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Total Economic Value of Cattle Farming in Integrated Waste Disposal Sites Bantul Yogyakarta

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Abstract

Cattle rearing in the Integrated Waste Disposal Area brings environmental pollution and reduces the comfort of livestock. This study aims to identify the condition of the cattle rearing profile, measurement of business feasibility, and analysis of the Total Economic Value of cattle existing values. The research location is in Ngablak Hamlet, Sitimulyo Village, Piyungan District, Bantul, Yogyakarta. The time of the study from August to November 2019. Sampling of farmers by census was 52 farmers. Data analysis with quantitative descriptive method. The results showed that farmers prefer with semi-intensive types for rearing and Simpo breeds. The biggest income is semi-intensive. Sustainability of cattle business is feasible from an economic and environmental if an intensive rearing is applied. If analyzed include the investment costs of feed, land, and cages, all maintenance systems are not feasible. The net benefit shows that if there is a cattle mortality, the farmer should be fined a minimum of that amount. Total Economic Value shows the value of cattle existing value assets in Ngablak Village annually. Overall, it is necessary to plan for shifting maintenance to an intensive system to maintain the existence and animal welfare of cattle as a resource input in the area.

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INTRODUCTION

Tempat Pembuangan Sampah Terpadu (TPST/Integrated Waste Disposal Site) in Piyungan, Bantul, Yogyakarta is the largest waste disposal site in the Special Region of Yogyakarta. The volume of refuse entering this site recorded in 2015 reached 158,599 thousand kg at the daily rate of 400-500 ton (Widyaningsih & Ma'ruf, 2017). The Sanitary Landfill Method is used to manage waste in Piyungan TPST, which involves layering waste and soil daily as it receives 550 ton/day input (Zuchriyastono & Purnomo, 2020). Currently, control landfill also takes place, in which sorting is conducted on materials with economic value, while the organic waste becomes feed for livestock belonging to the community members living near the waste disposal site.

Piyungan TPST is located in Ngablak hamlet of Sitimulyo village, which has four hamlets with the potential to develop livestock. This site provides opportunities for people to collect valuable waste as well as rear livestock in intensive, semi-intensive, or extensive (free range) systems. Many farmers in the vicinity herd their cattle in Piyungan TPST to utilize the available organic waste. However, the presence of cattle in a relatively large number can also hinder the operation of waste management. Front-loader operators moving waste and truck drivers queueing to unload have to slow down or wait for the livestock to get out of the way. This slow down often results in periodic closures to minimize the potential of environmental pollution from Piyungan TPST (Setiadi, 2015; Wahyono, 2010).

Livestock practices in Piyungan TPST often create dangerous pollution that negatively impacts animal safety and welfare. However, the resulting products meet the quality functional standards for meat production, and therefore, cattle rearing in Piyungan TPST must be reconsidered and allowed to be continued. As previously reported by Plaza & Lambertucci (2017), livestock rearing in waste disposal sites increases the risk of pathogen infections and poisoning. Additionally, waste disposal sites must be prepared for resource regeneration and land reclaimation in the immediate future to improve income in the community (Nanda & Berruti, 2021).

Total Economic Value (TEV) is the sum of use value and non-use value variables. The direct use value represents the yield of cattle production that can be directly valued, while indirect use value includes cultural and practical values that are relevant to local residents. Non use is the existence and bequest value associated with satisfaction as well as option values related to Willingness To Pay for environmental improvent carried out by the business pratitioners (Kakuru *et al.*, 2013; Zander *et al.*, 2013; Robhati & Kusumawardani, 2016). TEV of the herding system in Kenya showed the highest value for direct use and yield of cattle production (Nyariki & Amwata, 2019). Collado *et al.* (2014) reported that the highest TEV for in-situ conservation strategy of Alistana-Sanabresa breed in Spain came from the cultural values and the cattle breed existence.

The novelty of this study came from the combining of economic and environmental measurements to describe the potential of livestock resource in an area that is vulnerable to pollution. Some studies mostly discussed cattle rearing in a waste disposal site in relation to the aspects of pollution danger and heavy metal contents in livestock and human. This study aimed to 1) identify the cattle rearing profiles, 2) measure the finansial feasibility of the entreprise, and 3) analyze the Total Economic Value (TEV) of cattle existing value. These three objectives were used as indicators in the evaluations of sustainable strategy for cattle existing values in

Piyungan TPST, Bantul. This study could also facilitate farmers in understanding the importance of maintaining the existence of cattle existing values and being able to carry out a business strategy in beef cattle that is environmentally friendly.

