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To cite this article: James Hellyward *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **287** 012038

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The sustainability index of dairy cattle area in Padang Panjang City

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Abstract. This study aims to analyze the sustainability status of dairy cattle based livestock areas in Padang Panjang City West Sumatera from the five dimensions of sustainability (ecology, economics, socio-cultural, technological-infrastructure, and legal-institutional) and identifies key influential factors in the future development of the system. This research uses Multidimensional Scaling (MDS) method of analysis which results are expressed in the form of sustainability index. The result of the index of sustainability using approach Rapid Appraisal of Dairy Cattle Breeding System yielded the value of 55.09. Based on these values, the sustainability index of dairy cattle breeding system in Padang Panjang City is categorized as "quite sustainable". An increase in the value of the sustainability index can be done by improving the 15 sensitive attributes of 45 attributes of the system's sustainability assessment. Analysis of dependency between factors using prospective analysis resulted in 7 (seven) key factors influencing the development of dairy farming system. The key factors are: (1) milk price, (2) feeding capacity, (3) feed industry, (4) utilization of livestock waste, (5) job socialization, (6) development of cooperative, and (7) microfinance (bank/credit). In order to improve the sustainability status for the future (long term), the scenario that needs to be done is a progressive-optimistic scenario by making a thorough improvement on all the sensitive attributes in enhancing the status of the region.

Keywords – status of sustainability ecological, economic, socio-cultural, technological infrastructure, and institutional-law dimensions.

1. Introduction

National milk self-sufficiency is currently still difficult to achieve, it is seen that more than 75 percent of milk supply across the archipelago is dominated by foreign farmers, and the remaining 25 percent for national milk supply comes from the contribution of farmers in the country (Directorate General of Livestock and Animal Health, 2015). One way that can be done to achieve national milk self-sufficiency is by increasing the provision of assistance to farmers and at the same time increasing dairy cattle [1]. The policy of developing dairy farming in West Sumatera is more focused on increasing local food-based population and integration with other businesses, increasing consumption and developing local marketing. Government support in the development of an integrated dairy cow industry must also be based on the development of farmers groups and need to be pursued in particular in order to increase market-oriented dairy farm income. Padang Panjang City is one of the development centers for dairy cattle in West Sumatera Province. The dairy cattle population in Padang Panjang ranks first, with 343 dairy cows, followed by Tanah Datar Regency with 183 dairy cows, and Padang City with 134 tails [2].

According to Livestock Services Office of West Sumatera data in 2010 the milk production of Padang Panjang city was 522,495 liters. The number of dairy cattle population in the city of Padang



Panjang experienced an increase from 2006 to 2010, from 244 to 343. Based on the increase in the number of dairy cattle population, it indicates that there is potential in the development of dairy cattle business in Padang Panjang City. One of the interesting information from them is the new population of dairy cows in the city of Padang Panjang which is around 343, producing around 1.200 liters / day, apparently the largest in Indonesia outside Java. However, when compared with dairy cattle farms in Sumedang, Ciawi, Cibungbulang, Bogor, West Java, it is indeed small. Especially when compared to New Zealand, farmers generally have more than 400 dairy cows per person.

However, Padang Panjang City with its dairy cattle business development, plus a number of supporting facilities lately, was once mentioned by the Deputy of the Republic of Indonesia Ministry of Agriculture, which has the potential to become a dairy cattle business development center in West Sumatera, especially because Padang Panjang City is on the road junction the heart of West Sumatera. The dairy business support facility in the city of Padang Panjang was according to the Head of the Padang Panjang Agriculture Service: First, the availability of dairy houses where milk production was collected from the 9 dairy cattle business groups in the city. At the milk house, there are labor mini testers for milk samples, milk pasteurization equipment, culling units, packing equipment and marketing containers. Second, has a calf maintenance / enlargement center (Rearing Unit) which is considered the best in the country, so it is visited a lot. Third, there is a national standard Puskesmas (animal health center) for cattle inspection. In 2016, a unit of broodstock by the Level I Provincial Government of West Sumatera Province is being built and the most exciting recently conducted by the Government of Indonesia - New Zealand in the field of dairy cattle business development in Indonesia, five consultants from New Zealand. by staff from the Ministry of Agriculture (Ministry of Agriculture) RI came to review the dairy farming business in Padang Panjang City in 2015.

