



Potential of Organic Fertilizer from Beef Cattle Manure Supporting a Sustainable Integration System

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Abstract. Beef cattle farming was generally still maintained traditionally, farmers' knowledge in this case was still conventional. Traditional maintenance system, by moving cattle from one agricultural land to another. Unprocessed manure causes environmental pollution. The problem was to what extent was the potential for organic fertilizer from beef cattle manure to support a sustainable integration system. The research method used was a survey in Minahasa Regency and a study of published data. The data collected were primary and secondary data. Respondents were 60 beef cattle farmers. The data analysis used was descriptive with an approach to the potential and feasibility of organic fertilizer production. The results of the study showed that the beef cattle population had increased, thus increasing the amount of manure from beef cattle. The beef cattle population in 2022 in Minahasa Regency, amounted to 76,770 heads, producing 26,381.83 tons of solid fertilizer. Based on the results of the study, it can be concluded that beef cattle farming had the potential to produce organic fertilizer, thus supporting a sustainable integration system.

Keywords: potential, organic fertilizer, beef cattle, sustainable.

1 First Section

The goal of agricultural development was basically to increase production towards self-sufficiency, expand employment opportunities and improve people's standard of living. Achieving the intended goals requires innovations to increase agricultural production, including those supported by the land used by farmers. Agricultural land generally contains nutrients needed as nutrients for plants, which were balanced and their availability can maintain plant productivity and land sustainability [1]. Nutrients were one of the main factors in supporting agricultural productivity. Improvement of nutrients can be done by utilizing organic fertilizers. Organic fertilizers can be produced by utilizing cattle dung. This phenomenon indicates that the livestock sector had the potential to support the agricultural sector. An integrated system was a recommended program to support this phenomenon.

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Beef cattle farming was generally still maintained traditionally, farmers' knowledge in this regard was still conventional. The method was that beef cattle were moved from one agricultural land to another. Cattle manure was only left to cause environmental pollution, so it was one of the problems faced by the community [2]. Cattle manure also disrupts the comfort of life of the community around the farm [3].

Organic materials sourced from cattle manure need to be composted before being used as plant fertilizer. This was because: (i) if the soil contains enough air and water, the decomposition of organic materials occurs quickly so that it can interfere with plant growth; (ii) the decomposition of fresh materials only supplies very little humus and nutrients to the soil; (iii) the structure of fresh organic materials was very coarse and its resistance to water was small, so that if it was directly buried it can cause the soil to become very crumbly, (iv) cattle manure was not always available when needed, so composting was a way to store organic materials before being used as fertilizer [4].

Organic fertilizer was a fertilizer that consists mostly or entirely of organic material derived from plants or animals that had gone through an engineering process. Organic fertilizer can be in solid or liquid form which was used to supply organic material, improve the physical, chemical and biological properties of the soil. Organic fertilizer was the result of microbiological activity in breaking down organic material, and had slow release properties, but can be available longer in the soil than anorganic fertilizers [5]. The organic fertilizer referred to in this study was fertilizer derived from beef cattle manure. Organic fertilizer had advantages over anorganic fertilizers. Its advantages were that it was environmentally friendly, increases soil fertility by repairing physical damage to the soil due to excessive use of anorganic (chemical) fertilizers. Organic fertilizer was also a source of income for farmers. The problem was to what extent the potential of organic fertilizer from beef cattle manure supports a sustainable integration system. Based on several studies, beef cattle manure contains many nutrients that were essential for plants, so it can be used as organic fertilizer [6]. These nutrients include nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and boron. Research had been conducted with the aim of analyzing the potential and feasibility of fertilizer production for the income and profits of local beef cattle businesses.

