Measuring technology sustainability status of local beef cattle under extensive rearing systems in the dryland area, Indonesia

M M J Kapa1, Hasnudi2 and Y L Henuk2*

1Department of Agribusiness, Faculty of Agriculture, University of Nusa Cendana, Kupang, Indonesia
2Department of Science Department, Faculty of Agriculture, Universitas Sumatera Utara, Medan, Indonesia
Email: *profesorhenuk@gmail.com

Abstract. Beef cattle have become a leading commodity and performs several benefits in terms of providing income, and draught power as well as an important component in cultural purposes. The aims of the study were, (1) to know sustainability status of the local beef cattle production under extensive rearing systems, and (2) to identify sensitive attributes that influence the technological status of the Local Beef Cattle in the dryland area. Data on this study was obtained through interviewing 56 farmers. The respondents were from two different farming systems namely, rice field (low land) area and dry field (upland). The Rap-UTSP-laker as a modification of Rapfish method, was applied to assess the technological sustainability of the local beef cattle systems. Results of the research proved that the sustainability status of the local beef cattle system under extensive rearing systems from the technologial dimension both in lowland (rice field) and upland (dry field) systems was less sustainable with index values of 44.89 and 42.50 respectively. Among 10 attributes, there were 6 attributes were categorized as critical attributes. Therefore, serious attention should be given to those attributes in order to improve the technology sustainability of the local beef cattle in the region.

1. Introduction

Livestock sub sector in Indonesia plays a vital role both in national and in regional economic developments. Several roles of the livestock sub sector mainly beef cattle can be seen in GDP, foreign exchange, providing row materials for industries, as source of food, providing draught power for farm activities, and important component in socio and cultural events The livestock sub-sector in Indonesia plays a very important role in the national and regional economy. Role of the livestock sub-sector can be seen in the formation of GDP, foreign exchange earnings, the supply of food and industrial raw materials, the creation of employment opportunities, and the increase of community income. As with other sub-sectors in the agricultural sector, the livestock sub-sector is known to have a large multiplier effect through increased input-output between industries, consumption and investment [1]. The function of the livestock sub-sector over the past decade is quite encouraging, for example in terms of meat supply nationally reported an increase of 4.01% per year. This increase was also followed by an increase
in the demand or consumption of the meat of the community. In addition, the development of the livestock sub-sector is specifically directed to increase the income of the general public and especially farmers and at the same time to increase the regional revenue [2]. The development of beef cattle business in East Nusa Tenggara (ENT) is one of the right choices in order to achieve development goals, namely improving the welfare of the community, because beef cattle business is able to penetrate and touch all levels of society, especially the poor. In addition, beef cattle is important commodity to success a mission to support the meat self-sufficiency program [2, 3].

However, the success of the meat self-sufficiency program has not shown encouraging results. In NTT this program is still far from expectations. Previous studies indicated a tendency to decrease the productivity of beef cattle as the main element of the meat self-sufficiency program. Crucial problems that are thought to inhibit the increase in productivity of beef cattle farms in the research area are extensive rearing systems, lack of feed both in quantity and quality, prevalence several serious diseases such as brucellosis, and antrax, and lack of water resources due to long dry seasons ([4]. Those factors are directly influence the productivity of beef cattle in the study area. So far, several technologies have been proposed by both government and private sectors to help improve the productivity of local beef cattle in the region. For instance, introduction of exotic species of grass and legumes to the quality of pasture, preservation and processing of animal feed, the application of Artificial Insemination, and the most recent program is the compulsory pregnant of cows (SIWAB) [1]. The question is whether the status of the local beef cattle enterprise system in the study area is technologically sustainable? The aims of the study were, (1) to know sustainability status of the local beef cattle production under extensive rearing systems, and (2) to identify sensitive attributes that influence the technological status of the local beef cattle in the dryland area.

2. Materials and Method
This study was taken place in the dryland area of Kupang Regency East Nusa Tenggara Province, Indonesia. Two villages namely Raknamo in East Kupang Sub District and Kaerane in East Amabi Oefeto Sub District were chosen to be the research location. Data collected consisted of primary and secondary data. Two groups of respondents namely farmers and experts were interviewed to get the primary data. Data from the first group was mainly related to farm household characteristics, their local beef cattle production systems. While, data from the second group was their perceptions dealing with attributes that determined the technology sustainability of the local beef cattle systems. Secondary data was gathered from several government and private institutions which are close related to this research. Further, data about respondents’ characteristics and beef cattle production system were analyzed descriptively. Whereas, ordination technique of RapUTSP Laker as a modification of Rapfish method developed by [5, 6] was the method applied to analyze the technological sustainability status of beef cattle systems. Before run the Rap-USTP-Laker, several steps have to be made [7], namely (1) all attributes for technological dimension have to be determined, (2) assessing all attributes based on the sustainability criteria of the technology dimension, (3) data analysis using RAPFISH software, (4) testing the status of sustainability and index values of the technology dimension, (5) identifying sensitive attributes that affect the level of sustainability of local beef cattle business with leverage analysis and (6) using monte carlo analysis to determine the effect of errors in the calculation process.