RESEARCH METHOD

This study took place in Piyungan TPST, which is located in Ngablak hamlet, Sitimulyo village, Piyungan subdistrict, Bantul regency, Special Region of Yogyakarta. This waste disposal site is the largest in the province, where farmers rear their cattle and look for feed. The study period was in August to November 2019. The respondents consisted of beef cattle farmers in Ngablak hamlet and were chosen through a census. There were 52 participants that also made up the whole population.

Data were collected through observations and documentations. Observations resulted as the primary data that comprised of directly observing study objects through interviews and questionnaires. The secondary data were obtained from documentations that were issued by related offices. These documents were available on the internet, yearly reports of the Livestock Bureau, statistics from the subdistrict, and village monography.

The analyses for the first objective of identifying the cattle rearing profiles consisted of farmer characteristics and ownerships based on breeds and rearing system, using quantitative descriptive method. The descriptive statistics consisted of frequency, percentage, means, and standard deviation.

Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit/Cost Ratio (BCR) methods were used to provide analyses for the second objective of financial calculations for business feasibility. But prior to those analyses, income calculations were carried out with the assumption of cattle rearing for one whole year cycle with the following formula:

$$NI = TR - (TVC + TFC + TEC) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Notes:
NI : Net Income (IDR/farmer/year)
TR : Total Revenue (IDR/farmer/year)
TC : Total Cost (IDR/farmer/year)
TVC : Total Variabel Cost (IDR/farmer/year)
TFC : Total Fixed Cost (IDR/farmer/year)
TEC : Total Environmental Cost (IDR/farmer/year)

The next step was measuring the business feasibility using two assumption scenarios for all three rearing systems of extensive, semi-intensive, and intensive. Scenario I was no investment cost, while Scenario II incorporated investment costs in pen building, land leasing, and feed purchase.

The first method used to measure the business feasibility was NPV, which is the difference between the present value of the investment with the present value of future net cash income (Parama, 2014).

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+K)^t} - I_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Notes:
t = year

CFt = cash flow on year t
I_0 = investment at t=0
K = discount rate

The feasibility criteria are 1) when NPV > 0, it is feasible for the business, 2) when NPV = 0, the business reaches Break Even Point, and 3) when NPV < 0, it is unfeasible for the business.

The IRR method of business feasibility is a method to increase the investment proposal that refers to the Internal Rate of Return of assets. IRR is calculated by finding the difference between the present value of future cash flow and the present value of investment (Rumiyanto *et al.*, 2017).

$$IRR = P1 - C1\ x\ \ (p2 - p1)/(c2 - c1) \qquad \text{....................(3)}$$

Notes:
P1 = first interest
P2 = second interest
C1 = first NPV
C2 = second NPV

A business is feasible if the value of IRR is greater than the predetermined return (Rumiyanto *et al.,* 2017).

The B/C Ratio method is used to determine business feasibility by comparing income and expenditure or cost seen at present value (PV) (Ramadhani dan Soepriyono, 2019).

$$BCR = \frac{\Sigma_{t-1}^{n}\frac{Bt}{(1+r)t}}{\Sigma_{t=1}^{n}\frac{Ct}{(1+r)t}} \qquad \text{................(4)}$$

Notes:
Bt = income on year t
Ct = expenditure on year t
t = length of practice (year)
n = project year 1/(1+r) t; present value formula

A business is feasible if the B/C ratio greater than 1.

The third objective, which was determining the Total Economic Value, was achieved using a descriptive quantitative method. The Total Economic Value was determined by calculating the existence of cattle as the input for existing value in a region and formulated as:

Net benefit = (Total Revenue – Total Cost) x annual interest rate x cattle population (head or Animal Unit/AU) ....(5)

The net benefit shows the amount of cattle potential as the existing value input. Therefore, if extinction or mortality of cattle happened, the region would lose the potential of cattle existing value at the same amount of the net benefit

NI = TR – (TVC + TFC +TEC) ....(1)

Notes:
NI : Net Income (IDR/farmer/year)
TR : Total Revenue (IDR/farmer/year)
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RESULTS AND DISCUSSION

Profiles of cattle rearing

The profiles of cattle rearing could be seen from the characteristics of the farmers as the business practitioners, business, and cattle ownerships. These are important to identify the profiles of the farmers and business that they undertake, which in turn is used to determine the manpower potential in the study location.