2 Materials and Methods

The research materials consist of beef cattle, feed consumed, labor used and compost fertilizer produced. Beef cattle were cattle developed by farmers in Minahasa Regency with PO cattle type. Beef cattle were converted based on the number of cattle sold and stated as revenue. Feed was the amount of grass and corn feed consumed which was converted as production costs. Labor was the allocation of farmer's working hours converted into labor costs. Fertilizer was the amount of fertilizer produced based on the beef cattle population and converted into organic fertilizer costs and revenue. The research method used was a survey method in Minahasa Regency and a study of published data. The data collected were primary and secondary data. The location of the research in Minahasa Regency which was determined by purposive sampling, namely the district with the largest beef cattle population with an LQ value > 1 . Respondents

were 60 beef cattle farmers who were taken by simple random sampling. The data analysis used was descriptive with an approach to the potential and feasibility of organic fertilizer production. The feasibility of fertilizer production was analyzed using the RC ratio value to the revenue and profits obtained [7].

3 Results and Discussion

Fertilizer was one of the main production factors that plays an important role in efforts to increase agricultural yields [8]. The large scale use of anorganic fertilizers occurred after the green revolution took place. The presence of anorganic fertilizers had caused farmers to switch to using these fertilizers. This was because anorganic fertilizers were easy to obtain and their supply was sufficient. This was because anorganic fertilizers were easy to obtain, and their supply was sufficient. In addition, plants absorb nutrients continuously, as a result farmers need to add fertilizers in their cultivation activities. The fertilizers added were anorganic fertilizers [9]. Anorganic fertilizers according to research results were used with the assumption that farmers believe that the more organic fertilizers they use, the more production will increase. The use was due to the assumption of farmers that in terms of application to plants, the use of anorganic fertilizers was more practical. In addition, at that time anorganic fertilizers were cheaper because they were subsidized by the government. Anorganic fertilizers used in the long term have a negative impact on the land. Anorganic fertilizers used singly continuously in the long term cause the soil to become hard. This is because the sulfate residue and carbonate content contained in the fertilizer and soil react to the calcium in the soil which makes it difficult to cultivate the soil.

The indication was that farmers provide anorganic fertilizers and synthetic agrochemicals that do not comply with the established or recommended recommendations [10]. Anorganic fertilizers were fertilizers made with a mixture of chemicals so that they can cause increased pollution in the land. Another impact was a decrease in soil quality, both in terms of chemical, physical and biological properties. This causes a decrease in soil and plant productivity [11]. In fact, healthy soil had ideal chemical, physical, and biological properties, thus supporting plant productivity and land sustainability. The indication was that soil health was important in supporting ecosystems and the environment, because the ability of soil to act as a life ecosystem to support the sustainability of plants, animals and humans. In addition, healthy soil shows that land degradation can be maintained and minimized [12]. Furthermore, this can had an impact on the health of farmers and their families [13].

The results of the study showed that in 2021 to 2022 the beef cattle population increased by 2.27% for Minahasa Regency and 2.09% for North Sulawesi Province. Based on geographical location, Minahasa Regency was generally: hilly, mountainous, and fairly wide plains. The fairly wide plains were only around Lake Tondano. The Minahasa Regency area was an area with an average altitude of 591 meters above sea level. Based on elevation (height above sea level), the plains in Minahasa Regency consist of: 0 m - 100 m = 8%, 101 m - 500 m = 16%, 501 m -1000 m = 76%. Based on climatology, it shows that Minahasa Regency had a moderate rainfall pattern, namely

wet areas had rainfall of more than 2,000 mm per year and dry areas had rainfall of less than 2,000 mm per year. The air temperature in January-December 2023 ranges from 22.6-23.8 0C. The geographical and climatological conditions of this area greatly support the development of beef cattle farming. Based on these environmental conditions, it shows its influence on increasing the beef cattle population. The increase in population has led to an increase in the amount of beef cattle manure produced. Beef cattle manure that was not internalized had an impact on environmental pollution of land, air and water. The beef cattle population and the amount of organic fertilizer produced in North Sulawesi, Minahasa Regency, West Tompaso and Remboken Districts can be seen in Figure 1, Figure 2, Figure 3 and Figure 4.

