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Research Article

Sustainability of Agropolitan Areas in Lima Puluh Kota Regency, West Sumatra, Indonesia

Dwi Yuzaria[1], James H.[2], Fitrini[3], Fitrimawati[4], Rias M. I.[5]
[1,2,3,4,5]*Universitas Andalas Padang, Indonesia*
Email: dyuzaria@ansci.unand.ac.id

Abstract

The research aims to analyze two things; (1) identifying factors influencing regional development, (2) the status of the five dimensions of the agropolitan development sustainability index. Determination of sustainability status using Multidimensional Scaling (MDS) by adopting a Rapid Agropolitan Assessment (Rap-fish). The sensitive attributes affect the sustainability index, and the error effect is determined based on the Leverage analysis and Monte Carlo test. A prospective study obtained the determination of the influencing factors. The results of the sustainability analysis show that the dimensions of ecology (76.90%), technology infrastructure (66.40%), socio-culture (63.70%), and legal-institutional (64.00%) are sustainable. Meanwhile, the economic dimension (42.90%) has an inferior status. Based on the analysis of 45 attributes, 18 sensitive attributes need to be improved because of increasing the sustainability index's value. The prospective study resulted in seven key regional sustainability factors, namely: (a) availability of supporting infrastructure, (b) waste processing plants, (c) egg prices, (d) price and availability of the feed industry, (e) farmer association institutions, (f) Frequency and (g) frequency and resolution of conflicts. Improvement of critical factors Agropolitan area of laying hens is the primary basis for the future development of the Limapuluh Kota Regency.

Keywords: *Laying Hens, Sustainability, Agropolitan, Limapuluh Kota Regency*

I. INTRODUCTION

The disparity between urban and rural areas and poverty in rural areas has stimulated development efforts in rural areas. However, the approach to developing rural areas is often separated from urban areas (Suroyo & Handayani, 2014; Soleh, 2017; Pranoto et al., 2006). This has resulted in an urban bias, namely the development of rural areas, which was initially aimed at increasing rural communities' welfare area, but the opposite results, namely the suction of rural potential to urban areas (Saraceno, 1994; Rutan, 1971).

The high rate of urbanization reinforces this fact. Population survey data (SP) show that there has been an increase in urbanization as indicated by the high number of the urban population in Indonesia from 7.5 percent in 1961 to 30.91 percent in 1990 and reaching 42.1 percent in 2000. Meanwhile, in 2009 the people living in cities were 43 percent and 55.8% in 2019 (Worldmeter, 2019). The urbanization process that occurs often forces the agricultural sector to be marked by converting agricultural land into built-up areas. This condition's logical consequence is decreased agricultural productivity (Pewista & Harini, 2013; Yudhistira, 2013; Hendrawan, 2016).

Agricultural development must synergize with the development objectives of rural areas, namely increasing the community's social and economic standard of life. This goal can be achieved through developing potential sites based on rural areas as centres of growth by converting rural areas into agricultural cities or known as Agropolitan Area Development.

Agropolitan is an agrarian city that grows and develops with an agribusiness system to serve, encourage, attract, and promote agricultural development activities in the surrounding area (Deptan, 2002).

According to Estrada in Manik et al. (2013), an agropolitan concept is an approach to developing a rural agricultural area that can provide various services to meet the needs of communities in the surrounding agricultural production areas, both services related to production facilities, distribution services, and socio-economic services. (Syahrani, 2001; Pranoto et al., 2006). According to Mahi (2014), agropolitan is a development concept based on the aspirations of the lower class whose goal is not only to increase economic growth but also to develop all aspects of social life (education, health, arts-culture, politics, defense-security, religious life, youth, etc. and empowerment of youth and women). The definition of agropolitan in Law no. 26 of 2007 concerning Spatial Planning is an area consisting of one or more activity centres in rural areas as a system of agricultural production and the management of specific natural resources, which is indicated by the functional linkages and the spatial hierarchy of the residential and agribusiness system units.