To support the dairy farming business development program, it is necessary to develop a dairy farming business nationally. Sustainable development criteria need to be implemented to ensure the sustainability and optimal benefits of dairy farming that harmonizes economic, social and environmental sustainability [3]. That the criteria for sustainable development in principle involve the ecological, economic, socio-cultural and legal-institutional dimensions [4]. A technological aspect, so that the reference criteria for sustainable development include five dimensions, namely: (1) ecology, (2) economy, (3) socio-culture, (4) legal-institutional, and (5) technology [5]. In its development, the technological dimension is aligned with the dimensions of infrastructure [6]. Therefore, development sustainability criteria cover five dimensions, namely: (1) ecology, (2) economy, (3) socio-culture, (4) law-institutional, and (5) technologies.

The development of a farming system by applying the five dimensions of continuity requires modeling activities with a system approach. This is needed to describe the interrelationship between factors in the system. In addition, the resulting model is able to simulate the impact of interventions on factors, so as to be able to provide recommendations for better policy direction for the development of livestock systems in an effort to improve system performance. Modeling the dairy farming system in Padang Panjang by considering sustainability criteria is expected to improve system performance. Better system performance is expected to: (1) increase cow milk production, (2) increase farmer acceptance, (3) income distribution among farmers, (4) improve the quality of the local environment, (5) better management of livestock waste, (6) utilization of agricultural waste, and (7) the application of effective and efficient technology. Therefore, the sustainability analysis of the dairy farming system combined with an analysis of the dairy farming model is needed to provide convenience for stakeholders in determining the direction of the policy, so that optimal benefits can be obtained from the dairy farming business in Padang Panjang City. In addition, research related to the sustainability of the development of sustainable dairy farming in Padang Panjang has never been done before, so the results of this study are expected to be a reference for further related research and the West Sumatera Provincial Government in determining the direction of policy.

This study aims to assess the sustainability status of the dairy farming system in Padang Panjang in terms of each dimension of development sustainability, namely: ecological, economic, socio-cultural, technological-infrastructure, and legal-institutional dimensions, as well as identifying influential key

factors that determine the sustainability of the development of the dairy farming system in the city of Padang Panjang (West Sumatera).

2. Materials and methods

2.1. Place and time research

The entire research area is in Padang Panjang City. Determination of the research location was chosen intentionally (purposive) with the consideration that the area was the center of dairy cow milk production in West Sumatera Province. This research was carried out from January 2018 to July 2018.

2.2. Research data

The data needed in this study are primary data and secondary data. Methods of data collection in the sustainability analysis of the development of dairy farms in the city of Padang Panjang were conducted through interviews, discussions, filling out questionnaires, and field surveys with respondents in the study area consisting of various experts and stakeholders related to the topic of this research.

2.3. Data analysis method

The research method used in general is descriptive method based on case studies analyzed using a system approach. The system approach is used to formulate policy directions and scenarios for the development of a sustainable dairy farming system in the city of Padang Panjang based on the five-dimensional sustainability criteria. Determination of sustainability index and status using the Rap-SIBUSAPE approach based on MDS (Multidimensional Scaling Analysis) techniques. Sensitive attributes that influence the value of the system sustainability index that is reviewed further are assessed based on the level of influence and dependence between factors through prospective analysis. The results of the analysis are key sustainability factors based on existing conditions. In the next stage, a needs analysis is needed from all stakeholders, so that the attributes of stakeholders' needs are obtained. These attributes are then assessed based on the level of influence and dependence between factors through prospective analysis. The results of these analyzed are key factors of stakeholders' needs.

2.4. Multidimensional Scaling Analysis (MDS)

The sustainability status of the farming system is expressed in the form of a sustainability index based on the Rap-SIBUSAPE approach by applying MDS techniques. The Rap-SIBUSAPE approach was modified from the Rapfish program (Rapid Assessment Techniques for Fisheries) developed by the Fisheries Center, University of British Columbia [7]. The MDS method is a statistical analysis technique that transforms every dimension and multidimensionality in the dimensions of the sustainability of the dairy farming system.

