

Analysis of factors that influence production and cost of corn in Banten province

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Abstract. Banten Province on the 2019 year has to harvest area of corn was 66,356 ha with 331,865.38 tons production and the highest production in Pandeglang Regency. The purpose of this study was: 1) Knowing the pattern of corn farming in Banten Province, 2) Knowing the factors of production that affect corn production. 3) Knowing the cost factors that affect the cost of corn production. The analytical method used multiple linear analysis of the Cobb Douglas production and cost function. The results of the study were: 1) The planting pattern of corn was corn-corn - fallow. Dominant varieties were NK-212 (75.8%), Bima (12.1%) and BISI-18 (12.1%). Average productivity in RS 2018/2019 was 3.44 tons of dry shelled ha⁻¹. The B/C ratio is 0.7, it's mean financially not profitable. 2) Factors that significantly affect corn production were: number of seeds, amount of manure, and number of tractors rent, and variety dummy. A cumulative elasticity value of 1.0 means corn farming was efficient. 3) Factors that significantly influence the cost of production were liquid herbicide prices and human labor costs. Increasing corn productivity still needs to be done with the use of proportional farming inputs.

1 Introduction

1.1. Background

Corn production in Banten Province in 2019 amounted to 331,865.38 tons with a harvested area of 66,356 ha (CBS 2019)[1]. When compared with the harvested area in 2008 covering 27,725 ha (an increase of 139.3%) and production of 90,048 tons (an increase of 268.5%) this means a relatively high increase (CBS, 2009) [2]. The corn plant was centering in Banten Province is located in Pandeglang Regency and Lebak Regency each with a harvest area of 45,335 ha and 18,962 ha and production of 222,374 tons and 98,431.4 tons (CBS,

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2019)[1]. Typology of corn land in Gunung Kencana District, Lebak Regency was generally cultivated in dry land and in Cigugelis District, Pandeglang Regency in rainfed rice fields.

Various ways are carried out by the government in this case the Ministry of Agriculture to be able to increase corn production by increasing planting area and productivity. This is in line with the government's target for self-sufficiency and maize export in 2019 through the Special Efforts (Upsus) program. One of the Upsus programs is the cultivation of corn in an area called Corporations. Corn Corporation in Banten Province is located in Lebak Regency, namely in Gunung Kencana District in the State Company of Industry Forest (Perhutani) area. Free seed assistance and partly free fertilizer given to farmers to stimulate farmers to plant corn.

One of the obstacles in the development of corn farming in Banten Province is the very limited market. With the existence of a corn corporation, apart from extending the planting area, it also opens up the market by cooperating with animal feed manufacturing companies, namely Charoun Phokphand, Java Comfeed, Callgil, etc. To find out the condition of corn farming and the factors that influence the production and cost of corn, it is necessary to conduct an in-depth study so that it can be an input for corn commodity development policy in the future.

2 Materials and Methods

2.1. Data Collection Methods, Location and Time of Study

The method used in this study is a survey method for primary data collection. Primary data were collected through interviews using structured questionnaires at the farm level. Besides the survey method, literature studies and secondary data collection were also carried out by the District Agriculture Service agencies: Lebak. Also from the Central Statistics Agency of Banten Province and other agencies related to this study.

Primary data collection at the farm level is done intentionally (purposive sampling) because of the limited number of farmers. The number of samples of farmer respondents was 25 respondents in Gunung Kencana District, Lebak Regency and 8 farmer respondents in Cigugelis District, Pandeglang Regency.

The sample location was chosen purposively because it was the location of the development of a corn-based corporation from the Ministry of Agriculture. From the Lebak Regency, one sample district was chosen, namely Gunung Kencana District and several villages which were the areas of the corn corporation namely Bulakan Village, Gunung Kencana Village, Gunung Kendeng Village, and Kramat Jaya Village. Another sample location is Pusakanegara Village, Cigugelis District, Pandeglang Regency. The location selection was also deliberately chosen as the result of discussions with the Pandeglang Regency Agriculture Office. Study was carried out from January to December 2020.

