Exploration of potential regional resources for beef cattle farming development in West Java, Indonesia

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Abstract. More than 90% of cattle in Indonesia are raised by smallholder farmer. They are facing limited land resources so that the input of feed mostly depend on the agriculture waste and its environment. The aimed of this study was to determine the potential agricultural resources which influence to the development of beef cattle. The sample locations were 3 districts from the eastern part of West Java province. Panel data of variables that were thought have an effect on beef cattle development were taken from 2012 to 2019 in three regencies. These data were analyses by Multiple Regression Model using the OLS method. The stationary test was done before using time series data by unit root tests of Augmented Dickey-Fuller. The results of this research showed that the corn and Cassava production, as well as the population as a source of agriculture labor in a region was potential resources to increase of beef cattle population. The integration of cattle and corn farming on suitable land in a region needs to be considered as the strategy in beef cattle farming development, because the corn production per unit of land can produce the highest feed compared to the other food crop residues.

1 Introduction

Indonesia is an agricultural country. Most of its population live in rural areas and work in the agricultural sector. Unfortunately 57% of farmer households in Indonesia or 74.43% of them in Java controlled narrow areas of less than 0.5 ha (The Central Bureau of Statistics of the Republic of Indonesia, 2018). In addition to this, 96.41% of them grow food crops and raise livestock. Small farmers generally raise beef cattle with 1 to 3 Animal Units (AU) to support and complement the crop farming to generate the farmer household income [1]. Food crop farming produces crop residue for animal feed, and the livestock can produce manure to fertilize the agricultural land. These overall activities can increase the agricultural production. Small-scale livestock production activities in developing countries, including

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Indonesia, can be an important route to address poverty for rural communities [2]. Cattle can both generate income for farmers and produce meat for highly nutritious food needed to increase human intelligence. It has been recorded that beef consumption in Indonesia continues to increase. In 2014, it was 101,416 tons per year, and in 2018, it became 125,551 tons per year, there was an increase in beef consumption by 4.76% per year on average [3].

Beef cattle development is a prospective business opportunity for farmers in rural areas in Indonesia. Research shows that local beef cattle fattening is profitable and has comparative advantages [4, 5]. This opportunity is supported by the condition in Indonesia, which geographically, has abundant natural resources to support the production of the ruminant beef cattle farming [6]. However, there are still various kinds of obstacles in beef cattle farming development in Indonesia, especially in Java, including the availability of forage, especially during the dry season [7]. In addition, there are constraints of capital and technology, poor land, and incompetent human resources [6, 8, 9]. These constraints are part of the socio-economic dynamics of farmers and agricultural resources, such as types of soil, climatic conditions, and rainfall, so that many breeders experience difficulties in providing feed, especially forage. Cattles are large ruminants that require large volumes of feed. This study is to confirm the previous research that one of the strategies to grow the beef cattle industry in Indonesia is by encouraging people to invest on the forage industry as a feed supplier, the product of which is processed with technology [9]. This way, farmers will be facilitated to access large quantities of feed throughout the year with a low price. Administratively, an area of a village, sub-district, regency, and city can have extensive agricultural land resources, workforce, and consumers, and they can create market demand. Furthermore, they are also theowners of the capital in the region.

An agricultural production process including beef cattle farming in an area can be described in the following function [10]:

$$Y = f(A, L, l, M) \quad (1)$$

Where: Y = output or product is the function of A = area of land for various household activities, L = labor, I = investment/capital, and M = management or technology. Agricultural resources such as crops and beef cattle are interrelated, dependent, and mutually supporting. The availability of resources in an area is important to be researched to increase the population and production of beef cattle. The researchers have also conducted a similar study in East Java Widiati *et al.* [11], and on this occasion, the researchers conducted a study in West Java. This study tries to find alternatives to develop smallholder beef cattle farming based on the potential of regional resources, especially plant resources that can support beef cattle farming.

2 Materials and Methods

West Java was chosen as the research location based on some considerations. West Java is a buffer area for the capital city of Jakarta in terms of the provision of livestock products including beef. However, the balance of local beef supply and beef demand in West Java was in deficit throughout 2012-2017 [12]. The eastern part of West Java has also developed new facilities, such as the new Kertajati Majalengka airport and the toll road to the capital city of Jakarta. Besides, the beef culinary in Cirebon City has been well known for a long time, so that the eastern part of West Java was chosen as the research location. Furthermore, three (3) regencies with low population density per area of agricultural land whose residents were possible to develop beef cattle are Majalengka, Indramayu, and Ciamis Regencies BPS Jawa Barat [13] were chosen as the samples.