Table 1. Profiles of Cattle Farmers in Ngablak hamlet, Piyungan, Bantul

Component	n	%
Sex		
Men	47	90.39
Women	5	9.61
Formal Education (year)		
No Schooling	9	17.31
Elementary School	26	50.00
Middle School	10	19.23
High School	7	13.46
Occupation (%)		
Farmer	7	13.46
Waste recycler	7	13.46
Laborer	18	34.61
Waste disposal site employee	7	13.46
Waste collector	9	17.31
Civil servant	2	3.85
Entrepreneur	2	3.85
Number of families (person)		
Employed	37	71.15
Unemployed	15	28.85
	$\bar{X}$	SD
Age	50.65	11.70
Experience (year)	14.94	8.93

Source: Processed primary data, 2020

The cattle rearing activities comprised of procurement, herding, safety, and feeding, which were predominantly carried out by men. This observation supported the findings by Takasenserang *et al.* (2021). Welerubun *et al.* (2016) further proposed that men possessed greater strength and ability in managing the business, as well as role in the decision making.

The majority of the farmers possessed minimal formal education of elementary school (50.00%). This influences their vocation options to menial work, such as waste collectors and laborers, instead of service. Education level can determine a farmer's productivity, including their level of innovation adoption (Erick *et al.*, 2014; Jermias *et al.*, 2010).

Livestock rearing in Sitimulyo village had become an inherited activity long before the establishment of Piyungan TPST in 1992. The experience in livestock shows the length of time in carrying out the practice and ways in troubleshooting based on the gained knowledge (Saputro *et al.*, 2018).

Table 2. Characteristics of Cattle Rearing Entreprise

Component	n	%
Cattle Ownership System (person)		
Full ownership	39	75.00
Shared income (gadhuhan)	13	25.00
Reason for Rearing Cattle (person)		
Saving	17	32.69
Additional income	7	13.46
No feed cost	7	13.46
Side job	14	26.93
Others	7	13.46
Rearing System (person)		
Extensive	35	67.31
Semi-intensive	12	23.08
Intensive	5	9.61
Willingness to switch to intensive holding		
Willing	43	82.69
Reason:		
Following Government regulation	40	93.02
Being compensated	2	4.65
Owning a pen	1	2.33
Unwilling	9	17.31
Reason:		
Being inconvenient gathering forage	2	22.22
Not having time for animal care	7	77.78
Rearing type		
Rearing	52	100.00
Livestock group participation		
Participated	9	17.31
Never participated	43	82.69

Source: Processed primary data, 2020

The three rearing systems were intensive, semi-intensive, and extensive. An intensive system is when cattle are kept in enclosures full time to facilitate feeding, reproduction activity, and monitoring of health and security, as well as allow less labor (Baba *et al.*, 2014; Kalangi *et al.*, 2021). A semi-intensive system allows animals to be herded in pastures during the day and kept in enclosures at night (Pugliese et al., 2021). Most farmers chose to have an extensive system or free ranged with the rearing type of fattening. Beef cattle fattening is rearing of weaned calves starting at six months to 18 months, in which bull calves are for slaughter, while heifers are for dams (Ernawati *et al.*, 2013; Sodiq & Yuwono, 2016).

The extensive system was chosen because it could reduce the costs of feed and pen building, as well as facilitate natural reproduction. This finding supports previous reports by Greenwood (2021) and Temple & Manteca (2020) demonstrating that extensive cattle rearing could minimize feed cost. There were 17.31 % of farmer who had participated in a beef farmer group. However, there were conflicts among members about the security of the cattle caused by the different numbers of head each farmer owned. The beef farmer group has been defunct since 2011.