2.2. Analysis Method

Analysis of the data used consists of qualitative and quantitative analysis. Qualitative analysis using descriptive statistics and quantitative analysis using multiple linear regression analysis. This analysis is used to see the factors of production that affect corn production in Rainy Season (RS) 2018/2019 (Soekartawi, 2002)[3]. This means that there is a relationship between the independent variables or explanatory variables (LGRP1,

JBES1, etc) with the dependent variable or dependent variable PRDKJ (Gujarati, 2003)[4].
 The guess model is as follows:

$$PRDKJ1 = a_0 + a_1JBES1 + a_2JURE1 + a_3JSP361 + a_4JNPK1 + a_5JKDG1 + a_6JPESP1 + a_7JPESC1 + a_8JHERBC1 + a_9JTRSW1 + a_{10}JTKMDK1 + a_{11}JTKMSW1 + a_{12}LGRP1 + D_1 + e \dots\dots\dots 1)$$

Equation (1) is converted into the Cobb Douglas production function by changing it in logarithmic form, namely:

$$PRDKJ1 = \text{Log } a_0 + a_1 \log JBES1 + a_2 \log JURE + a_3 \log JSP36 + a_4 \log JNPK + a_5 \log JKDG1 + a_6 \log JPESP1 + a_7 \log JPESC1 + a_8 \log JHERBC1 + a_9 \log JTRSW1 + a_{10} \log JTKMDK1 + a_{11} \log JTKMSW1 + a_{12} \log LGRP + e \dots\dots\dots 2)$$

Where:

- a_0 = constant or intercept
 - PRDKJ1 = Corn Production in Rainy Season (RS) 2018/2019 (kg/ha)
 - JBES1 = Number of Certified Seeds in RS 2018/2019 (kg/ha)
 - JURE1 = Number of Urea Fertilizers in RS 2018/2019 (kg/ha)
 - JSP361 = Number of SP-36 Fertilizers in RS 2018/2019 (kg/ha)
 - JNPK1 = Number of NPK Fertilizers in RS 2018/2019 (kg/ha)
 - JKDG1 = Number of Manure in RS 2018/2019 (kg/ha)
 - JPESP1 = Number of Solid Pesticides in RS 2018/2019 (kg/ha)
 - JPESC1 = Number of Liquid Pesticides in RS 2018/2019 (kg/ha)
 - JHERBC1 = Total Use of Liquid Herbicides in RS 2018/2019 (liter/ha)
 - JTRSW1 = Number of Rented Tractors in RS 2018/2019 (Tractor Worked Day/ha)
 - JTKMDK1 = Number of Human Workers in the Family in RS 2018/2019 (Worked Man Day/ha)
 - JTKMSW1 = Number of Leased Workers in RS 2018/2019 (MWD/ha)
 - LGRP1 = Area of Rice Cultivation in RS 2018/2019 (ha)
 - D1 = Varieties, where 1 = NK212 and 0 = Other varieties.
 - e = random error.
 - $a_1 \dots a_{12}$ = guess parameters or elasticity
- Expected parameter sign:
 $a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10} > 0$

To find out the factors that influence the cost of corn production in RS 2018/2019 the cost function is used, namely:

$$BTUSTAN = b_0 + b_1 \log HBES1 + b_2 \log HURE1 + b_3 \log HSP361 + b_4 \log HKDG1 + b_5 \log HPUL1 + b_6 \log HPUDC1 + b_7 \log HPESP1 + b_8 \log HPESC1 + b_9 \log HHERBC1 + b_{10} \log HTRSW1 + b_{11} \log HTKMSW1 + e \dots\dots\dots 3)$$