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This study used panel data collected during the period from 2012 to 2019 (8 years) for each sample regency. The beef cattle development in an area could be measured from the increase in the population of beef cattle from year to year. The population of beef cattle could be affected by the area of land for livestock, the production of various types of plants that can produce animal feed, and the number of people who provide labor. The data sources were the Central Bureau of Statistics (BPS), the Livestock Service, the Agricultural Service in each sample regency, and other related agencies.

The existence of cattle development in an area can be measured from the increase in cattle population from year to year as dependent variable that was incl uded on the multiple linear regression model as shown as Equation 2 [14, 15].

$$BCP_{it} = \beta_0 + \beta_1 Pop_{it} + \beta_2 FL_{it} + \beta_3 RProd_{it} + \beta_4 CrProd_{it} + \beta_5 CsProd_{it} + \beta_6 SProd_{it} + \beta_7 MbProd_{it} + \beta_8 PnProd_{it} + \beta_9 SptProd_{it} + e_{it} \quad (2)$$

Where:

BCP_{it} = beef cattle population as the dependent variable in the region i in year t (head)
β_0 = intercept
$\beta_1, \beta_2, \ldots \beta_5$ = regression coefficient of independent variable
Pop_{it} = population in region i, in the year of t (person)
FL_{it} = farm land area in region i in the year of t (ha)
$RProd_{it}$ = rice production in region i and year t (ton/year)
$CrProd_{it}$ = corn production in region i and year t (ton/year)
$CsProd_{it}$ = cassava production in region i and year t (ton/year)
$SProd_{it}$ = soybean production in region i and year t (ton/year)
$MbProd_{it}$ = mungbean production in region i and year t (ton/year)
$PnProd_{it}$ = peanut production in region i and year t (ton/year)
$SptProd_{it}$ = sweet potato production in region i and year t (ton/year)
e_{it} = error term
I = 1,2,3…8 : region to 1,2,3…8
t = 1,2,3… 8 : year to 2012-2018

Estimation and validation of the model started from the correction of the time series data by using tests such as stationer, co-integration, and residual tests. The stationer tests considered here in are unit root tests of Augmented Dickey-Fuller (ADF) [15]. Furthermore, the coefficient of Regression estimated by using Ordinary Least Square method (OLS). The accuracy of the model was tested using a hypothesis test consists of a coefficient of determination (R^2), Overall test (F test) and partial test (t test). All of the above tests was done with the help of a computer using *EViews* 9th.

3 Results and Discussion

3.1 The conditions of the agriculture, beef cattle farming, and its supporting resources

Java is one of the major islands with 126.7 million ha or 6.63% of Indonesia's land area [16]. Nevertheless, it is also inhabited by 57.49% of Indonesia's population [17]. Meanwhile, West Java Province, which is one of the six provinces in Java, has a fairly large population, namely 31.52% of the population in Java. The detailed conditions of the agriculture, beef cattle farming, as well as agricultural and livestock households are presented in Table 1.

Table 1. The conditions of the agriculture, beef cattle farming, and supporting resources inWest Java, Indonesia

No	Activities	Indonesia		Java		West Java	
		Total	%	Total	%	Total	%
1	Beef cattle population (000 head)[a)]	16,433	100	7,156	43.55*	406	5.67**
	Population (000 person)[b)]	237,641	100	136,611	57.49*	43,053	31.52**
2	The area of agricultural land (000 ha)	7,460	100	3,128	41.93*	928	29.67**
3	The number of land-users agricultural sector households (000 RT)	27,682	100	13,862	50.08*	3,251	23.45**
	The number of land ownerhouseholds <0.5 Ha (000 Household)	15,809	100	10,318	74.43*	2,499	24.21**
4	The number of food crop farming (Households_	20,284	100	11,367	56.04*	2,666	23.45**
	Rice	13,155	64.85	7,129	54,19	2,249	31.54**
	Secondary crops (dry land food crops_)	7,129	35.15	4,238		417	15.64**
5	The number of households inbreeding sectors (000 RT)	13,562	100	8,242	60.77*	1,435	17.41**
	- Livestock and food crops	13,346	98.41	8,113	98.43**	1,414	98.54**
	-Livestock and non-food crops	216	1.59	129	1.56**	21	1.46**