The area of food production centres (agropolitan) consists of agricultural cities and villages around agricultural production centres with boundaries that are not determined by government administrative boundaries but are more determined by taking into account the economic scale of the area (Friedman, 1979; Fatkhiati et al., 2015; Pamwell, 2002). Space management is interpreted as an activity of regulation, control, supervision, evaluation, control, and review of food production centres/agropolitan areas (Rosdiana, 2014). Agropolitan regions are not determined by government administrative boundaries but are more determined by economies of scale and economies of scope. For this reason, the determination of agropolitan areas is designed locally by taking into account the realities of the development of agribusiness that exist in each region (Friedman 1979; Hashemianfar et al., 2014). In the end, the main goal to be achieved from the agropolitan area development policy is as an alternative regional development concept capable of encouraging regional economies, creating a more balanced development synergy between regions, overcoming development problems in rural areas, and improving sustainable agricultural management (Stohr, 1980; Simon, 2003).

Agribusiness development in an agropolitan perspective promises welfare for farmers; agribusiness has a vital role in national development, including livestock agribusiness and increasing food supplies and increasing income (Basuki, 2012; Daidullah & Hardyastuti, 2006). However, agribusiness development policies in the regions have not made any significant changes in improving the community's welfare. They have even created a welfare gap between cities and villages. This is what happens in the poultry industry, especially the layer poultry industry. On the one hand, a massive industry that has increased for nearly 30 years is located in urban areas.

On the other hand, almost all agricultural and small-scale industry sectors are based in rural areas. The development of the urban regions as growth centres does not have a downward dropping effect but instead affects draining resources from the surrounding area (Syonia, 2012). Apart from causing a backwash effect, the failure of development in rural areas also controls capital and markets. According to Rustiadi et al. (2009), if the agricultural sector with its agribusiness can play a role as the leading sector in the economy, then each agribusiness enterprise will have a forward and backward-linkage.

Limapuluh Kota Regency is one of the regencies in West Sumatra, which is well known as a chicken egg producer located at an altitude of 110-2261 masl, with a position between 7035

'- 7044' south latitude and 113030 '- 114042' east longitude. Limapuluh Kota Regency consists of 13 sub-districts, with a total area of 3,543 km2, with a population density of 198 people / km2. Limapuluh Kota Regency is an agricultural area. The agricultural sector, which consists of food crops and horticulture, livestock, plantations, and marine and fisheries, actually absorbs 56.40% of the workforce. This fact indicates that the increase in productivity and added value of agricultural products will increase the income of a large proportion of the existing workforce and the development of agricultural businesses and provide opportunities for more significant job opportunities in both th e production and processing aspects. Therefore, agricultural revitalization and agro-industrial development towards more modern agriculture are essential to do. The possibilities for the revitalization and modernization of agriculture in the Limapuluh Kota Regency in the future are at least three aspects of agribusiness, namely production, processing, and marketing.

Viewed from the economic aspect, Limapuluh Kota Regency has a massive enough potential to improve the community's economy and welfare, primarily through the agricultural sector, the livestock sub-sector. The people of the Limapuluh Kota Regency's enthusiasm is very high for the livestock sub-sector, especially layer poultry and broiler poultry. The profit from this poultry business is quite promising compared to the advantages of farming. Also, the increasing price of agricultural production facilities and the decreasing availability of agricultural land have made the laying poultry business even more attractive.

Optimal benefits are obtained if the development of livestock management meets the criteria for sustainable development that combines economic, socio-cultural and ecological sustainability interests (Saragih and Sipayung, 2002; Suyitman et al., 2009). In this regard, it is necessary to study the sustainability status of the area based on laying poultry farming in the Limapuluh Kota Regency to develop an agropolitan area and identify the factors that influence the site's sustainability for laying hens. The benefits of this research can be used as a reference and consideration for policymakers, especially the government of Limapuluh Kota Regency, to increase the area's sustainability status based on laying poultry farming in Limapuluh Kota Regency for the development of the agropolitan regions.