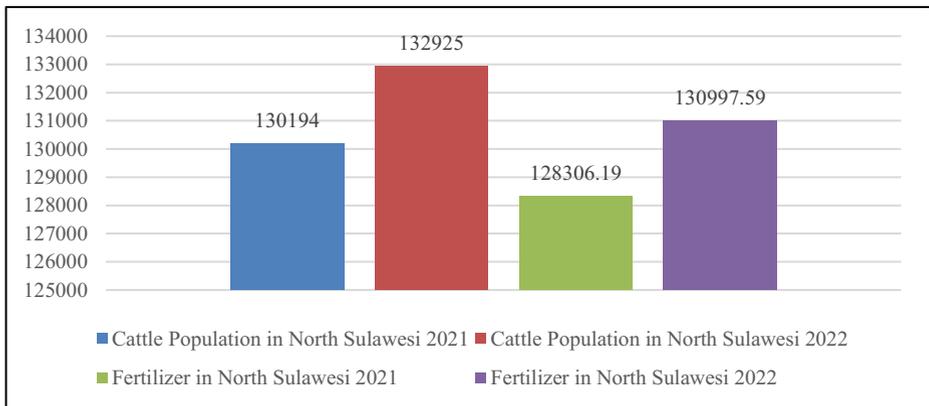


Fig. 1. Beef Cattle Population and Fertilizer in North Sulawesi Province.

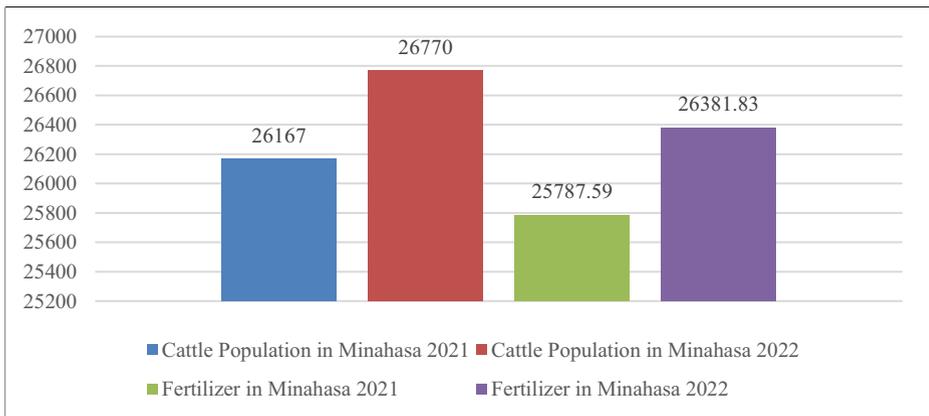


Fig. 2. Beef Cattle Population and Fertilizer in Minahasa Regency.

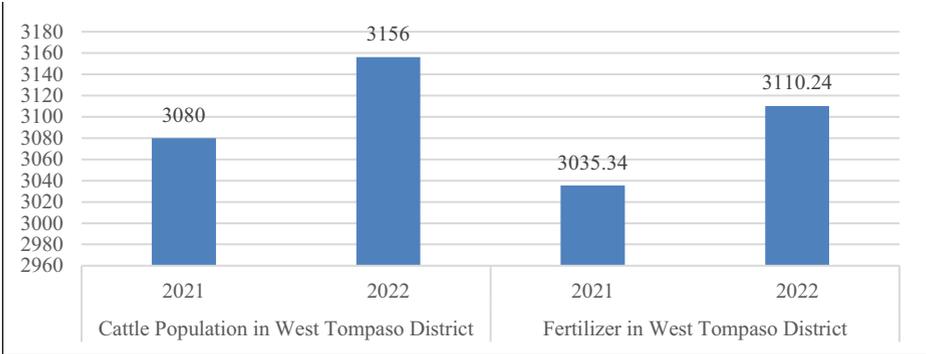


Fig. 3. Beef Cattle Population and Fertilizer in West Tompaso District.

