International Journal of Business and Society, Vol. 20 No 1, 2019, 417-431

PERFORMANCE AND ECONOMIC INCENTIVES OF COW-CALF OPERATION CROSSBRED IN THE SMALLHOLDER CATTLE IN YOGYAKARTA-INDONESIA

Rini Widiati[♣]
Universitas Gadjah Mada

Sudi Nurtini
Universitas Gadjah Mada

Tri Anggraeni Kusumastuti
Universitas Gadjah Mada

Suci Paramitasari Syahlani
Universitas Gadjah Mada

Mujtahidah Anggriani Ummul Muzayyanah
Universitas Gadjah Mada

ABSTRACT

Cow farmers in Indonesia have adopted artificial insemination technology for the Simmental and Limousin breed with the local cows (PO), which creates Cow-Calf operation (CCO). This paper aims to identify the performance of PO, SimPO and LimPO breed in the local livestock in Yogyakarta and to determine the economic incentive for CCO from PO, SimPO, and LimPO. We use multistage sample and select 270 cows that consist of PO, SimPO, and LimPO from several sub-districts. We use direct interview with a semi-structured questionnaire to collect the data. In addition, direct observation to the sample cattle is conducted. Our study reveals that SimPO and LimPO Crossbred significantly result in high input-high output, while PO significantly generates low-input-low output. Moreover, economic incentive in the form of PO net farm income of is the highest one and significantly different to others. Furthermore, we can identify the potential sub-districts to promote CCO. We recommend to terminate the utilization of the SimPO and LimPO for CCO business and focus on PO to improve the welfare of smallholder cattle.

***Keywords**:* Cow calf operation; Ongole crossbred SimPO and LimPO, Net farm income; Economic incentive; Performance

1. INTRODUCTION

The increase in the beef demand in Indonesia is faster than the increase of the national production, thus, it leads to increased import of beef (Widiati, 2014; Pahantus et al. 2017). The average meat consumption per capita per year in Indonesia over the 2002-2019 is 2.26 kg with the average yearly growth is 2.89%. However, the domestic production is not sufficient to cover the demand. Therefore

♣ Corresponding author: Universitas Gadjah Mada, Jalan Fauna 3, Bulaksumur Campus, Yogyakarta, Indonesia rini_w@ugm.ac.id

a substantial proportion of beef consumption has to be filled by import. In 2016, imported beef has reached 35.37% of the beef consumption in Indonesia, which is around 675,000 tons (Director General of Livestock and Animal Health, 2017). The demand for national beef is predicted to keep increasing along with the increase in the population of Indonesia by 1.2% per year, where Indonesia's population in 2016 is approximately 237,641,326 (Central Bureau of Statistics, 2013).

The main issue is the slow growth in beef production because almost all local beef supply comes from smallholder farms with small-scale maintenance efforts and lack of working capital (Widiati, 2014; Sodiq et al., 2017). Small-scale livestock businesses conducted by farmers are generally inefficient and have low productivity, however, it still contributes to overcome poverty (Rootman et al., 2015). Agricultural activities in developing countries, including Indonesia, generally are dominated by small farmers. They maintain a number of livestock such as cattle that can generate additional income to support the households (Ryschawy et al., 2012; Widiati and Widi, 2016). Efforts to improve the welfare of farm households in developing countries is crucial and have become a major global concern (Herrero et al., 2012). Limited grassy field in developing countries including Indonesia has led to a slow growth in beef cattle production. Therefore, the governments has to establish a policy to import beef. The issue with beef import policy in Indonesia is that imports are more profitable because the price of imported beef is cheaper than the domestic beef prices (Director General of Livestock and Animal Health, 2017; Widiati, 2014). This will create a disruption in the local beef market, thus local farmers will be less enthusiastic on increasing their production and finally the production cannot catch up with the increase in demand for beef. This problem also happens in Malaysia (Sheng, 2010). Cheaper price of imported beef compared to local beef has a significant effect on the increase of import volume (Rudatin, 2016). The limitation of beef imports and feeder cattle will increase domestic beef production but in the end it will reduce the cattle population because local cattle slaughter rate increases (Kusriatmi et al., 2014; Widiati, 2014). Therefore efforts to increase cattle population in Indonesia to increase beef production must be done. The increase in beef cattle population aims to increase local beef production, while at the same time increasing the welfare of smallholders who make the majority of these activities. Cow-calf operation (CCO) is the first stage of the beef production process. Through the breeding process, cows will produce calves to be breastfed, the usual weaning-off age is 6 months. Heifer calves may be retained for herd expansion (sold breeding) or sold along with the steers to feedlot operators, who will continue to grow out of these animals until it reach its slaughter age around 2.5 years old. Therefore, a beef cattle production process requires a long investment time. There are three business stages in the beef cattle production process, namely cow-calf operation that produces weaning calves, cattle feeders businesses that needs 1-1.5 years of calves' age, and then they will be transferred to the feedlot operators that prepare cattle to be ready to be slaughtered for meat production cattle (Widiati and Widi, 2016).