Table 3. Cattle ownerships based on breed and cattle rearing system

Cattle type	Limpo[1]				Simpo[2]				PO[3]	
	Full (head)		Shared (head)		Full (head)		Shared (head)		Full (head)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Sire	2.24	1.30	3.00	2.05	3.00	1.87	1.75	0.96	2.62	0.48
Dam	2.30	1.81	2.50	1.58	3.20	2.78	2.20	1.10	2.67	1.58
Male	2.00	1.41	0	0	2.50	0.71	0	0.00	5.00	4.66
yearling	1.10	0.05	0	0	2.00	0.05	0	0.00	1.33	0.58
Heifer	1.82	0.75	1.10	0.05	1.33	0.52	2.00	0.50	1.10	0.05
Male calf	1.50	0.71	0	0	1.50	0.58	0	0	0	0
Female calf										

Rearing System	$\bar{X}$	SD
Intensive	1.40	0.55
Semi-intensive	8.75	6.98
Free range	7.51	5.46

Source: Processed primary data, 2020; [1]Limousine-Ongole cross; [2]Simmental-Ongole cross; [3]Ongole

The highest numbers of cattle ownership were represented by semi-intensive rearing system (8.75 ± 6.98 head), dams as cattle type, and Simpo breed (Table 3). This finding supports the report by Rusdiana & Hapsari, (2020) showing that many farmers raise cattle breeds of PO, Brahman, and Limousine with simple capital and methods. Simpo is preferred because it is known to have efficient feed cost and its calves to be born with high weights and have high sale price. Carvalo *et al.* (2010) reported that the feed cost per gain for Simpo (IDR 16.948.00/head) was more efficient than that of PO (IDR 19,817.00/head). Meanwhile, Endrawati *et al.*, (2010) noted that Simpo calves had higher birth weight (31.10 kg) than calves of Limpo (25.60 kg), and Brahman-Ongole cross (24.5 kg). Carcass percentage of Simpo (51.18%) is also higher than that of PO (49.40%), as is the meat percentage of Simpo (81.80%) compared to that of PO (81.31%).

The choice of crossbred cattle, however, contradicts a report by Morgan-Davies *et al.,* (2014), which argued that local breeds are more suitable for sustained operations because of genetic uniformity and better climatic adaptability than crossbred cattle. Therefore, rearing of PO, which is not preferred by farmers, should be reconsidered. Farmers applied shared ownerships of cattle to overcome high investment cost. However, none of them practiced shared ownership on PO cattle because the sale of this breed is low compared to others.

The division of cattle rearing product in shared ownership consists of two ways, which are 1) 50%:50% for sales of calves and 2) 60%:40% for others. The 50%:50% split is locally known as *maro bathi*, and nowadays it becomes a partnership for profit sharing. Cattle sale happening on site where cow traders directly come to the farmers to get the cattle is preferred because of its ease and practicality for farmers in need of cash (Hikmah, 2019; Miftahudin, 2020).

Financial analyses of business feasibility

The analyses of incomes were measured based on two approaches, at the farmer households and region to determine the Total Economic Value describing the utilization of cattle resource.

Table 4. Cost in beef cattle rearing

Component	Free range (n =35)	Semi-intensive (n=12)	Intensive (n=5)
Fixed cost			
Pen depreciation	0	2,097,500	2,296,250
Equipment depreciation	0	287,000	205,500
Variable cost			
Cattle health	215,000	235,000	50,000
Mortality			
Sire	47,000,000	30,000,000	0
Dam	20,000,000	59,000,000	0
Male yearling	42,000,000	12,000,000	0
Heifer	0	11,000,000	0
Male calf	53,000,000	52,000,000	0
Female calf	35,000,000	13,000,000	0
Environmental cost			
WTP* in the form of social capital	41,800,000	11,100,000	7,000,000
Total cost/population	239,015,000	190,719,500	9,551,750
Total cost/farmer	6,829,000	15,893,291	1,910,350

Source: Processed primary data, 2020; *Willingness To Pay

The largest fixed cost came from pen depreciation. Pens are usually built with bamboos and dirt floor. This system is not the best because it poses high risk of pollution especially during the rain season. The largest variable cost was from cattle mortality. The risk of cattle mortality is especially high in the extensive system where cattle freely roam in the waste disposal area. Accidents with heavy machinery occur frequently and Piyungan TPST is not responsible for such events and, thus, not obligated to compensate the farmers. There is in fact prohibition to have free ranged cattle in Piyungan TPST, however farmers keep doing the practice because there is no written agreement between them and the authority. Meanwhile, the waste disposal site has expanded as well. Farmers reason that they do not have to buy feed since their cattle feed on organic waste in the site.

