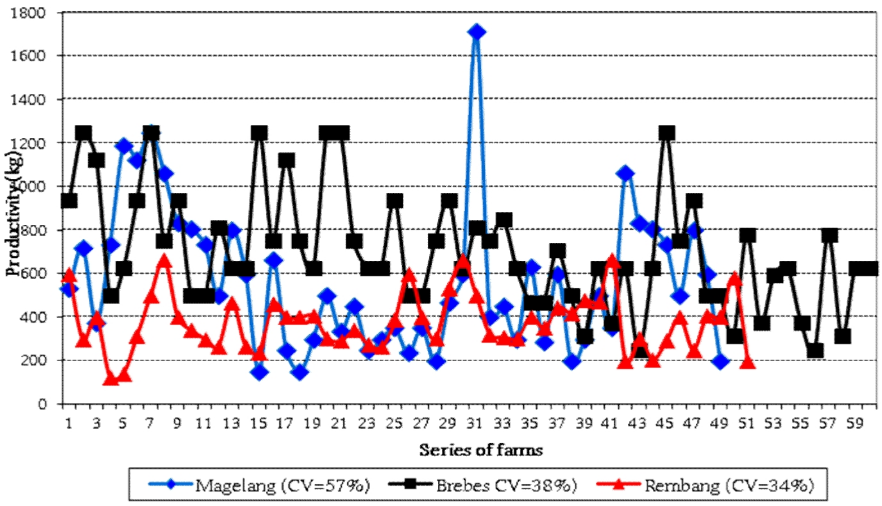

Figure 2. Dispersion of productivity of chilli

As we can see, that the standard deviations of productivity and monetary value of chilli relatively high compare to the mean value, meaning that the productivity and monetary value of chilli varied across farms. On average, the coefficient variation (CV) of productivity and monetary value were 52% and 73% respectively. The fact that CV of monetary value was higher than that of productivity indicated there was also variation in the price of chilli. The highest variations in productivity and monetary value of chilli were in Magelang, which were 57% and 64% respectively. The relative dispersion of productivity was represented in the Figure 2. We can see that variation in productivity of chilli in was relatively high, compared to that in Brebes and Rembang. In Magelang, the cultivation of chilli was more intensive, and the variation of technology adopted by farmers also varied.

[3] Real labour cost was calculated in the cost and return analysis. Real labour costs included family labour imputed with average wage rate.

Another factor was that the incidence of pest and disease attack in Magelang was reported high, compared to other regions. Thus, slight difference in the pest and disease management resulted in different outcomes. These were different from those in Rembang and Brebes, where the technology adopted by farmers in each region was relatively similar. As well, the incidence of pest and diseases attack was reported low.

Factor share analysis of chilli cultivation

Analysis on factor shares is shown in Figure 3 and Table 10. On average, share of labour in the production of chilli was the highest. It accounted for around 38% of the total value of output. This is an indication that chilli production was labour intensive. High share in labour was not bad condition because it means that more labour was absorbed in the farming. When the labour consisted of family labour, this was additional income for household of the farmers.

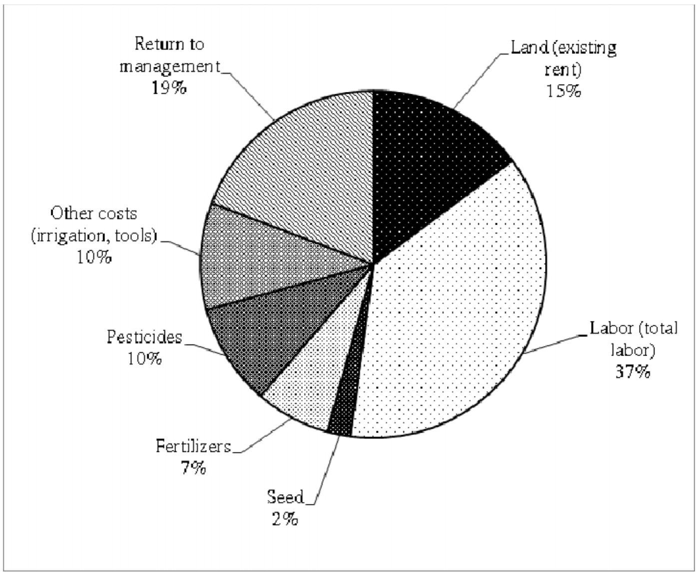

Figure 3. Factor share in chilli production

Table 10. Factor share

Factors	Share (%)			
	Magelang	Brebes	Rembang	Average
Land (existing rent)	9.07	6.83	10.46	14.81
Labour (total labour)	36.22	36.07	42.63	37.33
Seed	2.57	1.57	3.07	2.18
Fertilizers	7.06	7.15	6.49	7.00
Insecticides	4.29	10.50	2.27	6.91
Fungicides	0.71	3.26	0.78	1.94
Other pesticides	0.30	1.06	0.13	0.63
Other costs (irrigation, tools)	18.76	2.33	13.38	9.93
Return to management	21.04	31.24	20.79	19.26
Total	100.00	100.00	100.00	100.00

