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The sustainability status and the development strategy of collective cage-based beef cattle smallholder farming on Lombok Island: the dimension of disease incidence

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Abstract

The incidence of the disease is one of the problems faced by beef cattle farms in Lombok Island, West Nusa Tenggara Province in increasing the production and productivity of livestock. On smallholder livestock, beef cattle are maintained intensively using a collective cage group, making it easier to manage and promote them. This aim is to analyze the status of the sustainability of the development of beef cattle smallholder farming based on collective cages in Lombok Island from the dimension of disease incidence. The method used to determine the sustainability status is Multi-Dimensional Scaling (MDS) with the Rapid Appraisal Beef Cattle Diseases (RAPBCD) approach of 20 diseases as attributes. The sensitive attributes that affect the sustainability index and the effect of errors are determined based on the Leverage analysis and Monte Carlo test. The results of the sustainability analysis showed that the status of the dimensions of the disease incidence dimension was 56.38%. The analysis results of the 20 diseases as attributes studied, 9 diseases (diarrhea, scabies, flatulence, itching, demodec, pink eye, anthrax, reproductive, epizootic septimea) are sensitive attributes and need to be improved because they will affect increasing the value of the sustainability index. Determination of the key factors of sustainability is obtained by prospective analysis to determine the future strategy for the development of collective cage-based beef cattle smallholder farming. The conclusion is that the status of the sustainability of the development of collective cage-based beef cattle smallholder farming on Lombok Island from the dimension of disease incidence is in a fairly sustainable category with four recommended development strategies, namely: strategies to improve beef cattle health management; increasing access to information and livestock health technology; increasing the role of the government, businessmen, and other stakeholders and strengthening farmer institutions, farmer economic institutions.

Keywords: beef cattle, collective cages, disease incidence, smallholder livestock, sustainability status

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INTRODUCTION

West Nusa Tenggara Province is one of the national centers for beef cattle production to supply cattle and beef cattle for more than 12 provinces in Indonesia. The population of cattle in West Nusa Tenggara Province in 2018 was recorded at 1,183,570 heads, with details of the population on Lombok Island 514,936 heads and 668,634 heads on Sumbawa Island (BPSP NTB, 2021; Dinas Peternakan dan Kesehatan Hewan, 2022). Nearly 99% of the beef cattle population in West Nusa Tenggara is smallholder farming. Smallholder farming is farm carried out by the people, including farmers or breeders in addition to their small-scale agricultural businesses of 1-3 heads/head of the family (Mashur, 2017).

The cattle raising system in West Nusa Tenggara is carried out extensively on Sumbawa Island and intensively on Lombok Island. Extensive maintenance is carried out

either off the pasture or on slings. Intensive maintenance is carried out using cages either individually or in groups (collectively). (Novitasari, 2014) The development of a beef cattle community based on collective cages is a model of intensive beef cattle maintenance developed on the island of Lombok with the main objective of facilitating development and livestock health services and avoiding livestock theft. This model is built by implementing integrated farmer group management by integrating various aspects (technical, social, economic, and cultural) in animal husbandry including maintenance management, feed, breeding, animal health services, marketing, livestock manure processing, and livestock security systems. *One of the obstacles that can affect the acceleration of beef cattle development is livestock disease.* The problem of disease incidence in beef cattle farms is the third main problem of the 28 problems of smallholder livestock in West Nusa Tenggara facing the ASEAN Economic Community in 2015 (Mashur, 2021). The disease not only causes economic loss because it can reduce livestock productivity but can also lead to death. Another negative impact that can arise is the reduced interest of breeders to develop their businesses.

Animal health development policies in West Nusa Tenggara are based on the vision of animal health, namely the realization of ideal animal health through the development of advanced, effective, and efficient animal health. To achieve the vision and mission of animal health in West Nusa Tenggara Province, various efforts have been carried out to increase awareness of the early incidence of strategic infectious animal diseases (PHMS), animal disease observation (P2H); prevention and eradication of animal diseases (P3H); and supervision of veterinary drugs and animal health services (POH and PKH). Livestock health is one of the most decisive aspects of beef cattle maintenance (Dirjen Peternakan dan Kesehatan Hewan, 2020). Cows that are in a weak condition will be susceptible to disease, both infectious and non-communicable. Therefore, special attention is needed regarding the symptoms of the disease, and efforts to prevent and treat it. Generally, livestock diseases can be caused by microbes (bacteria, viruses, and protozoa), external and internal parasites, fungi, and metabolic disorders or nutritional deficiencies (Handayani, 2021; Meurens et al., 2021).