3. Results and Discussion
3.1. Sustainability status of local beef cattle
In the Sustainability the Status of Local Beef Cattle under Extensive Rearing Systems based on rice farming systems and rice field and field farming in the Kupang dryland area has been evaluated for its sustainability level. Assessment of the level of sustainability using the Infrastructure and Technology dimension with 10 attributes.
3.2. Technology dimension
The technology dimension is one of the dimensions that plays an important role in the development of a local beef cattle enterprise in the dryland area of Kupang Regency. Technology dimension has 10 attributes namely (a) Local accessibility, (2) Farm road facilities and infrastructure, (3) Transportation facilities, (4) Technology for making hay and silage, (5) Irrigation systems, (6) level of mastery of livestock husbandry technology, (7) Artificial Insemination usage, (8) Livestock waste processing technology, (9) Agricultural Education and extension facilities, and (10) availability of livestock (beef cattle) enterprise technology and information

3.3. MDS RapUTSLaker ordination analysis
The results of MDS RapUTSLaker analysis of the local beef cattle farming systems in dryland areas based on dry fields and rice fields on 10 attributes that affect the dimensions of technology explain that the sustainability index values as shown in Figure 1 are 44.89 for local beef cattle farming farm-based and 42.50 for rice-based local UTSP. This indicates that the development of the beef cattle enterprise system is less sustainable. The index values are in the range of 25.00-50.00 indicated that systems were less sustainable.

![Figure 1. Sustainability index of technology dimensions of the local beef cattle farming system based on dry fields and rice fields in Kupang Regency.](image)

3.4. Leverage analysis of infrastructure and technology dimensions
Leverage analysis aims to find out the attributes that are sensitive and affect the sustainability index value of the infrastructure and technology dimensions. The results of the analysis using MDS RapUTSLaker are presented in Figure 2.
Figure 2. Leverage Analysis of the technology dimensions of local beef cattle business in the dry land area of Kupang Regency.

Based on Figure 2, it is known that 5 attributes of 10 attributes that are sensitive to the sustainability index value of technology dimensions that can be sorted from the high value of RMS changes are, (1) the existence of irrigation networks (1.61); (2) Feed processing technology (1.01); (3) means of transportation (0.91); (4) Availability of UTSP information technology (0.77); and (5) Remember the mastery of livestock cultivation technology (0.68).

3.5. Monte Carlo analysis
Monte Carlo simulations are used to measure the level of errors; the results of their status are expressed in terms of percentages from 0 to 100% [5]. Figure 3 presents the simulation results of Monte Carlo at 95% confidence level.
The results of the analysis show the sustainability index value of the Monte Carlo simulation results with the number of iterations twice is not much different from the index value of the sustainability analysis of MDS with the RapUTSPLaker approach as listed in Table 1.

| Local Beef Cattle Enterprise | Technology Dimension | MDS | Monte Carlo | difference | Decision |
|-----------------------------|-----------------------|-----|-------------|-------------|----------|
| UTSP Dryland based          |                       | 42.50 | 42.36      | 0.14        | Stable   |
| UTSP Rice Field Based       |                       | 44.89 | 44.87      | 0.02        | Stable   |

The difference between the results of MDS and Monte Carlo analysis is relatively small, which explains 4 things, (1) Each score given to each attribute has a small error, (2) the level of error in the scoring as a result of differences in opinion from each relatively small resource person, (3) the analysis process with several iterations is relatively stable, and (4) the possibility of data entry errors and missing data can be avoided. Thus, these results indicated that the RapUTSPLaker analysis using the MDS method can be used to quickly assess the sustainability of the local beef cattle under extensive system based on rice fields and dryfields in the dryland area of Kupang.

4. Conclusions
The results of the MDS of Technology Dimensions analysis with RapUTSPLaker emphasized the sustainability status of local beef cattle farming systems in the Kupang District dryland, both dryland field-based and Rice field-based, showing an index with a less sustainable category. In addition, the results of the leverage analysis on the 10 attributes assessed, there are 5 attributes which are critical attributes that affect the sustainability status of the local beef cattle business in the research area. Improvements to the five critical attributes will improve the sustainability status of the local beef cattle under extensive rearing systems in the dryland area, Indonesia.

References
[1] Kapa M M J 2017 Strategi Pengembangan Sistem Peternakan Sapi Potong Lokal Yang Berkelanjutan Di Daerah Lahan Kering Kabupaten Kupang, Provinsi Nusa Tenggara Timur [Strategy for Sustainable Development of Local Beef Cattle Systems in the Dry Land Area of Kupang Regency, East Nusa Tenggara Province]. [Dissertation] (Malang, Indonesia: Universitas Brawijaya)
[2] Kapa M M J, Henuk Y L, Hasnudi and Suyadi 2018 Contribution of local beef cattle production on farmer’s income in the dryland farming of Kupang Regency, Indonesia. IOP Conf. Series: Earth and Environ.Sci. 122 012118
[3] Kapa M M J, Soemarno, Bagyoyanuwiyadi and Suyadi 2017 Sustainable status of biology dimension of local beef cattle development in the dryland region, Indonesia J. Econ. Sustain. Dev. 8 6 pp 102-8
[4] Kapa M M J and Henuk Y L 2018 economic performance of local beef cattle development under rice field in the dryland area Proc. 18th AAAP Congress 2018 (Kuching, Malaysia) p 85
[5] Pitcher T 1999 Rapfish, a rapid appraisal technique for fisheries, and its application to the code of conduct for responsible fisheries FAO Fisheries Circular 947
[6] Pitcher T J and Preikshot D 2001 RAPFISH rapid appraisal technique to evaluate the sustainability status of fisheries Fish. Res. 49 pp 255-70
[7] Fauzi A and Anna S 2005 Permodelan Sumberdaya Perikanan Lautan untuk Analisis Kebijakan. [Fisheries and Coastal Resources Modeling for Policy Analysis] (Jakarta, Indonesia: Gramedia Pustaka Utama) pp 265-88