II. METHOD

The research was conducted in three sub-districts in Limapuluh Kota Regency, West Sumatra Province. The criteria for determining the research location were based on: the determination of the three sub-districts as Agropolitan Areas defined by the Decree (SK) of the Regent of Fifty Cities Number 398 / BLK / 2005 dated June 6, 2005. The time of the study was from June to November 2018. The data used were secondary data and primary data. Secondary data obtained through a literature study. Preliminary data obtained from filling out questionnaires by breeders and the results of expert opinions. The criteria for determining the selected expert are: (a) having experience and competence according to the field under study, (b) having a reputation and position in the competence with the area being studied and showing credibility as an expert, (c) having a commitment to the problem being studied, (d) neutral and willing to accept other respondents' opinions, (e) ready to be consulted and be at the research location.

Methods: The analysis of the agropolitan area's sustainability was carried out using multidimensional scaling (MDS) technique called an approach (Rapid Appraisal Agropolitan of laying hens). This method is an extension of the Rapfish approach used to assess capture fisheries' sustainability status (Kavanagh, 2001). The results of the sustainability analysis are stated in the Agropolitan Sustainability Index of laying birds. Data analysis was carried out in several stages. First, determining the influencing factor as a critical factor (attribute) includes

the five dimensions of sustainability. Overall, there are 45 attributes analyzed, each of which: the ecological dimension (10 attributes), economic dimension (9 attributes); socio-cultural dimension (9 attributes); infrastructure dimensions (7 attributes); and the legal-institutional dimension (10 attributes). Second, the assessment of each attribute on an ordinal scale based on the sustainability criteria of each size and the preparation of the area's sustainability index and status both in multidimensional and on each dimension with Monte Carlo analysis to take into account the uncertainty aspect (Barlas, 2005 and Gao et al., 2008).

All data from the sustainability attributes are then analyzed in a multidimensional manner to determine the point of the position of sustainability relative to two reference points, namely the "good" (right) and "bad" (bad) points. The part of the point of sustainability for this development is visually challenging to map. Therefore, to facilitate this position's visualization, ordination analysis using the MDS method is used (Suyitman et al., 2012). According to Fauzi and Anna (2005), another result obtained in the MDS analysis is the leverage factor, a strategic element in future management activities. Leverage analysis aims to see changes in the error value of determining the sustainability value if one of the attributes is excluded from the study. Then calculate the error value or root mean square (RMS) compared with the RMS value generated when all attributes are analyzed.

According to Pitcher et al. (2002), a sensitivity analysis or leverage analysis was carried out on each dimension's attributes. The calculation is done using the stepwise method, which removes each attribute in sequence by calculating the error value or root mean square (RMS) compared to the RMS value generated when all attributes are analyzed. This method is known as the Jackknife method (Kavanagh, 2001). Evaluation of the effect of errors in the prediction process of the sustainability status analysis's ordination value was carried out using the "Monte Carlo" analysis. The prospective study is an attempt to explore future possibilities (Evans, 2006). The analysis results provide information about the key factors and strategic objectives that play a role in system development according to the needs of the actors in the system. The determination of the critical factors and strategic objectives is essential and is entirely the expert's opinion.

Determination of the critical factors using a prospective analysis. The study results of various factors will classify the quadrant group elements as follows: 1) Quadrant I (input) contains a strong influence with a less intense level of dependence. The factor in this quadrant is a critical factor in the system. 2) Quadrant II (stakes) contains elements that have strong influence and support. 3) Quadrant III (output) includes factors that have a small effect but high dependence. 4) Quadrant IV (unused) contains elements that have little (low) influence and dependence.

III. RESULT AND DISCUSSION

In the poultry industry, breeding broilers, especially laying breeds, has developed very rapidly and is generally commercial because people already know and understand a lot about the benefits obtained from the farming business. The development of egg-laying chicken farming is also driven by conditions in the agricultural sector, which provide indispensable feed ingredients for the livestock industry such as beans, grains, corn, etc. Besides, the development of broiler breeding is also influenced by the increase in egg consumption in Indonesia from year to year so that egg production also increases.