2.5. Prospective Analysis

Determination of key sustainability factors is carried out using a prospective analysis (Participatory Prospective Analysis). The analysis is used to determine important factors that affect the dairy farming system. Prospective analysis involves expert respondents to participate in order to find out, investigate, and anticipate changes to the system that are able to provide fast results [8].

3. Results and discussion

The results of Rap-SIBUSAPE analysis show that the Dairy Farm in Padang Panjang has an average index value of the sustainability of the dairy farming system of 55.09, so the sustainability status is categorized as quite sustainable. The results of Rap-SIBUSAPE analysis and leverage on each dimension of sustainability are as follows: ecological dimensions: 45.17 (less sustainable); economic dimension: 49.24 (less sustainable); socio-cultural dimensions: 48.89 (less sustainable); dimensions of infrastructure technology: 57.18 (quite sustainable); legal-institutional dimension: 74.98 (quite

sustainable). The sustainability index value is generated based on an assessment of 45 attributes included in 5 dimensions of sustainability, including: ecological dimensions (10 attributes), economic dimensions (9 attributes), socio-cultural dimensions (9 attributes), technology-infrastructure dimensions (7 attributes), and legal-institutional dimensions (10 attributes).

3.1. Ecological dimension

The sustainability status of the ecological dimension is based on the assessment of 10 sustainability attributes. These sustainability attributes include: (1) sources of clean water, (2) conditions of groundwater utilization, (3) carrying capacity of feed, (4) types of animal feed, (5) sanitation of pens and milking equipment, (6) the quantity of waste (faeces and urine) remaining livestock per day, (7) availability of biogas installations, (8) utilization of cattle waste for organic fertilizer, (9) utilization of agricultural waste for animal feed, (10) distance of livestock business locations with residential areas. The results of the ordination of the ecological dimensions of RAP-SIBUSAPE, indicate that the sustainability index of Dairy Farming in Padang Panjang City is 45.17. Based on the results of the analysis, the sustainability status of Dairy Farming in Padang Panjang is categorized as less sustainable.

The unsustainable status of the Dairy Farming system in Padang Panjang City is due to the poor scores on some of the assessment attributes for the preparation of the sustainability index. Sustainability attributes that have poor scores include: (1) clean water sources, (2) feed carrying capacity, (3) sanitation of pens and milking equipment, (4) quantity of waste (feces and urine) remaining in the cage per day, (5) availability of waste / biogas storage installations, and (6) utilization of cattle waste for organic fertilizer. Most of the attributes that have bad scores have a strong relationship with aspects of livestock maintenance management, this shows that the management of livestock raising in Dairy Cattle Farming in Padang Panjang City is not good from an ecological perspective. The implementation of such maintenance management, if it continues to be maintained, will reduce the quality of the surrounding environment, especially the environmental carrying capacity.

3.2. Economic dimension

The sustainability status of the economic dimension is generated based on the assessment of 9 attributes of sustainability. These sustainability attributes include: (1) profit (profit) of dairy farming, (2) market for dairy products, (3) price of milk for the last 5 years, (4) place for farmers to sell milk, (5) ownership (beneficiaries of ownership), (6) level of subsidies to inputs, (7) transfer of profits, (8) types of superior commodities, (9) level of dependence of consumers.

The index value of the sustainability of the dairy farming system in the economic dimension of Dairy Cattle Farming in Padang Panjang City has a value of 49.24. Based on the sustainability index value, the sustainability status of Dairy Cattle Farming in Padang Panjang is categorized as less sustainable. The results of the leverage analysis of the sustainability of the economic dimension show that of the 9 attributes analyzed there are 3 sensitive attributes affecting the sustainability of the economic dimension. These three attributes are sensitive to sustainability, including: (1) transfer of profits, (2) level of subsidies to inputs, and (3) price of milk for the last 5 years. These three sensitive attributes are related to one another.