Table 5. Income from cattle sale

Component	Extensive (n =35)	Semi-intensive (n=12)	Intensive (n=5)
Cattle sale			
Fully owned	715,500,000	437,000,000	54,000,000
Shared	69,800,000	18,800,000	6,800,000
IDR/population	785,300,000	455,800,000	60,800,000
IDR/farmer	22,437,142	37,983,333	12,160,000

Source: Processed primary data, 2020

Table 6. Income from beef cattle rearing based on rearing system IDR/farmer/year)

Component	Extensive (n =35)	Semi-intensive (n=12)	Intensive (n=5)
Gross income	22,437,142	37,983,333	12,160,000
Total Cost	6,828,999	15,893,291	1,950,350
Fixed Cost	0	198,708	500,350
Variable Cost	5,634,714	14,769,583	50,000
Environmental Cost	1,194,285	925,000	1,400,000
Net income	15,608,143	22,090,042	10,209,650

Source: Processed primary data, 2020

The highest net income was obtained by farmers practicing the semi-intensive system at IDR 22,090,042/year. This system apparently benefited the farmers because they did not have to buy feed and were able to rear their cattle more efficiently in terms of time and energy. Farmers unfortunately did not consider food safety for their product. Cow traders would buy cattle directly from them and take the cattle immediately to the abattoirs. The intensive system yielded the least income, nonetheless it should be recommended for the reason of operation sustainability that is in accordance with ethical, social, and environmental values, as well as in line with the food safety regulations. Cattle that are reared in waste disposal sites do not meet food safety requirements because they can be infested by parasitic worms and have high Lead (Pb) level in their livers (Ardani *et al.*, 2016; Trisdihar & Dewi, 2015).

Income calculations in one period of rearing are not sufficient to show business feasibility. Therefore, the assumptions of five-year rearing and Calving Interval of 19 months were added in the BCR, NPV, and IRR analyses. The results showed that intensive rearing system was more beneficial with values of BCR at 2.12, NPV at IDR 8,625,043, and IRR at 101% (Scenario I).

Investment cost must be considered in determining business feasibility to achieve high output and, therefore, economic efficiency (Nastic *et al.*, 2017). The analyses, thus, incorporated the assumption for cost of pen building, as well as the costs of land lease and feed. The results showed that all three systems were not feasible (Scenario II). Cattle rearing can be sustained and feasible when the need for nutrition is met. Low quality forage results in lowered conversion of feed to meat (Terry *et al.*, 2020). Additionally, insufficient pasture can reduce livestock productivity (Díaz-Gaona *et al.,* 2021).

Table 7. Financial analyses on business feasibility based on rearing systems

Rearing type	B/C Ratio	NPV (IDR)	IRR (%)	Results
Extensive				
Scenario I	1.10	699,945	15	feasible
Scenario II	0.21	-132,153,896	<interest	unfeasible
Semi-intensive				
Scenario I	0.80	-18,763,873	<interest	unfeasible
Scenario II	0.27	-165,335,896	<interest	unfeasible
Intensive				
Scenario I	2.12	8,625,043	101	feasible
Scenario II	0.83	-5,051,142	<interest	unfeasible

Source: Processed primary data, 2020

Total Economic Value of cattle resources

Assessment for environmental economic must be conducted, especially on the environmental impact of beef cattle and its influence in supporting the Life Cycle Assesment policy (Rotz *et al.*, 2019). The determination of Total Economic Value on the feasibility of beef cattle conservation was identified through the economic assessments of marketable environmental objects. These were then approached through market prices. Meanwhile, for the non-marketable environmental objects, that is farmers' Willingness To Pay, were approached with social capital.

Table 8. Total Economic Value of cattle rearing in Piyungan TPST

Component	Total
Cattle sale (*direct use*)	25,036,538
Fully owned	23,201,923
Shared	1,834,615
Direct cost	
Fixed cost	287,426
Pen depreciation	258,456
Equipment depreciation	28,970
Variable cost	7,967,062
Cattle mortality	7,957,447
Cattle health	9,615
Option value	
(WTP farmer)	1,151,923
Total cost	9,406,4111
Net benefit wt df 12%	1,875,615
Cattle population	327 head or 523 AU
Total Economic Value (IDR/year)	
per head	613,326,185
per AU (Animal Unit)	980,946,645

Source: Processed primary data, 2020

The results showed that the net benefit or potential value of cattle resource was in the amount of IDR 1,875,615/head. When damage occured and caused annual cattle extinction caused by death, negative externality arrised in Piyungan TPST. Cattle population grows slowly. Therefore, when extinction took place because of human neglect, the polluters, in this case farmers, had to bear the cost at the minimal of IDR 1,875,615/head/year. The reality among the residents is that a fine for farmers is not yet commonly applied as an environmental tax and, thus, is non existent.