Equation (3) is converted into logarithmic form, namely:

$$BTUSTAN = \text{Log } b_0 + b_1 \log HBES1 + b_2 \log HURE1 + b_3 \log HSP361 + b_4 \log HKDG1 + b_5 \log HPUL1 + b_6 \log HPUDC1 + b_7 \log HPESP1 + b_8 \log HPESC1 + b_9 \log HHERBC1 + b_{10} \log HTRSW1 + b_{11} \log HTKMSW1 + e \dots\dots\dots 4)$$

Where:

- BTUSTAN = Total Cost of Corn Farming in RS 2018/2019 (IDR)
- HBES1 = Corn Certified Seed Price (IDR/kg)
- HURE1 = Urea fertilizer price (IDR/kg)

HSP361 = SP36 fertilizer price (IDR/kg)
HKDG1 = Price of Manure (IDR/kg)
HPUL1 = Price of Other Fertilizers (IDR/kg)
HPUDC1 = Price of Liquid Leaf Fertilizer (IDR/liter)
HPESP1 = Price of Solid Pesticides (IDR/kg)
HPESC1 = Price of Liquid Pesticides (IDR/liter)
HHERBC1 = Liquid Herbicide Price (IDR/liter)
HTRSW1 = Price of Tractor Rent (IDR/TWD)
HKTKMSW1 = Price of Hired Human Workers (IDR/MWD)
 b_0 = constant or intercept
 $b_1 \dots b_{11}$ = guess parameters or elasticity
Expected parameter sign:
 $b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9, b_{10}, b_{11} > 0$

3 Results and Discussion

3.1. Characteristics of Respondents

From the enumeration results, the average age of the respondents was 43.0 years with a range of 23 - 68 years. The average level of education of respondents was 9.3 years with a range of 6-17 years. The average length of education is equivalent to the third grade of junior high school. While the average number of family members including family heads is 3.7 people, with the largest number of family members are 7 people and the smallest is 1 person. The average area of land owned by respondent farmers in Lebak regency is 1.81 ha with an ownership range of 0 - 8.0 ha. From the own area of land owned by an average of 0.87 ha and not owned by 0.93 ha. Based on the typology of the widest land is cultivated land that is 0.6 ha consisting of land owned by 0.48 ha and not owned by 0.12 ha. Then is the average arable land area of 0.5 ha consisting of land owned by 0.28 ha and not owned by 0.23 ha. The land in question here refers to arable land that was given the right to cultivate by Perhutani for 35 years without any certificate by the Decree of the Minister of Environment and Forestry.

3.2. Corn Farm Analysis

The typology of land in the survey location is dry land, corn farming in the Gunung Kencana area is carried out on dry land, namely State Company of Industry Forest (Perhutani) land, which has been given work rights. In the survey area, the planting pattern is corn-corn. Whereas in Cigeulis District, Pandeglang Regency on rain-fed rice fields. Corn crop farming is the main crop farming in Gunung Kencana District, Lebak Regency, while in Cigeulis District, Pandeglang Regency is the second crop after rice. The analysis of corn farming in RS 2018/2019 is presented in Table 1 below.

Based on the table above it is known that the level of use of certified seeds (100%) averages 16 kg/ha. Seed prices are low because most labeled seeds are obtained through assisted seeds from the government. Types of varieties cultivated are NK-212 (76%), BISI-18 (12%) and Bima (12%). The use of fertilizers is relatively good namely Urea fertilizer at an average of 129.6 kg/ha, SP-36 at an average of 124.5 kg/ha, NPK at an average of 193.9 kg/ha, manure at 1567.1 kg/ha, and also liquid fertilizer which is 2.2 liters/ha. The average productivity of corn is relatively low, namely 3,437 kg/ha, this is due to the long drought that happened in that year. When compared with the average productivity of Banten Province in 2018, which is 5001 kg/ha, it means 31.3% lower [1].