In an effort to increase the production and productivity of beef cattle in local farms, advanced technologies are adopted such as feeder technology and superior breed technology through Artificial Insemination (AI) that will produce superior calves that are larger than local cattle (Director General of Livestock and Animal Health, 2017). PO is a local cattle as the result of breeding cattle between Java cattle and Sumba Ongole (SO) cattle that developed in around 1930 (Ngadiyono et al., 2017). Many superior breeding cows in Yogyakarta livestock farms, Indonesia, are Simmental cattle (originating from Switzerland) and male limousines (of French origin), which is inseminated through AI with female PO breeds (Sumadi et al. 2010). Calves from this AI insemination will create a superior studs that known as SimPO and LimPO. SimPO cattle means that female PO is inseminated

(AI) with Simmental males and LimPO means that females PO are inseminated with Limousin males. At the local farmers in Yogyakarta, the female calves from the AI result are kept as a brood stock for the CCO business, while the male calves enter the feedlot operators to be fattened and then sold with a, generally higher, selling values than the PO cattle due to its body shape and larger SimPo and LimPO cattle meat (Setiyono et al., 2017). However, with its large body shape, compared to PO cattle, both the brood stock and the calves will require greater feeder input and better maintenance, thus it needs a huge production costs. The implementation of technology such as the distribution of superior breeds can increase production and productivity but it requires additional input costs. According to Berg (2011), the effort in developing a new technology should be able to deliver a result that can be used to finance additional inputs, thus it will be profitable and can contribute to the welfare of society. The complexity and high costs of developing technology is common in agriculture/livestock sector in developing countries that contributes to the stagnation in the production process (Todaro and Smith, 2015). This means that the use of technology must be economically filtered, where the value of increasing productivity from the use of these technologies must be able to cover additional input costs. On the other words, it should be profitable (Widiati, 2014). The objectives of this paper is to identify the performance of Ongole crossbred (PO), SimPo, and LimPO beef cattle breeders that developed in the Special Region of Yogyakarta, Indonesia, and to determine the economic incentives for PO, SimPO, and LimPO CCOs.

2. RESEARCH METHOD

2.1. Location and Sample

The population of the three types of beef cattle is unknown. Therefore, multistage sampling method is used in this study because it can be implemented more efficiently for the populations that are scattered over a wide area and for the hidden populations (Mukhopadhayay, 2008). We conducted the study in the Yogyakarta Special Province in Indonesia where the population of PO, SimPO, and LimPO could be found in four districts. The first stage is determining the three districts with large cattle populations which are Sleman, Bantul, and Gunung Kidul Regencies. The next stage, from each selected regency (district), one sub-district that is densely populated by beef cattle population is selected, namely Wonosari sub-district from Gunung Kidul Regency, Imogiri from Bantul and Prambanan from Sleman. Furthermore, from each sub-district, a convenience sample is taken that consist of 30 PO, SimPO and LimPO beef cattle as a CCO business maintained by farmers at the study site. Data collection at the sample location is carried out with the assistance from the additional staff from each sub-district, who understand the distribution of the three cows' types among the farmers at the study site. In total there are 270 productive samples of PO, SimPO, and LimPO cows as CCO business carried out by community farmers in 3 selected Sub-District locations. The study was conducted from April to November 2017.

2.2. Data Collection Method

The sample brood stock is a productive brood stock for PO, SimPO, and LimPO cattle that have produced a calf at least 1 time. This provision is made to make it easier for the researchers to explore the data about the brood stocks performance. The performance of the brood stocks in the CCO business that affect revenue and costs and determines economic incentives is the birth interval (calving interval), Service per conception (S/C), and calf mortality (Widiati and Widi, 2016). Calving

interval is the distance between one calf and the subsequent calf from one brood stock. The longer interval of one calf to the next one, the smaller the calving rate per unit time, thus inflict a greater cost to the farmers, such as brood stock feeding cost, and vice versa. Service per conception is the number of service (insemination) to the brood stock required to effect pregnancy. Direct observation of the brood stocks sample is carried out to obtain the data on the performance of PO, SimPO, and LimPO cows in the 3 (three) selected locations. Furthermore, the data related to livestock maintenance management as well as input and output prices are collected using survey through direct interviews with farmers. The owners of the brood stock samples are selected to participate in a survey using the semi-structured questionnaires. The unit of analysis in this study is the annual broodstock number per CCO business.

2.3. Data Analysis

The identification of the performance of PO, SimPO, and LimPO cows is analyzed descriptively. The economic incentives for the CCO business is measured using Net farm income analysis, and calculated from the amount of net proceeds or the return to farmers for labor, management, and unpaid equity capital used to produce livestock (Kay et al., 2011). This calculation is in accordance with the sample conditions in this study, where the CCO business operated by small farmers with their family members as the main employees and self-management, and unpaid equity capital. The calculation for the net farm income in this study is as follows:

Net farm income =

$$Total\ cash\ revenue - total\ cash\ expense\ (\frac{\frac{IDR}{cow}}{year}) \quad \text{.....(1)}$$

While, the estimation of revenue from calf sales/cow/year is

$$\frac{12\ months}{CI(months)+ACS(months)} x(1 - \%\ of\ CM)\ x\ PCS\ (IDR) \quad \text{.....(2)}$$

Where,
CI: Calving Interval
ACS: Age of calf sales
CM: Calf mortality
PCS: Price of calf sales
Total cash expenses =
Cash expenses for operation + interest payment for cows ..... (3)

We test the differences in calves' performance and economic incentives of PO, SimPO, and LimPO cattle as CCO businesses in 3 locations using the Completely Randomized 3X3 factorial design analysis. It includes testing the differences in the performance between PO, SimPO, and LimPO in the three locations indicated by the technical parameters in form of calving intervals, S/C, selling age, and calf values. Second, we also test the different economic parameters of PO, SimPO, and LimPO cows as CCO business in 3 locations in the form of cow prices, feeding costs, and Net farm income.