3.3. Socio-cultural dimensions

The sustainability status of the social dimension is generated based on the 9 attributes of sustainability. These sustainability attributes include: (1) socialization of work (individual or group), (2) the number of households of dairy farming workers, (3) the growth of dairy farming workers (last 5 years), (4) the frequency of conflicts relating to dairy cattle business, (5) alternative businesses other than dairy farming agribusiness, (6) time allocation for dairy cattle business, (7) population growth, (8) community role in management efforts, (9) frequency counseling and training.

Based on the RAP-SIBUSAPE analysis, it is known that the sustainability index value of the socio-cultural dimension of the dairy farming system in Dairy Cattle Farming in Padang Panjang City is 48.89. Based on the sustainability index value, the sustainability of the dairy farming system in the Dairy Cattle Farm in Padang Panjang is less sustainable. The results of the leverage analysis on the sustainability of the socio-cultural dimension show that of the 9 attributes analyzed there are 3 sensitive attributes that affect the sustainability of the socio-cultural dimension. The three attributes are sensitive to sustainability, among others: (1) alternative businesses, (2) frequency of counseling and training, and (3) job socialization.

The frequency of low intensity extension activities is only one time a year resulting in low levels of knowledge and skills of farmers in conducting dairy farming in a sustainable system. The low level of knowledge is reflected by the dependence on the involvement of the farmer's family in the implementation of dairy cattle cultivation, so that the efficiency in the input use of livestock business is low. The skills of farmers in the implementation of sustainable dairy farming systems are low.

The low level of farmer proficiency is reflected in the small number of business alternatives developed in addition to dairy farming, and does not even have an alternative business other than dairy farming. If the level of expertise of farmers is adequate, there are several business alternatives that can be done such as: building feed factories, animal medicine stores, yogurt making business, ice cream, butter, cheese, kefir, curd, frozen yogurt, making organic fertilizer from dirt or biourine cow urine, biogas making, cultivation of superior grass plants utilizing arbuscular mycorrhizal fungi (FMA) or other economically valuable plants. Alternative businesses, especially in this region are very limited, so alternative businesses other than dairy cattle breeding are difficult to develop, except business alternatives that are related to dairy cattle business from upstream to downstream.

3.4. Dimensions of technology-infrastructure

The sustainability status of the technology-infrastructure dimension is generated based on the assessment of 7 attributes of sustainability. These sustainability attributes include: (1) post-harvest handling, (2) feed technology, (3) deployment of poskeswan / IB places, (4) use of vitamins and probiotics for livestock, (5) availability of agribusiness facilities and infrastructure, (6) standardization of the quality of livestock products, (7) utilization of waste handling technology (biogas or organic fertilizer).

The results showed that the index value of the sustainability of the technology-infrastructure dimension in Dairy Cattle Farming in Padang Panjang City was 57.18. Based on the sustainability index value, the sustainability status of the technology-infrastructure dimension in Dairy Cattle Farming in Padang Panjang City is categorized as quite sustainable. The results of the analysis of the leverage of technology-infrastructure dimensions show that of the 7 attributes analyzed there is 1 sensitive attribute that influences the sustainability of the technology-infrastructure dimension. The sensitive attribute to sustainability is the use of waste handling technology (biogas or organic fertilizer).

The dairy farming business center in the Dairy Cattle Farming in Padang Panjang City has not fully utilized waste handling technology to be used as biogas or organic fertilizer. This is due to the quite high costs from the point of view of farmers in the application of the technology. In addition, the lack of maintenance (maintenance) activities in technology applications due to the limited knowledge of breeders is an obstacle that requires special attention.

3.5. Dimensions of institutional law

The sustainability status of the legal-institutional dimension is generated based on the assessment of 10 sustainability attributes. These sustainability attributes include: (1) the availability of formal management regulations, (2) land allotment zoning in accordance with the RTRW, (3) the intensity of illegal farming activities, (4) the development of cooperatives, (5) extension institutions agriculture, (6) transparency in policies or information delivery, (7) microfinance institutions (banks / credit), (8)

livestock farmer groups, (9) institutional input of livestock businesses, and (10) institutional output of livestock businesses.