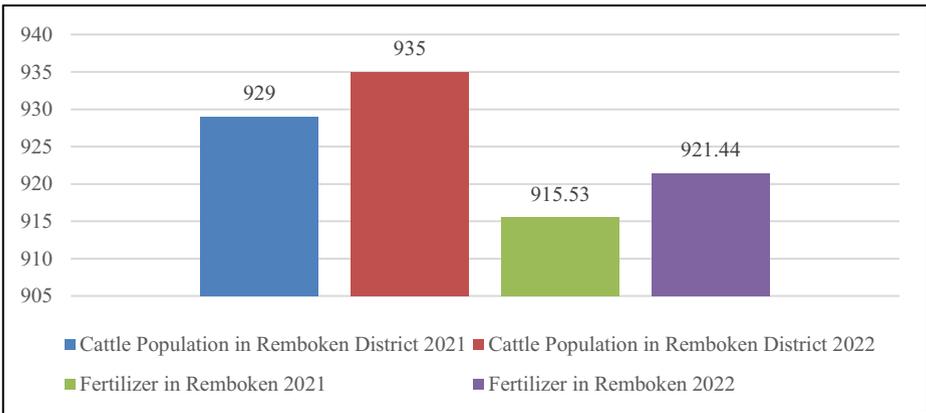


Fig. 4. Beef Cattle Population and Fertilizer in Remboken District.

The population of beef cattle in North Sulawesi in 2022 was 132,925, producing 130,997.59 tons of organic fertilizer per year (Figure 1). Furthermore, the population of beef cattle in Minahasa Regency was 26,770, producing 26,381.83 tons of organic fertilizer in 2022 (Figure 2). The population of beef cattle in West Tompaso and Remboken Districts was 3,156 and 935, respectively, producing 3,110.24 tons and 921.44 tons of organic fertilizer respectively (Figure 3 and Figure 4). Population growth had an impact on increasing beef cattle manure. This waste can be a source of disease, on the other hand, there was an increase in methane gas, and it also disrupts the aesthetics and comfort of humans in their activities [14]. The disturbance from beef cattle manure was in the form of an unpleasant odor caused by gas. The gases in question were mainly ammonia gas (NH₃) and Hydrogen Sulfide gas (H₂S), which in certain concentrations will interfere with both livestock and farmers. Both gases, when inhaled by cattle, cause respiratory tract disorders so that the cattle were more sensitive to disease attacks [15]. The use of organic fertilizers aims to maintain the quality or sustainability of soil and plants [16]. Cattle farm waste was one of the potential materials for making organic fertilizer [17], and had an impact on reducing production costs [18].

Efforts to optimize plant growth and productivity were through the use of organic fertilizers. Organic fertilizers come from beef cattle manure that had undergone a decomposition or weathering or fermentation process. The process of making organic fertilizer (fermentation) can be done aerobically or anaerobically. The fermentation process in question was the process of reducing the C/N of organic materials to the same or close to the C/N of the soil. Beef cattle manure that was used as organic fertilizer was a very appropriate alternative. Organic fertilizers were used to reduce production costs [19] [20]. On the other hand, organic fertilizers were a solution to the disposal of beef cattle manure on agricultural land and even in farmers' yards.

The results of the study showed that farmers in the research location who had 164 cattles (88 cattles for farmers in West Tompaso and 76 cattles for farmers in Remboken District). The population can produce 161.62 tons of fertilizer per year consisting of 86.74 tons (53.66%) for farmers in West Tompaso District and 74.90 tons (46.24%) for farmers in Remboken District (Figure 5).