3. RESULTS AND DISCUSSION

3.1. Description of the Locations

In this study, the CCO businesses is owned by cattle farmers who, generally, are farmers with a relatively narrow agricultural land. To fulfill the needs of cattle feed, they depend on the by-product of their agricultural products and their surrounding agricultural environment. Such condition is common in the developing countries, where plants and live stocks are the main economy of rural households and most of the citizens cultivate food crops and raise livestock to meet their household needs (Adebowale, 2018). The general conditions of the research location related to the maintenance of beef cattle is presented in Table 1 below.

Table 1: Types and area of land use in each sub-district

Note	Wonosari-Gunung Kidul	Imogiri-Bantul	Prambanan-Sleman
Area (ha)	7561	5448	4135
Rice field	1.34%	20.15%	40,8%
Garden	54.23%	34.12%	11,15%
Yard	33.50%	40.36%	32,63%
Forest	7.40%	5.23%	0%
Others	3.53%	0.15%	15,7%
Density	1055/km^2	947/km^2	1296/km^2
Cattle (cow) population	6091	5075	4983
Temperature	29.3-31.7 ^{o}C	23-26^{o}C	24-26 ^{o}C

Sources: Local Institution, Wonosari District in Figures 2017. Central Bureau of Statistics Gunung Kidul Regency, Prambanan District Statistic 2017, Imogiri District Statistic 2017

The existence of agricultural land is important for raising livestock, especially cattle. It is because forage as a basic feed for cattle (ruminants) is produced from grasslands or agricultural residues that are not consumed by humans such as hays and other by-products. It can be seen that in the three research locations, feed sources came from rice fields and gardens and there are no grazing land. Farmers in the research location maintain livestock by straining their cattle in a cage, while farmers look for grass, collect, and give it to the cattle. Feed is a source of growth and reproduction that will ultimately determine the performance and production of livestock. Therefore, it is important to understand the use of land that is suitable for cattle farming, thus the food supply around the study site can be estimated (Widiati et al., 2017). Based on the analysis in Table 1, it appears that there is a positive correlation between the type and extent of land use and the population of cattle heaps in each district.

Besides the role of land usage, environmental temperature also affect livestock life. With appropriate environment's condition, livestock can live comfortably and its physiological processes can function normally. The appropriate environmental temperature of the physical environment for cattle in the tropics region such as Indonesia is 18 ° C-32 ° C (Suhaema et al., 2014). The research location has the environmental temperature that is appropriate for the life of beef cattle.

3.2. Cattle Farming of CCO Business at the Research Location

The identities of cattle farmers of CCO respondents PO, SimPO, and LimPO are presented in Table 2.

Table 2: Identities of PO, SimPO, and LimPO cattle farmers

Variable	PO	SimPO	LimPO	Average
Age	55.08±11.47	56.06±11.53	56.26±12.28	55.8±11.76
Education	7.49±1.25	6.90±1.08	8.22±1.29	7.54±1.21
Experience (cattle)	20.67±14.31	25.18±15.29	24.26 ±17.37	23.37±15.66
Experience (farm)	28.85±16.49	29.19 ± 16.13	28.85±16.49	28.96±16.37
Number of family members	3.90	4.15	4.39	4.15
Number of cows (AU)*)				
Gunung Kidul	2.23±1.5	2.33±1.02	2.5±1.45	2.36±1.34
Imogiri	1.83±1.23	2±1.45	1.6±0.56	1.81±1.03
Prambanan	2.63±0.85	2.76±0.93	2.27±0.86	2.55±0.90
Agricultural area (m^2)				
Gunung Kidul	2535 ±2250	2673±1841	2985±2145	2731±2071
Imogiri	996 ±775	1315±1247	1684±1493	1332±1228
Prambanan	1276±860	2506±2980	2762±2945	2181±252

Note:*) Cow = 1 AU, bull =1 AU, young cow =0.5 UT, calves = 0.25 UT

The average age of the farmers is 56 years, which is a productive age. The Indonesian government determines the productive age is between 15 to 65 years old (Central Bureau of Statistics, 2013). The average formal education taken by the farmers is 7.5 years, which mean most of the farmers are not graduated from junior high school, thus it can be concluded that their education level is still under the compulsory education program established by the Indonesian Government where every Indonesian citizen must graduate from junior high school or 9 years of formal education. Nevertheless the respondents have had an average farming experience of 23 years, but their business remain on a small scale. This shows that the cattle farming business is considered as a side business and they have a weak capital thus they are unable to increase their scale of business. The average cattle ownership is around 2-3 AU and the average land ownership area is around 1000-3000 m2 with a large variation seen from the standard deviation. Farmers are also cattle farmers and have 29 years of livestock farming experience (Table 2). In poor and developing countries, livestock in smallholder farms and kept by a number of farmers are said to be very important to help get the benefits of their products (Bimrew, 2018). Livestock production is considered to be an important pathway out of poverty for the rural community in developing countries (Kristjanson et al., 2010). The cattle farms in developing countries that are carried out by smallholders farmers, is a businesses that needs mutual supports from both livestock and plants, thus they can optimize the use of their resources. According to Ates et al. (2018) there are constraints on smallholder livestock in the form of limited land resources, water scarcity, poor infrastructure, and environmental degradation. However, in the small scale, crop-livestock farming systems can overcome problems related to production efficiency, system risk, and the development of the entire value chain system.

Therefore, beef cattle farmers in Indonesia need to be empowered, thus they can increase their contribution in supplying beef and at the same time are capable to contribute to the farmers' welfare.

Increasing production and productivity can be done by adding investment and/or using technology (Berg, 2017). The technology implementation that has been carried out by beef cattle farmers in the research location are: the use of concentrate feed, superior grass planting, and breeding of cattle through AI. The results of the PO, SimPO, and LimPO crossbred as CCO business is influenced by technological results that are interrelated with feeding and maintenance management. The application of concentrate and forage feed technology is presented in Tables 3 and 4.