Table 1. Farming Analysis of Corn in RS 2018/2019 per Ha in Lebak and Pandelang regency, Province of Banten

No.	Type of Input/Output	Volume	Price/Unit	Value
			(IDR)	(IDR)
1	Seed (kg)			
	a. label	16	1,921.2	30,739
2	Fertilizers (kg):			
	a. Urea	129.6	1,839.8	238,438
	b. SP-36	124.5	2,452.3	30,5311
	c. KCl	0.5	10,000	5,000
	d. NPK Ponska	193,9	2,647.1	513,273
	e. Manure	1567,1	194	304,017
	f. Others fluid fertilizer (ltr)	0.1	50,000	5,000
	h. Fluid leaf fertilizer (ltr)	2.2	61,971.8	136,338
3	Pesticides:			
	a. Solid (kg)	1	22,473.1	22,473
	b. Fluid (ltr)	0.3	30,479.2	9,144
4	Herbicides:			
	a. Fluid (ltr)	3.4	67,428.3	229,256
5	Others:			
	a. The tax of building and land (PBB)			1,228
	d. Land rent			52,167
6	Cost of Labour rent:			
	a. Rent labour (MDW)	55.8	66,015	3,683,637
	b. Family labour (MDW)	7.8	0	0
	c. Wage of Tractor service	1.3	84,516.3	109,871
7	Total Cost			5,645,893
8	Return	3,436.9	2,809.1	9,654,596
10	Income			4,008,703
11	R/C			1.7
12	B/C			0.7

Sources: Primary data, processed in 2019 year.

Expl. : n = 33 respondents.

Based on the above table, corn farmers' receipts were IDR. 9.65 million/ha with a total cost of IDR. 5.64 million so that an income of IDR. 4.0 million/ha was obtained. Thus a B/C ratio of 0.7 is obtained, meaning that each additional cost of IDR 1,000 will increase income by Rp 700, meaning that corn farming is not profitable. Based on the research results of Hermawan *et al.* (2017)[5] in Ciamis Regency, West Java province, it is known that the productivity of BISI-2 corn was 4,939 tons/ha at IDR 3,400/kg. The total production cost was IDR. 7.71 million/ha with an income of IDR. 9.1 million/ha. Based on this, a B/C ratio of 1.18 was obtained.

3.3 Factors That Influence Corn Production

To find out the factors that influence corn production in RS 2018/2019, testing with logarithmic multiple linear regression is done through the guess equation of Corn Production on RS 2018/2019 as shown in Table 2. Based on Table 2 it is known that the factors affecting significantly corn production in RS 2018/2019 are the Number of Certified Seeds (JBES1), Number of NPK Fertilizer Used (JNPK1), Number of Manure Fertilizer Used (JKDG), and Number of Used of Outside Family/Renting Workers (JTKLK). The

elasticity value of JBES1 Variable is 0.63142, meaning that every 1% increase in the number of certified seeds will increase corn production by 0.6% at a significant level of 1%. The total use of NPK fertilizer has a significant effect on corn production with an elasticity value of 5.60888 (elastic) meaning that every 1% increase in the use of NPK fertilizer will increase production by 5.6% at a 1% level. The JTKLK1 variable significantly influences corn production (PRDKJ) with an elasticity value of 45,58850 meaning that every 1% increase in rental labor will increase corn production by 45.6% at the 1% level. Then the NK 212 Dummy Variety is 0.67% higher than the non-NK 212 variety at 1% significance level. The details above are listed in the following Table 2.