The environmental conditions of the cattle shed are one of the factors that determine the health of beef cattle. Sanitation of the cage is a preventive activity that includes the cleanliness of the building where the livestock lives or the cage and the environment are concerned in order to maintain the health of the livestock as well as their owners. (Rizki & R, 2018) Several things that can affect the sanitary conditions of the cage include the location of the cage, the construction of the cage building, the cleanliness of the cage, and the density of flies. If the sanitary conditions can be maintained then the sustainability of the beef cattle business. Based on this description, it is important to review the sustainability status and development strategy of smallholder beef cattle farming based on collective cages on the island of Lombok: dimensions of disease incidence.

METHOD

This research was conducted in January-July 2018 on the island of Lombok using a survey method equipped with a questionnaire. The type of data needed for the sustainability analysis and development strategy of collective cage-based beef cattle farming in Lombok Island from the incidence dimension is primary data in the form of attributes related to the dimensions of disease incidence Primary data comes from interviews with respondents who are members of the collective cage group, prospective assessments by selected experts and stakeholders and direct observations in the field. Determination of respondents using purposive random sampling technique, namely breeders who have breeding experience of at least five years and are members of collective cage management. The number of respondents (n) is determined by the formula: n = N/1 + Ne2 (Pitcher & Preikshot, 2001).

Determination of the sustainability status and the strategy for developing beef cattle farming based on collective cages from the dimensions of disease incidence was carried out

using the Multi Dimensional Scaling (MDS) method called the RAP-BCS (Rapid Appraisal Beef Cattle Smallholder) approach or the Rapid Assessment of Beef Cattle Farms. This method is a development and modification of the Rapfish approach used to assess the sustainability status of capture fisheries; Sustainability Status of Integrated Beef Cattle Farming Based Areas in Fifty Cities District of West Sumatera (Suyitman, *et al*., 2012); Rap-Agrosapot which is used to assess the sustainability status of Beef Cattle Farming Areas for the Development of Agropolitan Areas in Bondowoso Regency (Ramadhan et al., 2014) Analysis of the Sustainability Status of Feed Banks in the 1000 Village Cow Program in Pujut District, Central Lombok: (Dimension of Availability, Human Resource Management, and Production System, Price, Feed Distribution) and Sustainability analysis of beef cattle and development strategy based on collective cages in Lombok Island (Mashur, 2020; Mashur et al., 2021)

The data were analyzed through seven stages, namely: (1) Determining the attributes of the dimensions of sustainability beef cattle disease incidence. The number of attributes that will be analyzed is 20 attributes; (2) assessment of each attribute in an ordinal scale based on the criteria for the continuity of the dimensions of disease incidence; (3) compilation of indexes and status of the development of dimensions of disease incidence sustainability; (4) ordination stages; (5) leverage analysis to determine variables sensitive to sustainability; (6) Monte Carlo analysis to take into account the uncertainty aspect and (7) formulation of a strategy for developing smallholder cattle breeding based on collective cages in Lombok Island based on the dimensions of disease incidence.

RESULTS AND DISCUSSION

Incidence of beef cattle disease on smallholders farming based on collective cages on Lombok Island

The results showed that as many as 78% of respondents stated that their livestock had been sick. 17 types of diseases have attacked beef cattle on people's farms in Lombok Island, both infectious and non-communicable diseases. The most dominant disease is worm disease. As many as 75% of respondents stated that their livestock had experienced worms (Table 1).

Table 1. The incidence of beef cattle disease in smallholders farming based on collective cages on Lombok Island in 2018.