The sustainability index value of the legal-institutional dimension in Dairy Cattle Farming in Padang Panjang City is 74.98. Based on the sustainability index value, the Dairy Cattle Farm in Padang Panjang City is quite sustainable. The results of leverage analysis of legal-institutional dimensions show that from 10 attributes of sustainability assessment there are 3 sensitive attributes that affect sustainability. These three attributes are sensitive to sustainability, including: (1) microfinance institutions (banks / credit), (2) transparency of policies, and (3) development of cooperatives.

The existence of microfinance institutions that have the role of providing capital for dairy farming business such as cooperatives and banking institutions, is very sensitive to influencing the sustainability index of the legal-institutional dimension. The existence of microfinance institutions needs to get attention because of their function as credit channeling institutions. In addition, capital credit is the main factor to obtain good input for livestock business production. The better the input of livestock production, the greater the chance of better livestock business results.

The development of cooperatives has links with microfinance institutions. Cooperatives that are increasingly developing will be able to channel capital loans in larger amounts. The dairy cattle business cooperative in the city of Padang Panjang is considered not sufficiently developed based on the amount of milk received, the distribution of credit received by farmers, and the provision of available livestock input facilities. The problems that have been the concern of the cooperative in recent years include: (1) the number of members who are not active and do not understand the meaning of cooperating so that such members demand their rights more and ignore their obligations, (2) the amount of bad loans is caused by the many members who have difficulties pay credit installments, especially for members who are not active and their livestock are gone, (3) decrease in milk production due to the increasingly high price of beef so that farmers choose to cut their dairy cattle, (4) the number of farmers who sell milk outside the cooperative, (5) decreased volume of milk reception.

3.6. Key Factors for Developing Dairy Farming Systems in Padang Panjang City

The concept of development that harmonizes environmental, economic and social interests is a concept of development that has been accepted by all countries in the world. The concept of development is then called the concept of sustainable development with the aim of creating a sustainable condition as a result of the development process. The concept, has similarities with the concept of the development trilogy that was implemented during the reign of the New Order. The development trilogy requires that development is not only limited to creating economic growth, but also must pay attention to aspects equity and the creation of national stability.

The concept of sustainable development aims to create a balance between economic growth (economic dimension), environmental conservation (ecological dimension), equity (socio-cultural dimension). Some opinions add the dimensions of technology-infrastructure (development and application of technology to better infrastructure), legal-institutional (compliance with the law and institutional functioning) for the implementation of sustainable development. The application of the concept of sustainable development in the real system requires a strong commitment of the main actors of the system (stakeholders) to ensure the success of development.

Prospective analysis is able to explore the possibilities of the future based on predetermined goals. The determination phase of sustainability index and status aims to provide an overview of the existing system of actual dairy farming systems. Prospective analysis aims to prepare strategic actions in the future by determining key factors that play an important role in the various possibilities that will occur in the future. These possible future variations, formulated in the form of a scenario for the development of a sustainable dairy farming system. Stages of analysis that need to be done in prospective analysis, namely: (1) identification of key factors in the future, (2) determining the

objectives and interests of the main actors, and (3) definitions and descriptions of possible future evolution as well as determining priority actions in accordance with the resources owned by the main actors and their implications for the system being studied.

The stages of determining the key factors for the development of the dairy farming system in the future, among others: (1) determination of key factors derived from the sensitive attributes of the sustainability index of existing actual dairy farming systems from leverage analysis of Rap-SIBUSAPE, (2) determination Key factors based on needs analysis (need analysis) sourced from the needs of stakeholders on the system that are reviewed through expert discussions with the help of questionnaires, (3) determine the key factors that influence the system based on a combination of existing condition and need analysis key factors.

Based on the results of leverage analysis on each dimension of sustainability, 15 sensitive attributes were obtained from 5 dimensions of sustainability, including:

1. Ecological dimension: (a) the quantity of waste (feces and urine) of livestock left in cages per day, (b) availability of waste / biogas storage plants, (c) feed carrying capacity, (d) utilization of cattle waste for organic fertilizer, and (e) sanitation of milking equipment and cages.
2. Economic dimensions: (a) profit transfers, (b) the level of subsidies to inputs, and (c) the price of milk in the last five years.
3. Socio-cultural dimensions: (a) business alternatives, (b) job socialization, and (c) frequency of counseling and training.
4. The technology-infrastructure dimension is only one attribute, namely the use of waste handling technology (biogas or organic fertilizer).
5. Legal-institutional dimensions: (a) microfinance institutions (cooperatives / credit), (b) transparency of policies, and (c) development of cooperatives.