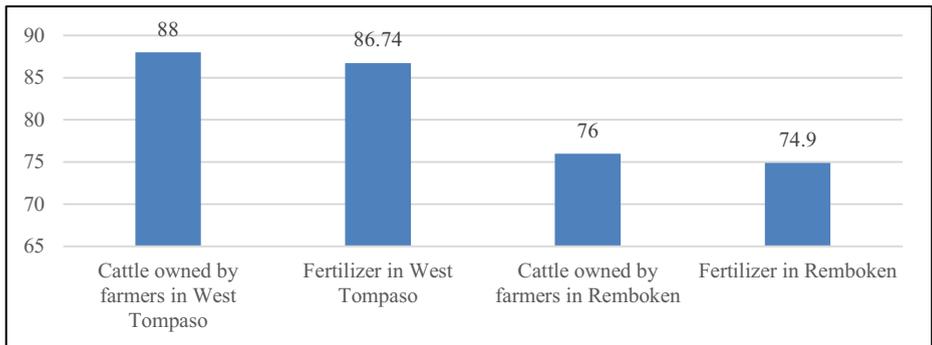


Fig. 5. Farmer's Beef Cattle Ownership and Fertilizer Produced

The increasing population of beef cattle has an impact on the increasing amount of solid and liquid fertilizer produced. One beef cattle can produce around 10-15 kg of manure [21]. The organic material in the organic fertilizer also tends to be more and even more abundant. Another advantage was that the nutrients in organic fertilizer were more easily absorbed by plants [22]. Organic fertilizer from beef cattle manure can support agricultural activities by restoring land fertility [23]. The amount of fertilizer produced was greater, also indicating a greater contribution to the revenue of farmers as respondents. The revenue of farmers as respondents at the research location was presented in Table 1.

Based on the data in Table 1, it shows that the revenue received from the sale of cattle was 74.31%. Income from fertilizer was 25.69%, this contribution was considered adequate, and greatly supports the welfare of farmers. The sale of organic fertilizer was assumed to be IDR 5,000 per kg. The indication was that the profit was higher than without the sale of fertilizer. The RC ratio value was 3.02, meaning that for every expenditure of IDR 1.00, farmers receive an revenue of IDR 3.02. This condition shows the potential to develop organic fertilizer sourced from beef cattle manure. Based on the results of the study, it shows that the business was feasible

to be developed which was supported by a profit cost ratio value of more than one (2.02). Furthermore, the utilization of waste or beef cattle manure provides added value into solid and liquid organic fertilizer [24].

Organic fertilizer or soil organic matter was the main source of soil nitrogen, its role was quite large in improving the chemical and biological properties of the soil and the environment. Utilization of organic fertilizers avoids the use of pesticides or anorganic fertilizers. The risk of poisoning substances and their impact on long term soil damage in this case can be reduced. This was because organic fertilizers have the advantage of being an environmentally friendly alternative. The use of organic fertilizers was thus recommended in order to save production costs, so that farmers' income increases. Furthermore, soil fertility can be increased by overcoming physical damage that occurs due to excessive use of anorganic fertilizers. Farmers produce organic fertilizers, opening up opportunities for creating agricultural innovations as an effort to meet market demands [25]. The final impact was that farmers will benefit. Cattle manure is not only wasted, but also provides benefits to farmers [26], organic fertilizers can improve the structure of soil organic matter [27].

Table 1. Table captions should be placed above the tables.

No.	Description	Total (Rp/Year)	Average (Rp/Farmers)	%
1	Revenue			
	Revenue of Cattle	2,337,000,350.00	38,950,005.83	74.31
	Revenue of Fertilizer	808,110,000.00	13,468,500.00	25.69
	Total Revenue	3,145,110,350.00	52,418,505.83	100.00
2	Cost of Production			
	Cost of feed	748,432,500.00	12,473,875.00	71.84
	Cost of Labor	206.724.702,40	3,445,411.71	19.84
	Cost of Fertilizer Production	86,645,000.00	1,444,083.33	8.32
	Total Cost	1,041,802,202.00	17,363,370.04	100.00
3	Profit	2,103,308,148.00	35,055,135.79	
4	RC	3.02		
5	Profit/C	2.02		

4 Conclusion

Based on the results of the study, it can be concluded that beef cattle farming had the potential and was feasible in producing organic fertilizer so as to support a sustainable integration system. Based on the results of the study, it is recommended for government intervention in utilizing beef cattle manure as organic fertilizer.