Note: *) percentage in Indonesia, **) percentage in Java

Sources: a) Directorate General of Livestock and Animal Health [3], b) Kartawisastra et al. [16], Central Bureau of Statistics [17]

The development of beef cattle farming cannot be separated from its agricultural conditions, especially the land area, land use, and types of plants that will produce crop residues. Since beef cattle are plant-eating ruminants or herbivores, the source of feed depends on theagricultural land to produce forage. From Table 1, it can be seen that regarding the supply of beef, West Java is a beef consumer area as seen from the total population of 31.52% of the population in Java. However, the whole population of beef cattle as a beef producer is only 5.67% of the population in Java. Based on the capacity of the agricultural land in West Java, which is 30% of the agricultural land in Java can produce forage, this condition gives an opportunity to increase the cattle population in West Java. Unfortunately, 74.43% of farmers only control 5,000 m2 of land in Java, and 24.21% of the farmers are in

West Java. Becauseof the dependence of ruminants on the agricultural land as a producer of forage and the narrow land, the integrated farming and livestock activities are generally carried out by the farmers, especially in Java. It can be proven that 98.41% of farmer households in Java have livestock and food crop activities (Table 1), including beef cattle farming. For that reason, itis necessary to explore local resources, especially what kind of food plants that can increase the population of beef cattle.

3.2 Factors that influence to the development of beef cattle population

Based on the root test using the Augmented Dickey-Fuller (ADF) method, at the stationary level, there are 5 stationary independent variables out of the 9 independent variables in the model, namely the population, corn production, cassava production, green bean production, and peanut production (ADF Prob <0.05). Furthermore, the multiple linear regression analysis was carried out with stationary independent variables using the OLS method. The results of the multiple linear regression analysis show that the population variable (*Pop)*, corn production (*CrProd*) and cassava production (*CsProd*) has a significant positive effect (p<0.01) on the beef cattle population, while the independent variables of green bean and peanut production have no significant effect on the beef cattle population (Table 2).

Table 2. The results of the regression analysis of the factors that influence the development of beef cattle population

Variable	**Coefficient**	**Sig**
(Coefficient)	-68951.99	0.0000***)
Population (Pop)	0.0469	0.0000***)
Corn Production (CrProd)	0.1775	0.0000***)
Cassava Production (CsProd)	0.1640	0.0005***)
Green Bean Production (Gb Prod)	-0.1248	0.8772
Peanut Production (PnProd)	1.7644	0.2643
R-square	0.9242	
Adjusted R^2	0.9032	
Prob (F-statistik)	0.0000	

Note: ***) Significant at p<0.01

Rice straw production has not significant effect on the increase of beef cattle population even though the rice plant produces potential rice straw for beef cattle feed. This is because the recorded rice straw data were fluctuated and not stationer, so that the data were not included in further analysis. The crop residue of corn and cassava has a significant positive effect, which means that the increase in the yields in West Java will increase the population of beef cattle. Nevertheless, the crop residue production of corn per hectare is greater than that of cassava as can be seen from the following research results (Table 3).

Table 3. The crop residue production of corn vs. cassava from some previous research

The crop residue production of corn*		
No.	Tons/ha/harvest	Reference
1	5.99	[18]
2	6.00	[19]
3	5.70	[20]
The crop residue production of cassava**		
1	4.90	[21]
2	5.00	[22]
3	6.3	[23]

Note: *harvested twice a year, ** harvested once a year

Table 3 shows that the crop residue production of corn per ha per harvest is almost the sameas that of cassava. The production of corn, however, is shorter than that of cassava. Corn can be harvested 2 to 3 times per year, while cassava can only be harvested once per year [21]. Thus, the crop residue production of corn per ha per year is higher than cassava. From the results of this study, it can be concluded that the integration of corn and beef cattle farming is an instrument for the development of beef cattle farming in West Java and can be used as the basis for policies, especially the development of beef cattle for smallholder farmers.

4 Conclusion

The development of beef cattle in West Java should be directed towards the areas whose land has the capacity to grow corn and cassava. In addition, it is necessary to consider areas where the population has the potential to work in the sector of agriculture-breeding. The integration of corn and beef cattle farming is an instrument for the development of beef cattle farming in West Java and can be used as the basis for policies, especially the development of beef cattle for smallholder farmers. This is because corn can produce crop residue as forage for beef cattle higher than that of cassava per unit of land per year.

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