These sensitive attributes are then assessed, so that the results obtained in the form of grouping of attributes in the four groups of quadrants are based on the level of influence and dependence of attributes on the system. Based on the assessment of the 15 sensitive attributes, 7 (seven) key factors were identified that had a strong influence on the system, namely: (1) milk prices, (2) feed carrying capacity, (3) feed industry, (4) utilization of livestock waste, (5) the nature of work (6) the development of cooperatives, (7) micro finance institutions (banks / credit).

4. Conclusion

1. This study resulted in the index value of the sustainability of the dairy farming system in the city of Padang Panjang of 55.09 (quite sustainable). The results of the analysis of each dimension of development shows that the legal-institutional dimension has the highest index value (74.98 / quite sustainable), then followed by the technology / infrastructure dimension (57.18 / quite sustainable), the economic dimension (49.24 / quite sustainable)), socio-cultural dimensions (48.89 / less sustainable), and ecological dimensions (45.17 / less sustainable). The results of the leverage analysis show that there are 15 sensitive attributes that influence the sustainability of this dairy farming system.
2. Based on the prospective analysis (level of influence of interest) the results of combining existing conditions (important factors derived from the sensitive attributes of leverage analysis) and need analysis (important factors derived from stakeholder needs) are known to seven important factors affecting the system, including: (1) five important factors have a high influence on the performance of the system with a low level of inter-factor dependency (milk prices, feed carrying capacity, feed industry, utilization of livestock waste, and the nature of work); and (2) two important factors have a high influence on the performance of the system with a high level of inter-factor dependency (the development of cooperatives and microfinance institutions). Seven important factors affecting the dairy farming system need to be managed properly and various states that may occur in the future to achieve the goal of creating a sustainable dairy farming system.

5. References

- [1] Edwardi. 2016. Prospects of dairy farming in West Sumatera. Livestock Service Office of West Sumatera. Padang.
- [2] West Sumatera Livestock Service. 2010. Population of dairy cattle in West Sumatera. Report of the Livestock Service Office. West Sumatera. Padang.
- [3] Saragih, B. and T. Sipayung. 2002. Biological utilization in developmentalism and environmentalism. Paper Presented at the International Seminar on Natural Resources Accounting Environmental Economic Held in Yogyakarta, Indonesia, 29 April 2002. Yogyakarta.
- [4] Munasinghe, M. 1993. Environmental Economic and Sustainable Development. The International Bank for Reconstruction and Development / The World Bank. Washington D.C.
- [5] Mersyah, R. 2005. Design of sustainable beef cattle cultivation systems to support the implementation of regional autonomy in South Bengkulu Regency [Dissertation]. Bogor Agricultural University. Bogor.
- [6] Suyitman. 2010. Model of the development of sustainable agropolitan area based on integrated beef cattle breeding in the Situbondo sub-district [Dissertation]. Bogor Agricultural University. Bogor.
- [7] Fauzi, A. and S. Anna. 2005. Modeling of Fisheries and Ocean Resources for Policy Analysis. Gramedia Pustaka Utama. Jakarta.
- [8] Bourgeois, R. and F. Jesus. 2004. Participatory Prospective Analysis, Exploring and Anticipating Challenges with Stakeholders. Center for Alleviation of Poverty through Secondary Crops Development in Asia and The Pacific and French Agricultural Research Center for International Development. Monograph (46): 1 - 29.

Acknowledgments

Thank you to the Directorate of Research and Community Service, Directorate General of Research and Development Strengthening - Ministry of Research, Technology and Higher Education, through the National Innovation Wave I Year 2018 Research Incentive System Program which has funded this research, according to the Research Contract No. 25 / INS-1/ PPK/E4/2018 and Andalas University.