Table 3: Types of feed concentrates for PO, SimPo, LimPo cattle used by respondent farmers in Wonosari-Gunung Kidul District, Imogiri-Bantul District and Prambanan-Sleman District

Types	**PO**		**Simpo**		**Limpo**	
	N	**(%)**	**N**	**(%)**	**N**	**(%)**
Gunungkidul (n=90)						
Pollard	20	66.67	20	66.67	24	80
Soybean skin	0	0	0	0	0	0
Tofu	0	0	0	0	0	0
Bran	19	63.33	21	70	17	56.67
Cassava pulp	5	16.67	3	10	7	23.33
Bantul (n=90)						
Pollard	8	26.67	7	23.33	6	20
Soybean skin	3	10	6	20	5	16.67
Tofu	1	3.33	2	6.67	0	0
Bran	24	80	25	83.33	27	90
Cassava pulp	1	3.33	1	3.33	0	0
Sleman (n=90)						
Pollard	20	66.67	16	53.33	11	36.67
Soybean skin	2	6.67	0	0	2	6.67
Tofu	2	6.67	0	0	0	0
Bran	26	86.67	27	90	29	96.7
Cassava pulp	1	3.33	3	10	0	0
No Concentrate (n=90)	14	15.55	5	5.55	6	6.67

From Table 3, it appears that most farmers use concentrate feed technology in the form of pollard, which is an imported raw material. Whereas another concentrate feed resources is local feed ingredients. Of all the cows observed there are 14 (15.55%) PO cattle that are not fed using concentrate, thus there are also 5 (5.55%) SimPO cows, and 6 (6.67%) LimPO cows that are not fed using concentrate. Farmers that do not use concentrates states that they do not have the capital or they only has enough capital for forage feed. Breeders generally provide more than one type of concentrate and forage feed. Farmers in Gunung Kidul, shows the largest percentage of pollard usage, it is because the largest agricultural land in that area is moor (Table 1), which is generally planted with secondary crops (polowijo), thus there are only a small amount of rice bran is produced. Meanwhile, in Bantul and Sleman there are plenty paddy farmers who produce by-products in the form of rice bran (especially Bantul), thus the percentage of farmers who provide bran for their livestock is greater. This proves that farmers are already rational in utilizing existing feed resources, thus costs can be reduced.

Table 4: Forage types for PO, SimPo, LimPo cattle used by farmers in Gunung Kidul, Bantul, and Sleman

Feed type	PO		SimPo		LimPo	
	N	(%)	N	(%)	N	(%)
Gunungkidul (n=30)						
Straw	27	90	28	93.33	24	80
Field grass	12	40	13	43.33	7	23.33
Superior grass *)	30	100	25	83.33	30	100
Bantul (n=30)						
Straw	29	96.67	29	96.67	30	100
Field grass	17	56.67	14	46.67	13	43
Superior grass *)	24	80	23	76.77	24	80
/Sleman (n=30)						
Straw	30	100	30	100	30	100
Field grass	20	66.67	18	60	21	70
Superior grass *)	13	43.33	16	53.33	14	46.67

*) Superior grass can be elephant grass, king grass and *kolonjono*

Table 4 shows that farmers generally provide more than one type of forage feed. More than 50% of farmers in all three research locations use superior grass plants for their livestock feed. In Wonosari-Gunung Kidul sub-district moor land is generally planted with secondary crops (polowijo), wood, and grass and the average land ownership is relatively broad, thus almost all farmers plant and provide superior grass for cattle. Feed is a determining factor for the survival and success of livestock production businesses.

3.3. Performance of PO, SimPo, and LimPo

Increased cattle population cannot be separated from cow performance (Ngadiyono et al., 2017). In livestock business including cattle, the performance of livestock will affect the revenues and costs of (Widiati and Widi, 2016), both cows and calves in growth. Performance on calf production includes service per conception (S/C), Calving interval, and quality of calves born. The quality of calves born is measured in the form of birth weight or weaning weight (Sutarno and Setyawan, 2015), which can also be referred to as technical parameters for the basis of economic calculations. This study use survey method and the approach used to measure the quality of calves born is the price of calves sold as CCO business revenues, assuming all rational breeders maximize their business, thus prices are the attributes of quality. The results of the technical parameters for the performance of PO, SimPO, and LimPO cows from the three research locations is presented in Table 5.

3.4. Calving Interval (CI)

CI is the distance between two subsequent calf births, shorter CI will generate larger income per year from a CCO business and vice versa. The results of the analysis show that the interaction between origin and different locations do not significantly affect the CI of beef cattle. The regional difference in beef cattle has a significant effect ($P < 0.05$) on beef cattle CI. In general, PO cattle have the lowest CI of 15.85 ± 3.18 months, which is the best because it is the lowest CI value compared to SimPO CI 16.72 ± 5.14 months and LimPO CI is 17.94 ± 5.21 months. Different results from the research

conducted at Central Java Regency, recorded CI for PO, SimPO, and LimPO cows respectively are 14.40 months, 14.87 months, and 15.37 months (Aryogi and Adinata, 2015). Another study noted that CI of PO and LimPO are 449.04 ± 39.97 days (14.97 months on average) and 466.04 ± 44.09 months (on average 15.53 months) (Akriono et al., 2017).