Table 2. Result of Guess Equation of Corn Production on RS 2018/2019 in Banten Province

Variables	Symbols	Guess Parameter	t-counted	Significant level
Intercept	ao	6.70567	9.47	<.0001
Sum of Certificate Seed	JBES1	0.63142	2.54	0.0200**
Sum of Urea	JURE1	-0.06719	-3.41	0.0029***
Sum of SP-36	JSP361			
Sum of NPK	JNPK	5.60888	3.03	0.0059***
Sum of Manure Fertilizer	JKDG	3.68590	1.47	0.1549
Sum of Fluid Pesticide	JPESC	-940.15895	-5.50	<.0001
Sum of Fluid Herbicide	JHERBC	-44.88798	-2.71	0.0124
Sum of Family Labour	JTKDK	-18.08420	-4.05	0.0005
Sum of Rent Labour	JTKLK	45.58850	2.32	0.0298**
Area of Operated Land	LGRP	-0.25404	-0.92	0.3700
Dummy Varieties 1 = NK212, 0= Non NK 212	D1	0.67191	1.74	0.0977**
R ²	0.9676			
F	5.85			0.0003

Source: Primary data, processed in 2019.

Expl. : n= 35 respondents.

The coefficient of determination (R²) is 0.9676, which means the diversity of Corn Production Variables can be explained by 96.8% by the diversity of independent variables. Nugroho's study (2015) [6] regarding the analysis of corn production and efficiency functions in Pakean Subdistrict, Kendal Regency, Central Java Province found that the factors influencing corn production were land area, pesticides, and labor. According to Livingstone (2010)[7] based on his study in Uganda with the Cobb-Douglas function, it was found that the factors that significantly affected corn production were family labor, the number of seeds used, the amount of corn sold. The same thing was done by Utami (2016) [8] in Malang Regency, East Java Province. It was found that the factors that had a significant effect on corn production were land area, number of seeds, and the amount of manure. Furthermore, Sutarni and Apryani (2011) [9] also conducted a study of corn production in the South Lampung Regency, Lampung Province. From the results of his study, it was known that the factors that influence corn production were the area of land cultivated, the amount of KCl fertilizer, the amount of manure, and the number of labor. Based on the study of Nurwahidah *et al.* (2015) [10] in Sumbawa Regency, West Nusa Tenggara Province, it is known that the factors that significantly influence corn production were the number of seeds used, urea fertilizer, and insecticides. Suryana (2007) [11] in his study in Blora, East Java province found that factors significantly influenced the production of corn namely variation land area, new varieties, distance and plantation lots, manpower cost, and cost of variables fertilizer buyer. Atika *et al.* (2020) [12] in they were researched

in Muna District, South East province found that factors influenced the production of corn significantly namely land area and seed.

Adhikari *et al.* (2018) [13] in his study in Nepal, found that the factors that significantly affected corn production were the amount of Urea and DAP fertilizer used, and the planting area. The same study was carried out by Ombuki (2018) [14] in Kisii County-Kenya, finding that the factors influencing corn production were land ownership, weak use of high-yielding varieties, household income, number of extension visits, area of land cultivated for corn. Also the results of research by Suprapti *et al* (2014)[15] in Sumenep Regency, Madura Island show that the productivity of hybrid corn is 4.2 tonnes/ha with an average income of IDR 5.35 million/ha. Based on farming corn research by Umar *et al* (2017)[16] in Nasarawa State, Nigeria, showed that variables significantly influencing corn output in the study area were farm size, number of labor, herbicide, and fertilizer. Also research of Galingging (2020)[17] in Berau Regency, North Kalimantan Province, it was known that the factors that significantly influence corn production were the number of fertilizer and labor. Average corn productivity was 1,885 kg/ha. Nainggolan and Ulma (2020)[18] also researched Muaro Regency, Jambi Province, it was found that for the program of special efforts (UPSUS) farming, the production factors of land area, seeds, urea fertilizer, phonska fertilizer have a significant effect on production. For non-special effort farming, the level of production was very significantly influenced by land area, urea, phonska fertilizer, and decis. Osundare (2017)[19] from his research in Southwestern Nigeria, found that the number of seed planted; labor, fertilizer usage; herbicides; contact with extension workers, and farm size as regressors influenced the level of corn output under the different technology types. Geta *et al* (2013)[20] in their research in Ethiopia found that productivity of corn was significantly influenced by the use of labor, fertilizer, and oxen power. Hutami *et al* (2016)[21] in their research in Wonogiri regency in Province of Yogyakarta, found individually, the factors significantly influenced corn production were land area, number of seeds, manure, and Urea fertilizer. Zang *et al* (2020)[22] in Daqing City, China found that factors affected the production of corn were the amounts of pesticide applications, planting area, amounts of chemical fertilizer applications, and effective precipitation. Tefaye and Beshir (2014) in Illuababora zone in Ethiopia from their result research, revealed that area allocated under maize and chemical fertilizers were appeared to be significantly influencing maize production at 1 percent probability level [23].