No	Disease incidence	Respondents' answers (%)
1	Cattle have been sick	78
2	Worm disease	75
3	Diarrheal diseases	70
4	Flatulence	50
5	Scabies (scabies)	40
6	Itching disease	45
7	Eye worm disease	30
8	3 days of fever (BEF)	20
9	Demodec disease	30
10	Pink eye disease	20
11	Anhtrax disease	21
12	Septichaemia Epizootica disease	22
13	Reproductive disorders	40
14	Catarrh	32
15	Lack of appetite	57
16	Myiasis disease (ulcers)	15
17	Brucellosis	10
18	Poisoning	25
19	Calves are dead	20

No	Disease incidence	Respondents' answers (%)
20	Treatment efforts	70

This is following the results of research by (Astiti et al., 2020) stated that nematodiasis was found in all sub-districts on Lombok Island. The highest prevalence of nematodiasis was found in two districts in East Lombok (94.4%). Tricostrongylidae was recorded as the Nematode worm family with the highest prevalence rate (51.4%). The results of this study are following the 2019 West Nusa Tenggara Province Animal Husbandry and Animal Health Service report, as shown in Table 2.

Table 2. Cases of Infectious Animal Diseases in West Nusa Tenggara in 2018

No.	Type of disease	Incidence cases / year						
		2013	2014	2015	2016	2017	2018	amount
1	Anthrax	7	1	2	1	-	2	12
2	Septichaemia	210	153	76	164	97	58	758
3	Epizootica	62	83	38	43	61	46	333
4	Surra	8,676	12,213	8,169	9,389	4,588	6,093	39,739
5	Helminthiasis	719	796	1,081	1,571	515	597	5279
6	Pink Eye	530	554	629	1,070	571	609	3963
7	Demodecosis	1,103	1,236	1,407	1,945	1,287	880	7858
8	Myiasis	2,206	2,763	2,652	3,060	3,359	1,703	15,743
9	Bovine Ephemeral	144	114	122	72	110	16	578
10	Fever	223	248	277	175	328	157	1408
11	Malignant Catharral	416	982	678	640	264	223	3203
12	Fever Balizeakte Teleziation Scabies	10,131	8,395	7,931	7,940	2,928	6,400	43,725

Based on the data in Table 2, it appears that Scabies (scabies), Helminthiasis (worms), and Bovine Ephemeral Fever (three days of fever) are the dominant types of disease occurring in NTB according to the results of this study in Table 1. To support animal health services, the NTB Provincial Animal Husbandry and Health Service in 2018 has purchased ingredients for veterinary medicines for handling worm disease in calves, namely 3,500 boluses of 300 mg Albendazole and 300 bottles of 50 ml of vitamin B12 injection. Apart from worms, diarrheal disease is the second dominant disease suffered by beef cattle on smallholders farming on Lombok Island based on collective cages. The third dominant disease incidence is beef cattle experiencing a lack of appetite, so that the cattle become thin, which causes their selling price to decline. Among the zoonotic diseases that need to be watched out for are Anthrax and SE. Even though various types of diseases have attacked beef cattle on the smallholder farm-based on collective cages on the island of Lombok, 75% of farmers stated that they had taken preventive measures. For more details regarding the various matters related to the incidence of beef cattle disease on smallholders farms based on collective cages on Lombok Island can be seen in Table 1.

The Status of the Sustainability of the Development of Collective Cage-Based Beef Cattle Smallholder Farming in Lombok Island from the dimension of disease incidence

Nine sensitive attributes need to be improved from the dimensions of the incidence of beef cattle disease in collective cage-based smallholder farms on Lombok Island because of the effect of increasing the value of the sustainability index, namely: the incidence of dengue disease 0.73; scabies 0.58; flatulence 0.58; hives 0.57; demodectic 0.56; pink eye 0.55; anthrax 0.55; reproductive disorders 0.51 and septicemia epizootic 0.51 as shown in Figure 1.