Table 5: Technical parameters of PO, SimPO, and LimPO CCO

Variable	Breed / Location	cco PO	cco SIMPO	cco LIMPO	*Total average*
CI (month)	Wonosari- Gunung kidul	16.18 ± 3.10^{*NS}	17.83 ± 6.43^{*NS}	18.53 ± 5.72^{*NS}	17.52 ± 5.08^{*NS}
	Imogiri- Bantul	15.57 ± 3.43^{*NS}	17.13 ± 4.68^{*NS}	17.13 ± 4.45^{*NS}	16.61 ± 4.19^{*NS}
	Prambanan- Sleman	15.80 ± 2.93^{*NS}	15.20 ± 3.73^{*NS}	18.17 ± 5.46^{*NS}	16.06 ± 4.04^{*NS}
	Average	15.85 ± 3.18^{a}	16.72 ± 5.14^{a,b}	17.94 ± 5.21^{b}	
S/C (times)	Wonosari- Gunung kidul	1.90 ± 0.80^{*NS}	2.03 ± 1.16^{*NS}	1.83 ± 0.79^{*NS}	1.92 ± 0.92^{a}
	Imogiri- Bantul	2.50 ± 1.59^{*NS}	2.57 ± 1.10^{*NS}	2.23 ± 0.97^{*NS}	2.43 ± 1.22^{b}
	Prambanan- Sleman	2.40 ± 1.40^{*NS}	2.47 ± 1.12^{*NS}	2.43 ± 1.28^{*NS}	2.43 ± 1.26^{b}
	Average	2.27 ± 1.32^{*NS}	2.36 ± 1.13^{*NS}	2.17 ± 1.05^{*NS}	
Selling age (Month)	Wonosari- Gunung kidul	6.53 ± 1.36^{a}	6.80 ± 1.58^{a,b}	6.15 ± 1.23^{a}	6.49 ± 1.39^{*NS}
	Imogiri- Bantul	6.90 ± 1.18^{a,b}	6.23 ± 1.22^{a}	7.53 ± 2.27^{b}	6.89 ± 1.56^{*NS}
	Prambanan- Sleman	6.53 ± 1.46^{a}	6.40 ± 1.71^{a}	6.27 ± 2.10^{a}	6.40 ± 1.76^{*NS}
	Average	6.66 ± 1.33^{*NS}	6.48 ± 1.52^{*NS}	6.65 ± 2.00^{*NS}	
Calf mortality (% probability)	Wonosari- Gunung kidul	0.00 ± 0.00^{*NS}	0.00 ± 0.00^{*NS}	0.17 ± 0.38^{*NS}	0.06 ± 0.13^{a}
	Imogiri- Bantul	0.10 ± 0.31^{*NS}	0.20 ± 0.41^{*NS}	0.20 ± 0.41^{*NS}	0.17 ± 0.37^{b}
	Prambanan- Sleman	0.20 ± 0.48^{*NS}	0.26 ± 0.45^{*NS}	0.10 ± 0.30^{*NS}	0.07 ± 0.41^{b}
	Average	0.10 ± 0.34^{*NS}	0.16 ± 0.36^{*NS}	0.16 ± 0.36^{*NS}	

Note:

$^{*a, b, c}$ Significant at 5% level

^{*NS} Not significant at 5% level

Ngadiyono et al. (2017) noted that the CI of PO cow is 15.25 ± 0.42. The study in northern Poland noted that the CI of pure Simmental and Limousin are 391 ± 100.60 days (mean 12.64 months) and 457 ± 163 days or 14.87 months (Czerniawska-Piątkowska et al., 2012). Accordingly, it can be concluded that the CI of PO cow is the shortest compared to SimPO and LimPO cattle, and LimPO

cattle has the longest CI. Normally the CI of cow is 12 months, consisting of days open cattle that last for 85-120 days and the average length of pregnant cow that lasts 278 days (Andrabi et al., 2017).

3.5. Service per Conception (S/C)

S/C is the number of services required to establish a viable pregnancy, the more S/C will increase the cost of mating and the cost of feed because it extends the holding time to produce calves. All cows in the study location have used AI. The results of the analysis show that the interaction between the breeds of cattle and different research locations does not significantly affect the S/C. The differences of breeds also have no significant effect on S/C. Cattle locations have a significant effect ($P < 0.05$) on S/C. Wonosari District - Gunung Kidul Regency has the best S/C (1.92 ± 0.92) because the S/C value is lowest compared to Imogiri-Bantul (2.43 ± 1.22) and Prambanan-Sleman ($2, 43 \pm 1.26$). This is probably because the location of Wonosari-Gunung Kidul is the furthest away from the capital city of Yogyakarta Province, thus there is a possibility that there are less industrial employment opportunities that makes the farming community is better at managing cattle, which leads to short S/Cs. The cost of each AI appointment at the research locations ranged from IDR 40,000 to Rp. 50,000. Other researchers noted that PO S/C is 1.56 ± 0.75, SimPO is 2.02 ± 0.69 and LimPO is 1.97 ± 0.72 (Aryogi and Adinata, 2015). Furthermore, Akriono, et al., (2017) noted that the S/C of PO and LimPo are 1.42 ± 0.70 and 1.62 ± 0.76 respectively. Ngadiyono et al. (2017) notes that the S/C of PO cattle is 1.71 ± 0.14. Accordingly, it can be concluded that the S/C of PO cattle is the best compared to SimPO and LimPO cattle.