Share of land accounted for around 15% of the total output. Shares pesticides and other costs including mulching and irrigation costs were 9% and 10% respectively. These indicate that chilli needed good maintenance to grow. Relatively high share in pesticides suggests that chilli also need good protection from pest and disease attacks. Shares in fertilizers and seed accounted for around 7% and 2%.

Interestingly, share in the return of management was around 19%. This fraction represents the good farm management, where farm operator was able to obtain around one fifth of the total value of output. In Brebes, the share of the return of management was the highest, which accounted for 31%. The positive net return of chilli is one of motivations of farmers to grow chilli (Mariyono & Sumarno, 2015).

In Magelang and Rembang, the share was almost the same. This is an indication that farm management in Brebes was better than in Magelang and Rembang. More involvement of family labour in the farming in Rembang and Magelang could be one cause, because not all family members were familiar with chilli production technology. Family labour might not efficient in conducting task related to chilli production technology.

Conclusion

There were different production practices of chilli farming in Magelang, Brebes and Rembang. With respect to uses of input, level of fertilizer use varied across sites. Commonly, farmers in Rembang used lower level of inorganic fertilizers, but the highest in terms of organic fertilizer use. In Rembang, there was huge such material in the place. Rembang. Urea was commonly used, beside other composite fertilizers. Even though the use of Urea was higher than that of other fertilizers, the monetary value of Urea was lower because of lower price of Urea.

Pesticides were used in all sites. In Brebes, the use of pesticides was the highest, contrast to that in Rembang. Surfactant was mostly used in Megelang and Brebes. In terms physical form, the use of fungicides was the highest. But, in terms of monetary value, the value of insecticides was the highest.

Mulching technology was adopted in Magelang and to some extent in Rembang. Farmers in Brebes did not adopt mulching because of different cultivation technology, particularly for watering. In Magelang, the use of mulching and supporting materials was three times higher than that of Rembang.

Labour devoted in the main field of chilli farming in Magelang and Rembang was higher than that in Rembang. Labour devoted mostly in land preparation and several regular activities. Of the total labour, around 30% was female, and around 40% were family members. In Brebes, more female labour employed in chilli farming. In Magelang, more family members were employed in the farming. In total, labour use for the main field was 96 percent of the total labour. Labour cost in Brebes was the highest because the fraction of hired labour was higher than that in Magelang and Rembang.

Production cost in Magelang and Rembang was quite similar, but almost double that in Rembang. This was because chilli cultivation in Magelang and Rembang was more intensive, meaning that more labour and material costs were devoted the chilli farming. However, variation in production was high, particularly in Magelang where chilli production technology was more advanced and not all farmers were able to apply such technology.

Productivity in Brebes was the highest, as well as the monetary value of production. Yield losses associated with harvesting process was very low, which was only around 1%. Average price in Brebes and Magelang was slightly higher than that in Rembang, because the location was close to the vegetable market, and less transportation cost.

Net return in Brebes was almost similar to that in Magelang. However, as in Magelang, family labour use was much higher than that in Brebes, the level of real net return in Brebes became the highest; when family labour was imputed at the average wage rate. The production costs per unit output in Brebes was also high, resulting from higher level of output and relatively lower total production costs. As a result, level of profit generated from a kg of chilli was the highest.

In terms of share, labour cost had the highest share, indicating that chilli was labour intensive farming. This was good condition because more labour can be absorbed both from family member and hired labour. Shares of pesticides, and other materials including watering cost and fertilizers were also relatively high. This was also indication that chilli farming needed more maintenance and protection from pests and diseases. It is interesting to note that the share of return to management was around 20%. Brebes gained the highest share in the return to management, or in other words, higher net return can be generated in chilli farming.

Some supporting factors, which have technological characteristics, are needed to develop the small-scaled business enterprise of chilli cultivation which can still be developed and improved to anticipate the demand opportunity as mentioned above. The structure includes improvement in technology implementation for each production cycle. The improvement on these supporting factors of the technology implementation basically has a purpose to reduce the failure of chilli production to its minimum level.

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