3.4 Factors That Influence Corn Production Costs

To find out the cost factors that affect the total cost of corn production is estimated by the guess equation of corn production costs, which are listed in the following Table 3.

Based on Table 3, it is known that the factors that significantly influence the Production Costs of Corn in RS 2018/2019 are Liquid Herbicide Price (HHERBC1) and Price (wages) of human labor (HTKMSW1). The coefficient value of the HHERBC1 variable is 0.17565, meaning that every 1% increase in the price of liquid herbicides will increase the cost of corn production by 0.17% (inelastic) at a significant level of 1%. The HTKMSW1 variable significantly affects the Corn Production Costs with an elasticity value of 0.50550 which means that every 1% increase in human labor costs will increase the cost of corn production by 0.5% (inelastic). The results of the study of Paudel and Matsuoka (2009) [24] on corn production in Nepal using the stochastic frontier cost function found that the factors that significantly affected the cost of corn production were costs of: tractors, animal power, chemical fertilizers, manure, seeds, and corn products. It is also known that the average cost efficiency of 1.634 means that there is an excess of 63.4% minimum cost above the cost set by the frontier.

Table 3. Guess Equation of Corn Production Cost in Banten Province

Variable	Symbol	Guess Parameter	t-counted	Significant level
Intercept	b ₀	9.08857	2.81	0.0106
Price of certified seed	HBES1	-0.04032	-0.23	0.8192
Price of Urea Fertilizer	HURE1	-0.04032	0.82	0.4201
Price of SP-36	HSP361	0.13692	1.21	0.2403
Price of Maure fertilizer	HKDG1	-0.03220	-0.30	0.7675
Price of other fertilizer	HPUL1	0.07507	0.64	0.5292
Price of Fluid Leaf Fertilizer	HPUDC1	0.5292	-0.76	-0.76
Price of Solid Pesticide	HPESP1	0.00868	0.10	0.9184
Price of Fluid Pesticide	HPESPC1	0.03101	0.9184	0.7251
Price of Fluid Herbicide	HHERBC1	0.17565	1.91	0.0702*
Price of Rent Tractor wage	HTRSW1	0.03271	0.23	0.8169
Price of Rent Human Labour Wage	HTKMSW1	0.50550	4.86	<.0001***
R ²	0.6744			
F	3.95			0.0033

Source: primary data, processed in 2019.

4 Conclusion and Suggestion

4.1 Conclusion

The cropping pattern in Gunung Kencana District, Lebak Regency is corn-corn, while in Cigeulis District, Pandeglang Regency it is rice-maize. The dominant varieties cultivated are NK-212 (76%), BISI-18 (12%), and Bima variety (12%). The productivity and selling price relatively low. Corn farming income is IDR 4,008,703/ha/Planting Season with a B/C value of 0.7, which means this farming is not profitable. Factors that significantly affect corn production are the area of cultivated land, the amount of Urea fertilizer use, the number of NPK fertilizer use, the number of manure uses, and the number of rental laborers. Factors that significantly influence the cost of production are liquid herbicide prices and human labor costs.

4.2 Suggestion

The government needs to provide cheap hybrid corn seeds and provide basic fertilizer assistance, and also guarantee the market price for the corn harvest and provide assistance of shellers and dryers

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