3.6. Selling Age of Calves

Cattle farmers generally sell their calves after weaning them. Cattle CCO businesses require a long time thus they sell calves to get cash income immediately. Generally they sell the calf to capital owners to be raised as breeding stock (female calf) and feeder cattle (male calf) (Widiati and Widi, 2016). The results of the analysis show that the interaction between different breeds and locations has a significant effect on the age of selling calves. However, different locations have no significant effect on the age of calf selling. The difference in beef cattle breed also does not significantly affect the age of calf selling, which varies from 4-7 months. The location does not have a significant effect on the age of selling calves, because all farmers in all three locations are small farmers with the same maintenance management, thus they also have similarities in making decisions to sell the calves. Besides that, the market is likely to require calves to be sold for around 4-7 months.

3.7. Calf Mortality

Calf mortality will reduce the revenue of the CCO business. Our results indicate that the interaction between breeds and different locations does not significantly affect the difference in mortality rate. The difference in beef cattle breeds does not significantly affect the mortality rate. Different locations have a significant effect ($P < 0.05$) on the mortality rate. Location with the lowest mortality rate is the Gunung Kidul Regency.

The mortality rate in this study is calculated from the number of calf mortality for 3 years in each respondent's farmer by assuming that there are 2 calf births, thus it is expected to produce better data. Furthermore, the average percentage of mortality per head is calculated from 30 respondents or 30 cows per research location. The results showed that the mortality rate is 0.35% / cow (Table 5), thus

if the average mortality of all sample cow per breed per location is calculated = (0.35% x30) / 3 years, then the calf mortality rate from the results of this study is 3.5% / year. The mortality of calves from the results of this study is smaller than the previous study of 4-5%/year (Wiyatna et al., 2012). Performance or technical parameters of cows together with economic parameters in the form of input and output prices related to cattle CCO business will determine the economic incentives of the business. The economic parameters of the PO, SimPO, and LimPO cattle CCO business in 3 research locations are presented in Table 6.

Table 6: Economic parameters of CCO of PO, SimPO, and LimPO in 3 locations

Variable	**Locations**	**CCO PO**	**CCO SIMPO**	**CCO LIMPO**	*Average*
Price of cow (000IDR)	Gunung kidul	12000 ±2080.28^{*NS}	15150 ± 3471.93^{*NS}	15700 ± 1622.05^{*NS}	14283.33 ± 2391.42^{*NS}
	Bantul	12016.67 ± 2350.65^{*NS}	15150 ± 3707.28^{*NS}	15433.33 ± 3692.33^{*NS}	14200.00 ± 3250.09^{*NS}
	Sleman	12633.33 ± 2906.39^{*NS}	15850 ±3499.14^{*NS}	15016.67 ± 2805.42^{*NS}	14500.00 ± 3070.32^{*NS}
	Average	12216.67 ±2459.84^{a}	15383.33 ± 3536.37^{b}	15383.33 ± 2818.53^{b}	
Concen trate cost (000IDR)	Gunung kidul	1354.45 ± 748.31^{*NS}	2286.73 ± 959.44^{*NS}	2151.55 ± 741.10^{*NS}	1930.91 ± 816.28^{*NS}
	Bantul	1502.58 ± 732.64^{*NS}	2398.66 ± 1659.13^{*NS}	2165.06 ± 626.61^{*NS}	2022.10 ± 1006.12^{*NS}
	Sleman	1719.88 ± 831.66^{*NS}	2728.38 ± 1533.01^{*NS}	2304.37 ± 2533.70^{*NS}	2250.87 ± 1632.79^{*NS}
	Average	1525.64 ± 770.87^{a}	2471.25 ± 1383.86^{b}	2206.99 ± 1300.47^{b}	
Selling Price (000IDR)	Gunung kidul	5350.00 ± 1160.78^{*NS}	6466.67 ± 2008.32^{*NS}	6600.00 ± 1599.57^{*NS}	6138.89 ± 1589.56^{*NS}
	Bantul	5966.67 ± 1173.95^{*NS}	6283.33 ± 2115.96^{*NS}	7883.33 ± 1836.80^{*NS}	6711.11± 1708.91^{*NS}
	Sleman	5596.67 ± 998.79^{*NS}	6280.00 ± 2421.37^{*NS}	6867.86 ± 1710.55^{*NS}	6248.17 ± 1710.23^{*NS}
	Average	5637.78 ± 1130.53^{a}	6343.33 ± 2165.93^{b}	7122.73 ± 1788.90^{c}	
Net Farm Income (000IDR)	Gunung kidul	3535.60 ± 2903.20^{*NS}	1055.75 ± 1690.38^{*NS}	617.88 ± 1421.23^{*NS}	1736.4 ± 2004.94^{*NS}
	Bantul	1613.39 ± 2133.05^{*NS}	805.96 ± 1516.06^{*NS}	1313.02 ± 1384.70^{*NS}	1244.12 ± 1677.94^{*NS}
	Sleman	1941.25 ± 4387.90^{*NS}	453.28 ± 1322.23^{*NS}	1189.18 ± 1317.23^{*NS}	1194.57 ± 2342.45^{*NS}
	Total average	2363.41± 3141.38^{a}	771.66 ± 1509.56^{b}	1040.03 ± 1374.39^{b}	

Note: $^{*a, b}$ Significant at 5% level, ^{*NS} Not significant at 5% level

3.8. Cow Price

The cow price determines the investment cost of the CCO business, namely interest rate. The results of the study show that the interaction between breeds and different locations does not significantly affect the price of cow. Different locations have no significant effect on the price of cow. The location difference in cow breeds has a significant effect ($P < 0.05$) on the price of cow. The prices of SimPO and LimPO cows are not different, but are significantly different from the prices of the PO cows. This is in accordance with the physical conditions of SimPO and LimPO cows that are larger than PO cow (Trifena et al. 2011), thus the price is more expensive than PO cows.