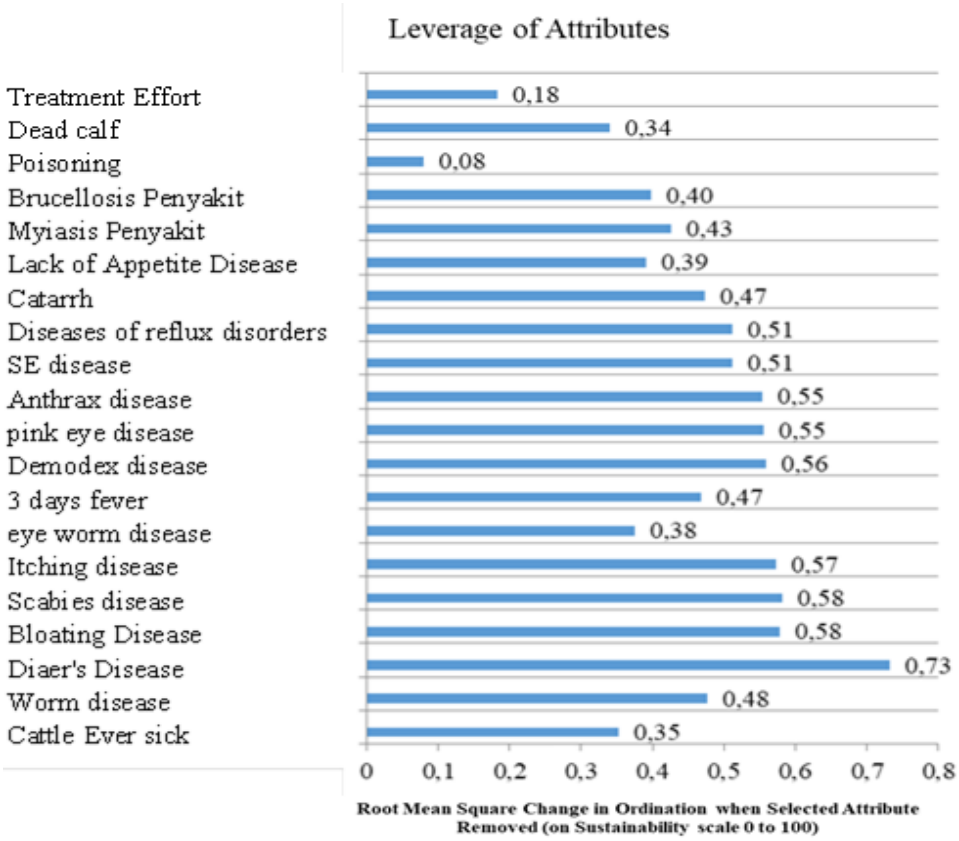

Figure 1. The results of the attribute leverage analysis of the 20 attributes from the dimensions of disease incidence

The determination of the value of the sustainability index in a multidimensional manner is a picture of the sustainability of the development of smallholders livestock based on collective cages in Lombok Island. The multidimensional value is obtained by multiplying the index value by the weight of the dimension of disease incidence based on the opinion of experts and related stakeholders. According to (Budiharsono, 2011) in seeing multidimensional values cannot be done with an average, however must be done with a pairwise comparison test obtained from the assessment of experts and stakeholders in the field of community livestock (disease incidence and socio-economic and cultural), to obtain the weight of the dimensions of disease incidence 56, 38; the weighted value is 19.31% and the weighted index value is 10.89, as shown in Figure 2.

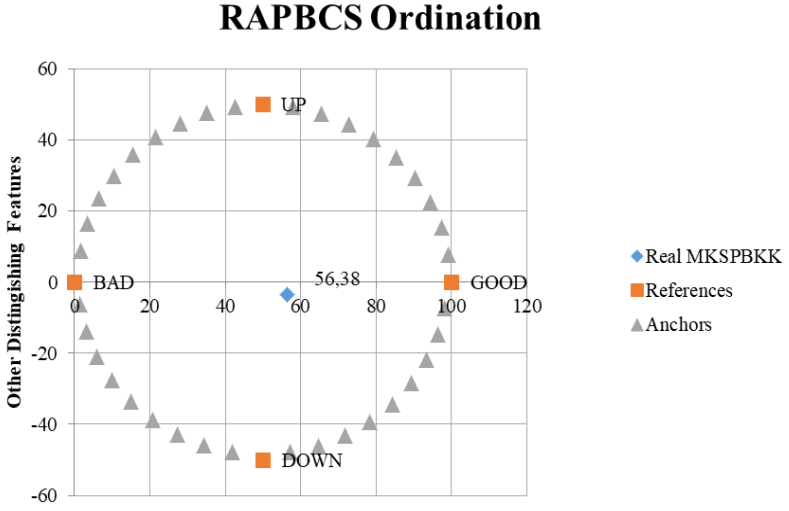

Figure 2. The sustainability of disease incidence dimension

Based on these nine types of diseases must be anticipated to increase the sustainability status of beef cattle development in collective cage-based smallholder farms on Lombok Island. Of the 9 types of diseases that are dominant, four of them are priority programs of the West Nusa Tenggara Provincial Government to be handled sustainably, namely handling reproductive disorders.