The laying hen's livestock sector is a business sector that plays a huge role in meeting animal protein and various industrial needs. The protein in eggs has an essential function in daily human life because it contains multiple amino acids necessary for social growth and intelligence. Vegetable protein sources cannot replace this role. During its development,

chicken eggs have been one of the staple foods of society since ancient times. Before the existence of laying hens, people consumed traditional reared chicken eggs. People in Indonesia are very fond of consuming chicken eggs, especially purebred chickens, due to their delicious taste and excellent health benefits because chicken eggs are one of the foodstuffs that have a complete animal protein because they have a high enough protein content. Namely 13-14%. Chicken eggs are often used as the primary side dish and a mixture of food making (Martabak, Bread, etc). Egg consumption in Indonesia is mostly fulfilled from eggs (91.82%). All society levels are accustomed to purebred chicken eggs, which are much cheaper than native chicken eggs (Setyono et al., 2013).

Statistical Analysis of Sustainability Index Value

Based on the results of the analysis using the Rapid Appraisal Agropolitan approach to laying hens, the sustainability index value of the ecological dimension was 76.90% with sustainable status, 42.90% economic dimension with unsustainable status, legal and institutional dimensions of 64.00% with OK quality, socio-cultural dimensions of 63.70% with a sustainable rate as well as infrastructure and technology dimensions of 66.40% with sustainable status. The MDS analysis's stress value has a value of 0.001 <0.25, where the smaller the stress value, the better the MDS analysis output. The coefficient of determination (R2) in this study was 0.958. This is indicated by a value close to 1. Based on the two statistical parameters, it is concluded that all the attributes used in each dimension can describe the sustainability of the laying poultry farming system.

Table 1.Montecarlo Analysis Results at a 95% Confidence Interval

	50 Kota Regency		Differences
	MDS	Montecarlo	
Ecology	76.9	76.0	0.9
Economic	42.9	41.9	1.1
Socio-cultural	63.7	62.7	1.0
Infrastructure	66.4	65.4	1.0
Institution	64.0	63.1	0.9

The results of the Monte Carlo analysis in Table 1 show a small difference in values between the MDS and Monte Carlo sustainability index values at the 95 percent confidence interval. The slight difference in scores indicates: (1) the error in scoring each attribute is relatively small, (2) the variation in scoring due to relatively small differences in opinion, (3) the stability of the repeated MDS analysis process, and (4) data entry errors and lost data can be avoided.

The concept of development that harmonizes environmental, economic, and social interests is a development concept that has been accepted by all countries in the world. The development concept is then referred to as the concept of sustainable development to create a sustainable condition due to the development process. This concept is similar to the development trilogy concept, which was implemented during the New Order government. The development trilogy requires that development is limited to creating economic growth and must pay attention to aspects of equity and the creation of national stability.

The concept of sustainable development aims to create a balance between economic growth (economic dimension), environmental preservation (ecological measurement), equity (socio-cultural dimension) (Rivai & Anugrah, 2016; Rahadian, 2016). Some opinions add the technology-infrastructure (development and application of technology to better

infrastructure), legal-institutional (law-abiding and institutional functioning) dimensions for implementing sustainable development. The application of sustainable development to a whole system requires a strong commitment by the system's main actors (stakeholders) to ensure development success (Susiana, 2015; Cahyandito, 2010).

The economic dimension is related to maximizing the income streams that can be obtained by at least maintaining the productive assets that are the basis for obtaining the income. The leading indicators of this economic dimension are efficiency and competitiveness, the magnitude and growth of added value, and financial stability. The economic size emphasizes th aspects of meeting human economic needs for both present and future generations. The social dimension is a social orientation related to the need for social welfare, reflected by a harmonious social life (including prevention of social conflict), reservation of cultural diversity, and socio-cultural capital, including protecting ethnic minorities. For this reason, poverty alleviation, equal distribution of business opportunities and income, socio-political participation, and socio-cultural stability are essential indicators that need to be considered in the implementation of development. The natural environment dimension emphasizes the need for the peace of natural ecosystems that include biological life systems and raw materials. Included in this is the maintenance of biodiversity and biological carrying capacity, soil, water, and agro-climate resources, as well as environmental health and comfort (Hadi, 2001; Litasari, 2019). Emphasis is placed on preserving the flexibility and dynamics of the ecosystem to adapt to change, not on the conservation of a static ideal condition that is impossible to achieve (Rivai & Anugrah, 2016).