3.9. Cost of Concentrate Feed

Cattle feed consists of forage and concentrate feed. Most farmers in the provision of forage feed do not need to buy the material because it is originated from the agricultural remnants, grass on the embankments of agricultural land, and depend on their agricultural environment, thus it is considered as a non-cash expenses or the provision of forage feed that does not require cash capital. As for the procurement of concentrates feed, it is generally bought. The results of the analysis of this study indicate that the interaction between different breeds and locations does not significantly influence the cost of concentrates feed for cow. Different locations have no significant effect on the price of concentrate feed. The breed difference in beef cattle has a significant effect ($P < 0.05$) on the cost of concentrate feed. The cost of concentrates feed on PO cows is the smallest compared to SimPO and LimPO cows. Farmers have understood that large SimPO and LimPO cattle need more feed than PO cattle. However, giving concentrates also depends on the capital owned by each farmer, therefore some farmers do not provide additional concentrate feed for their cows (Table 3).

3.10. Price of Calf

Calf is the main product of the CCO business, thus calf selling price will determine the income/economic incentive of the CCO business. The results of the analysis of this study indicate that interactions between different breeds and locations have no significant effect on calf selling prices. Different locations have no significant effect on calf sale prices. The breed difference in beef cattle has a significant effect ($P < 0.05$) on calf selling prices. Calves produced from the PO cattle that have the lowest calf selling price compared to other cattle. In marketing cattle, including calves produced by people's farms, most of the sales are performed through broker because the number of sales of only 1-2 which is less efficient in transportation costs (Widitananto et al., 2012). Based on the observations in the field, PO offspring calves are rated lower by the middleman (blantik) compared to the offspring of SimPO and LimPO cow, although AI implementation used the same type of semen. SimPO and LimPO cows physically are larger than PO cows (Trifena et al., 2011), thus their offspring or their calves are also possible to correlate with their parents.

3.11. Net Farm Income

Net farm income is found to have a high variations and even negative, which indicated by a high standard deviations (Table 6). However, on average, the net income is positive. Our results indicate that the interaction between different breeds and locations does not significantly affect net farm income. Different locations have no significant effect on net farm income. While, the differences of breed in beef cattle has a significant effect ($P < 0.05$) on the net farm income. Net farm income of the

PO CCO is the highest, which is categorized as low input-low output. Low input, in terms of the price of PO cows, which is the cheapest compared to the SimPO and LimPO cattle, because it requires the least or cheapest feed concentrate. However, the performance measurement of PO cows is favorable as the CI rate of PO cows is the shortest. In term of low-output category, the calf prices of PO cattle broods is significantly different from the calves of SimPO and LimPO cows, the broods for PO calves is the cheapest. However, the overall CCO business performance from PO cattle produces the largest net farm income compared to SimPO and LimPO cows that use high input-high output. Judging from the location, Gunung Kidul Regency has good prospects based on the cows' S/C rate and the smallest calf mortality. The location does not have much effect on the technical parameter variables because the Yogyakarta government implements programs related to the development of the same beef cattle for all districts in special region of Yogyakarta. Besides that, market information about input and output prices related to cattle business has also been spread evenly across the 3 research locations. Our findings conclude that the local CCO livestock business needs to be maintained and developed by the farmers. SimPO and LimPO cattle CCO businesses do not contribute to a better prosperity for farmers compared to PO cattle CCO business. The results of this research are in line with Sutarno and Setyawan (2015) who explain that cross-breeding activities are feared to change the genetic diversity of Indonesian local cattle, where offspring cannot adapt to environmental conditions and reproductive capacity continues to fall, thus the availability of local cattle must be maintained.

4. CONCLUSION

Superior breed technology through the artificial insemination in the CCO business using feed concentrate technology has been implemented to deal with the issue of the low production of local beef cattle in Indonesia. The results show that SimPO and LimPO cattle crossbred significantly have high input-high output, while, PO has low input-low output. Overall economic incentives in the form of net farm income is significantly different and PO cattle has the highest income. Sub-district Wonosari has the best prospects for the development of beef cattle CCO business compared to Imogiri and Prambanan. The availability of local PO cows should be continuously maintained and widely developed. We recommend to terminate the utilization of the SimPO and LimPO for CCO business and focus on PO to improve the welfare of smallholder cattle.

ACKNOWLEDGEMENT

We thank to the financial support from the Faculty of Animal Science, Universitas Gadjah Mada through the 2017 laboratory competence grant. We also thank to the agricultural and farm extension for their help in collecting the information needed for this research.

REFERENCES

Adebowale, L. (2018). Crop-livestock integration: The ensuing conflicts and resolution strategies among rural dwellers in Ogun state, Nigeria. *Journal of Rural Development, 37*(1), 95-114.

Akriono, M. L., Wahyuningsih, S., & Ihsan, M. N. (2017). performans reproduksi sapi peranakan ongole dan peranakan limousin di kecamatan padang kabupaten lumajang. *Ternak Tropika Journal of Tropical Animal Production*, *18*(1), 77-81.

Aryogi, Adinata, Y. (2015). Physiology and reproductive responses of crossing beef cow. *The 6 th international seminar of tropical animal production integrated opproach developing sustainable tropical animal production*. Yogyakarta, Indonesia

Ates, S., Cicek, H., Bell, L. W., Norman, H. C., Mayberry, D. E., Kassam, S., Hannaway, D. B., & Louhaichi, M. (2018). *Sustainable development of smallholder crop-livestock farming in developing countries*. IOP Publishing, 142, 1-11.