Reproductive disorders examination activities are still prioritized considering that many cases still occur. SE vaccination activities are only carried out in five districts/cities on the island of Sumbawa because they are still endemic, while on the island of Lombok, SE vaccination is free based on the 1997 Kepmentan so that priority activities are only carried out on Sumbawa Island. Anthrax vaccination activities through APBD funds have a target of 8,000 doses which are only given to Central Lombok Regency because it is still considered an area at risk of infection. This is because the last Anthrax incident on Lombok Island occurred in Central Lombok Regency in 1987. The implementation of Anthrax disease control activities was vaccinated with a target of 320,000 doses in 2018 (308,000 operational target doses), Lombok (DITJENPKH, 2020).

Value of stress and coefficient of determination (R2)

The stress value and coefficient of determination are used to see the accuracy of the results of the sustainability index value or in other words whether or not it is necessary to add attributes to reflect the level of accuracy of the dimensions studied so that it can be scientifically accounted for. The stress value is defined as a measure to see the accuracy of the results obtained whether it is close to the original data (goodness of fit). If the stress value gets closer to zero it indicates that the resulting data can be trusted. To see the effect of errors or disturbances from the results of ordination on the sustainability of the development of collective cattle pens based on the island of Lombok, a Monte Carlo analysis is performed, which is a statistical simulation method to evaluate the effect of errors or the effect of errors on the statistical process. The results of the Monte Carlo analysis show that the points in the scatter plot are in a collecting position, this means that the results of the ordination points used in determining the sustainability status of the development of collective cage-based beef cattle farming on the island of Lombok are quite stable so that errors or disturbances can be resolved. In detail, the results of the Monte Carlo ordination from the dimensions of disease incidence of sustainability in the development of smallholder cattle breeding based on collective cages on the island of Lombok are shown in the form of a scatter plot as shown in Figure 3.

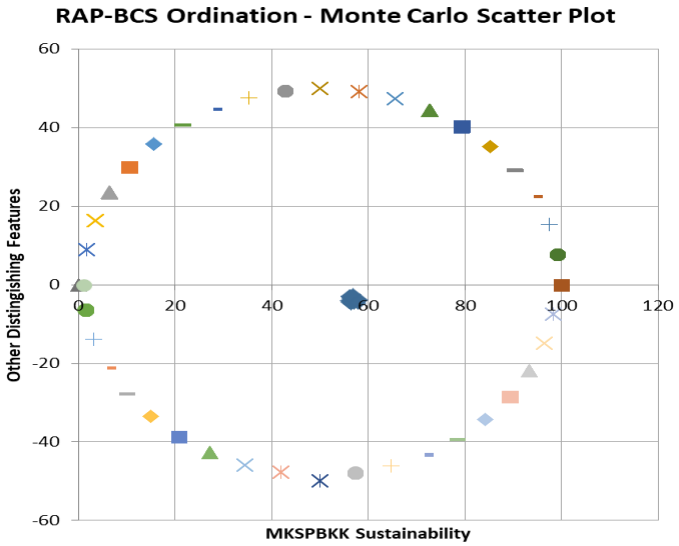

Figure 3. Scatter plot of Monte Carlo analysis results

The value of stress and the coefficient of determination of the dimensions of disease incidence to determine the sustainability status and development strategy of community livestock based on collective cages in Lombok Island is 0.1380562 (13.81%) with a coefficient of determination (R2) 0.9530509 (95.31%). This data shows that all the attributes studied from the dimensions of disease incidence in the development of smallholder cattle breeding based on collective cages are accurate enough to provide good analysis results and can be scientifically accounted for. This is in accordance with the research results Fauzi and Anna (2015) in a good Rapfish model are indicated by stress values <0.25 (25%). While the coefficient of determination (R2) is closer to greater than 80% or closer to 100% (Pitcher & Preikshot, 2001).