The Total Economic Value per head is IDR 613,326,185/year or per animal unit (AU) of IDR 980,946,645/year. These values show the extent of the annual assets in beef cattle resource in Piyungan TPST or Ngablak hamlet. To increase the Total Economic Value, the waste output from cattle should also be considered, in addition to the cattle resource itself. This could simultaneously reduce methane emission (Capper & Hayes, 2012). Therefore, the planning for intensive rearing should consider an indirect use of marketable waste utilization.

Table 9. Causes of cattle mortality Piyungan TPST

Cause	Sire	Dam	Male yearling	Heifer	Male calf	Female calf
Heavy machinery	2	4	2	-	10	8
accident	-	1	1	-	7	3
Buried in waste	3	-	2	-	1	-
Poisoning	-	-	-	-	3	-
Weak condition	-	1	0	1	-	-
Sire aggression						

Source: Processed primary data, 2020

Currently, extinction is mostly caused by high mortality rate. The main causes of cattle mortality are accidents with heavy machinery, poisoning, and being buried in waste. This phenomenon indicates that animal welfare in Piyungan TPST is not in the minds of these farmers. They care more about profits than animal welfare. Losses from free range herding can come from reduced animal welfare, as reported by Temple & Manteca (2020), who further explained that such a system causes unmet feed quality, difficult water access, increased stress on livestock, increased exposure to diseases, and increased fighting among livestock.

Market sounding was carried out in 2020 for Piyungan TPST as a part of regional landfill development program. This activity aimed to gain inputs from the private sector, potential investors, and lenders on the forms of collaboration or technologies to be introduced, as well the potential risks. In relation to this, the strategy to have sustainable beef cattle rearing with ecological responsibility is to require intensive practices of having enclosures. Rust (2019) described that the intensive system can mitigate climate change and facilitate biosecurity as well as be environmentally friend and appropriate for an urban setting. Additionally, Dick et al (2015) proposed that this system also reduces the environmental impact of methane production from cow waste. Heat stress caused by climate change can cause reductions in live weight and fecundity in cattle (Thornton *et al.,* 2022).

To obtain additional investment for cattle procurement, pen building, and safe sites, farmers can restart the farmer group that has been defunct. Farmer group is important in which members have goals for their collaboration to increase income (Bachtiar *et al.*, 2021). Furthermore, farmer group will facilitate the proposal to lease village land and get financial aid or credit.

The roles of government and education institutions are also immensely needed. Avilez *et al.*, (2021) reported that a collaboration between farmers and government institutions on intensive rearing system is necessary for improving livestock profitability. Pereira *et al.*, (2020) added that supports for farmers on access to finance, improvement of guidance services, land regulation, and infrastructure improvement are also required. Guidance programs and methods as well as the development of production facility and sites are very influential on the farmers' participation in carrying out their enterprise (Maulidiah *et al.,* 2021). Periodic steps to be taken to educate farmers on the importance of internal social cost on the benefits of intensive rearing and improve the rearing management to stimulate farmers' performance that directly affects the reduction of cattle extinction. Improving the managerial skills on farmers through training is a social benefit that supports livestock sustainability (Bragaglio *et al.*, 2020).

CONCLUSION

Farmers chose extensive or free-range system over others because it reduced the cost of feed and pen investment. In order to feasibly continue the intensive system economically, socially, and environmentally, business feasibility study that incorporates environmental cost must produce positive BCR and NPV as well as IRR value that is higher than bank interest rate. Overall, beef cattle resource must be conserved because it brings net benefit and high Total Economic Value for the region.

RECOMMENDATIONS

Cattle rearing in Piyungan TPST can continue economically, socially, and environmentally if conducted correctly. The strategy to be developed is to aimed at the intensive system and reactivation of farmer group. Village government assists on providing sites, group enclosures, and infrastructures including financial supports. Governmental and educational institutions provide periodic guidance and training to farmers. This study only analyzed the livestock potential based on the economic and environmental aspects, and therefore, further studies on social and food safety aspects should be conducted. The results of this study are hoped to benefit as the initial recommendation for policy makers to build coordination among farmers, the Agricultural bureau, and educational institutions to conserve beef cattle enterprise as an input from livestock resource.

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