Berg, H. V. D. (2011). *Economic Growth and Development*. Mc.Graw Hill, The International Edition. Singapore.

Bimrew A. (2018). Smallholder farmers' livestock production and marketing in Bahir Dar Zuria District, Northwestern Ethiopia. *Journal of Development and Agricultural Economics*, *10*(5), 159-164.

Central Bureau of Statistic. (2013). *Indonesian Population Projection 2010-2035*. National Development Planning Agency, United Nations Population Fund. Jakarta.

Czerniawska-Piątkowska, E., Szewczuk, M., Chociłowicz, E., & Konstancik, N. (2012). Comparison of limousin and simmental primiparous cows based on the variability of age at first calving, body weight and the analysis of their growth and development. *Electronic Journal of Polish Agricultural Universities, 15*(2), 1-6.

Director General of Livestock and Animal Health. (2017). *Livestock and Animal Health Statistics 2017.Directorate General of Livestock and Animal Health*, Ministry of Agriculture. Republic of Indonesia

Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S., & Rufino, M. C. (2012). The roles of livestock in developing countries. *Animal*, *7*(1), 3-18.

Kay, R. D., Edward, W. M., & Duffy, P. A. (2011). *Farm Management*. 7th Edition. McGraw Hill

Kristjanson, P., Mango, N., Krishna, A., Radeny, M., & Johnson, N. (2010). Understanding poverty dynamics in Kenya. *Journal of international development*, 22, 978–996.

Kusriatmi, R. O., Syaukarrt, Y., & Said, A. (2014). Analysis of the effects of beef import restrictions policy on beef self-sufficiency in Indonesia. *Journal of International Society Southeast Asian Agricultural Science*, 20, 115-30.

Mukhopadhayay, P. (2008). *Theory and Methods of Survey Sampling Second Edition*. PHI Publishing. India.

Ngadiyono, N., Panjono, Budhi, S. P. S., & Susanti, A. E. (2017). Characteristics of Ongole Grade Cows in the Kebumen Regency, Central Java Province. *The 7th International Seminar on Tropical Animal Production*, 835-839.

Pahantus, M., Dessy, M. A. A., & Didik, S. (2017). The Impact of the policy on the imported beef from Australia and the production of domestic Beef. *RJOAS*, 5(65), 283-295.

Rootman, G. T, Stevens, J. B., & Mollel, N., M. (2015). Policy opportunities to enhance the role of smallholder livestock systems in Limpopo province of South Africa. *South African Journal of Agricultural Extension, 43*(2), 91 – 104.

Rudatin, A. (2016). Analysis on Indonesia's beef import. *Economic Journal of Emerging Markets*, *8*(1), 65-72.

Ryschawy, J., Choisis, N., Choisis, J. P., Joannon, A., & Gibon, A. (2012). Mixed crop-livestock systems: an economic and environmental-friendly way of farming? *The Animal Consortium*, 6, 1722-1730.

Setiyono, A., Haryono, Kusuma, A., & Rusman. (2017). Effect of breed, age, and sex on quality of beef in special region of Yogyakarta. *Buletin Peternakan*, *41*(2), 176-186.

Sodiq, A., Suwarno, Rizki, F., Fauziyah, Wakhidati, Y. N., & Yuwono, P. (2017). Livestoct production system of beef cattle in the village and their development strategies. *Agripet, 17*(1), 60-66.

Suhaema, E., Widiatmaka, & Tjahjono, B. (2014). The regional development of cattle based on physical and forage land suitability in cianjur regency. *Jurnal Tanah Lingkungan*, *16*(2), 53-60.

Sumadi, Hartatik, T., & Sulastri. (2010). Distribution of population estimate of some cattle breeds at Yogyakarta Prvince, Indonesia. *The 5th International Seminar on Tropical Animal Production*, 561-564.

Sutarno, Setyawan, A. D. (2015). Review: Genetic diversity of local and exotic cattle and their crossbreeding impact on the quality of Indonesian cattle. *Biodiversitas, 16*(2), 327-354.

Sheng, T. Y., Shamsudin, M. N., Mohamed, Z. A., Abdullah, A. M., & Radam, A. (2010). Demand analysis of meat in Malaysia. *Journal of Food Products Marketing*, *16*(2), 199-2011

Todaro, M. P., & Smith, S. C. (2015). *Economic Development, 12th Edition*. George Washington University.

Trifena, Budisatria, I. G. S., & Hartatik, T. (2011). The Phenotypic changes of first filial, and Backcross of Ongole Grade Simpo and Limpo cross. *Buletin Peternakan*, *35*(1), 11-16.

Widiati, R. (2014). Developing beef cattle industry at smallholders to support beef self-sufficiency. *Wartazoa, 24*(4), 191-203.

Widiati, R., & Widi, T. S. M. (2016). Production systems and income generation from the smallholder beef cattle farming in Yogyakarta Province, Indonesia. *Journal of Animal Production*, 18(1), 51-58.

Widiati, R., Umami, N., & Gunawan, T. (2017). Land capability for cattle-farming in the Merapi Volcanic Slope of Sleman Regency Yogyakarta. Indonesia. *Journal of Geography*, *49*(1), 80–88.

Widitananto, A., Sihombing, G., & Sari, A.I. (2012). The analysis of marketing of beef cattle in playen district, Gunungkidul Regency. *Tropical Animal Husbandry*, 1(1), 59-66.

Wiyatna, M. F., Fuah, A. M., & Mudikdjo, K. (2012). Development potency of beef cattle farming based on local resources at Kabupaten Sumedang West Java. *Jurnal Ilmu Ternak*, *12*(2), 16-21.