According to (Kavanagh & Pitcher, 2004) errors or disturbances in ordination results are indicated by points that spread or are separated from a collection of other points in a scatter plot caused by: (1) the effect of attribute scoring errors caused by lack of information, misunderstanding of attributes or methods. attribute scoring; (2) the effect of the variation in scoring due to differences in opinion or judgment by different researchers; (3) stability of the iterative MDS analysis process (the risk position is unstable); (4) data entry errors or missing data; and (5) the high "stress" value from the analysis

Development Strategy of Beef Cattle Smallholders Based Collective Cage

Development strategy beef cattle farming based on collective cages on Lombok Island, by looking at the sensitive attributes of the dimensions of disease incidence that need to be a top priority. These sensitive attributes are the main factors in supporting sustainability development of beef cattle farming based on collective cages on Lombok Island. For this reason, various efforts are needed both beef cattle breeders, government and multi-stakeholders related to improving the attributesthese sensitive attributes, and maintain or re-enhance well-identified attributes to achieve sustainability (Mashur et al., 2019). In Table 3, the sensitive attributes of the dimensions of disease incidence in the development of collective cage-based beef cattle farms on Lombok Island are shown. Furthermore, from the nine sensitive attributes a prospective assessment was carried out by experts and three key success factors were determined namely controlling anthrax disease, septicemia epizootic, and avoiding reproductive disorders.

Table 3. Sensitive attributes of the dimensions of disease incidence of sustainability in the development of smallholder beef cattle based on collective cages in Lombok Island

Dimensions		**Sensitive attribute (Leverage factor)**	**RMS***
Disease incidence	1	The incidence of diarrhea	0.73
	2	Scabies disease	0.58
	3	Flatulence	0.58
	4	Itching disease	0.57
	5	Demodec disease	0.56
	6	Pink Eye Disease	0.55
	7	Anthrax disease	0.55
	8	Reproductive disorders	0.51
	9	Epizootic Septicemia Disease	0.51

*RMS= root mean square

Based on the priority order of the dominant/sensitive attributes of the results of the leverage analysis that affect sustainability and the key success factors, a development strategy has been prepared Beef cattle farming based on collective cages in Lombok Island from the dimension of disease incidence, namely increasing collective cage health management, through: (1) enhancing the livestock health service system (especially periodic Anthrax and SE vaccination) and avoiding reproductive disorders in livestock; (2) improving the

management of livestock manure so as not to have a negative impact on environmental hygiene and health; (3) the cage should be cleaned every day to prevent the floor of the cage from becoming slippery which will endanger livestock; (4) pay attention to the size of the cage, especially the main cage so as not to exceed its capacity; (5) sustainable supply of cheap feed based on agricultural and industrial waste in sufficient quantity and quality according to livestock needs (Mashur, 2021); (6) processing of livestock manure into solid and liquid organic fertilizers in order to provide added value for breeders; (7) developing an information network system that is easily accessible to breeders, including through social media; (8) increasing the capacity of members of farmer groups through training, technical guidance, counseling and farmer apprenticeships and (9) enhancing the roles and functions of agricultural extension workers, medical veterinarians and officials of related agencies/agencies in fostering and assisting farmer breeders and livestock health services.

CONCLUSION

Being aware of the results of this study, it can be concluded that the status of the sustainability of the development of collective cage-based beef cattle farming on the island of Lombok from the dimensions of disease incidence with 20 attributes is in the sufficient category continues with a score of 56.38 There are nine sensitive attributes that need to be intervened and with the prospective assessment of relevant experts and stakeholders, there are three key success factors that need to be considered so that the development of collective cage-based beef cattle farming on the island of Lombok, from the dimensions of future disease incidence, is more effective and efficient, namely controlling Anthrax, Septichaemia Epizootica, and avoiding reproductive disorders. Therefore, a strategy for developing beef cattle-based on collective cages in Lombok Island has been recommended, namely improving health management for beef cattle based on collective cages.

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