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References

1. Prasetyo, D, and R. Evizal. *Agrotro J*, 20 (2): 68-80. (2021)
2. Junaidi, M.R., A. Rahma., S. Ayu, and C. Marcello. *J of Comm Empow Learn (JP2M)*, 4 (1): 300-306. (2023)
3. Ningsih, H. *J of Approp Tech Serv*, 3 (1): 69 – 73. (2022)
4. Ratriyanto, A., S.D. Widyawati., W.P.S. Suprayogi., S. Prastowo., N. Widyas. *J of Semar*, 8 (1) : 9 – 13. (2019)
5. Ameeta, S. and C. Ronak. *Intern J for Res in App Sci and Engin Tech*, 5(2): 677-680. (2017)
6. Alam, S., M. Megawati., R. Sadanu., H. Hasruddin., M. Ilham., M.A.S. Mandra., and A.Z. Yusuf. *J of Madan*, 3(2), 200-208. (2022)
7. Suratiyah, K. *Penebar Swadaya*. Jakarta. (2015)
8. Rachman, R., L. Amalia, and Y. Taryana. *Fruit Sains J*, 10 (5): 358 – 365. (2022)
9. Rahmad, R., A. Karim., N.L. Nafie, and M. Jayadi. *J Chem Act Ind*, 11(2): 28- 41. (2018)
10. Darwis, V. *J of Agric Pol Anal*, 11(1): 45-60. (2014)
11. Hartati, S., S. Sumani and H.E. Hendrata. *J of Sust Agric*, 29(1): 53-60. (2014)
12. Miner, G.L., J.A. Delgado, J.A. Ippolito, and C.E. Stewart. *Agric & Envir Letters*, 5(1): 1-8. (2020)
13. Fitriyah, A., R. Harmayani., A. Jamili., Y. Mariani., N.M.A. Kartika, and Isyaturriyadhah. *KITA Comm Serv J*, 4 (2): 22-28. (2021)
14. Nenobesi D., W. Mella, and P. Soetedjo, *Food J*, 26 (1): 43 – 56. (2017)
15. Sukamta, Shomad, MA, Wisnujati, A. *Berdikari J*. 5 (1): 1-10. (2017)
16. Hou, J., M. Li, X. Mao, Y. Hao, J. Ding, D. Liu, and H. Liu. *J of Plos One*, 12(4). (2017)
17. Huda, S., and W. Wikanta. *Journal of Aksiologi*: *J of Comm Serv*, 1(1): 26-35. (2017)
18. Kumala, B., L. Fikriyah., E.S. Syahla, and P. Lestari. *Ta'awun: J of Comm Serv*, 3 (1): 64-72. (2023)
19. Sidik, R.F and M. Ahied. *Scien Eng J*, 8 (2) : 137-142. (2015)
20. Fuad, K, and Winarsih. 2021. *Abdi J*, 7 (4) : 293 - 297. (2021)
21. Muzammil, M.H., Sudarti, and Yushardi. 2023. *J of Educ, Sci and Tech (JPST)*, 2 (4): 992-996. (2023)
22. Solihin, E., A. Yuniarti, and M. Damayani. *IOP Conference Series: Earth and Env Sci*, 393(1): 012026. (2019)
23. Farid, M. *Khidmatuna: Comm Serv J*, 1(1): 59-74. (2020)
24. Maulana, M.A., Zulkifli, and A.A. Pata. *Agric J*, 7 (1): 30-38. (2018)
25. Sutrisno, E., I.W. Wardhana., M.A. Budiwardjo., M. Hadiwidodo, and R.I. Silalahi. *Pas J: Comm Serv and Innov in Tech Dev*, 2 (1): 13-16. (2020)
26. Wardana, L. A., N. Lukman., M. Mukmin., M. Sahbandi., M.S. Bakti., D.W. Amalia., and C.S. Nababan. *J of Comm Serv for Mast of Sci Educ*, 4(1): 201-207. (2021)
27. Mangalisu, A., A.K. Armayanti., B. Syamsuryadi., A.H. Fattah, and Khaeruddin. *Farm Cont Media*, 4(1): 14-20. (2022)

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