These three dimensions influence each other so that the three must be considered in a balanced manner. A stable and healthy social system and natural and environmental resources are the basis for economic activity. In contrast, economic welfare is a prerequisite for the maintenance of socio-cultural stability and the preservation of natural resources and the environment. An unstable or sick social system will tend to cause actions that destroy the conservation of natural resources and damage the environment's health. In contrast, threats to preserving natural resources and the environment can lead to social chaos and disease.

The sustainability of the infrastructure technology dimension is reflected in the extent to which the development and use of technology can increase business productivity and added value and minimize the possibility of adverse impacts that can harm natural resources and the environment. The application of artificial insemination technology and animal health, waste treatment technology, feed technology, product processing technology, information technology and transportation can be used for the sustainability of this technological dimension of infrastructure (Suyitman et al., 2009).

To assess the sustainability of the legal and institutional dimensions, it is determined by looking at how far the legal and institutional instruments along with their enforcement and compliance can promote the sustainability of the livestock cultivation system. The availability of adequate laws and regulations, customary rules and religion / belief that are still recognized by the community, legal counseling, the presence of law enforcement officials and respected traditional leaders are examples of attributes that can encourage the sustainability of the livestock cultivation system. Apart from that, it is also important to look at the attributes of transparency, justice and democracy in the making and implementation of policies which will also affect the sustainability of this system. However, the key to all these attributes is, of course, community compliance with applicable laws and customary rules (Suyitman et al., 2009).

Factors Affecting the Sustainability of Layer Chicken Areas

The prospective analysis can explore future possibilities based on predetermined goals. The prospective analysis aims to prepare strategic actions by determining the key factors that play an essential role in the various options that will occur in the future.

Based on the results of the leverage analysis on each of the dimensions of sustainability, 16 sensitive attributes were obtained from the 5 dimensions of sustainability, namely:

1. Ecological dimensions: (1) utilization of laying poultry waste for organic fertilizer, (2) availability of feed, and (3) utilization of agricultural waste for animal feed.
2. Economic dimensions: (1) egg prices in the last 5 years, (2) ownership (beneficiaries of privilege), and (3) the level of subsidies to inputs.
3. Socio-cultural dimensions: 1) the frequency of conflicts related to the business of laying poultry, (2) the number of household workers in laying poultry farms, and (3) the level of consumer dependence.
4. Dimensions of technology-infrastructure: (1) distribution of poskeswan places, (2) availability of agribusiness facilities and infrastructure, (3) feed technology, and (4) use of vitamins and probiotics for livestock.
5. Legal-institutional dimensions: (1) intensity of livestock business activities that violate the law, (2) institutional livestock input, and (3) development of cooperatives.

Based on the assessment of these 16 sensitive attributes, 8 key factors were identified that strongly influenced the system. These eight key factors have a low level of dependence. Still, they have a significant effect on the course, namely: (1) feed technology, (2) institutional input for livestock businesses, (3) frequency of conflicts related to laying poultry business, (4) Level of consumer dependence, (5) intensity of livestock business activities that violate the law, (6) utilization of agricultural waste for animal feed, (7) availability of feed and (8) development of cooperatives. Apart from that, only one other attribute is a critical factor with a strong influence and dependence on the system, namely the price of eggs for the last 5 years.

The next stage of the analysis is a need analysis of the main actors (respondents) or stakeholders. Based on this analysis, 12 factors were obtained to create a sustainable laying poultry farming system. These factors are:

1. Ecological dimensions: (a) feed carrying capacity, (b) sewage treatment plant, (c) utilization of livestock waste.
2. Economic dimensions: (a) egg prices and (b) feed prices.
3. Socio-cultural dimensions: (a) conflict resolution, and (b) consumer dependence.
4. Technological-infrastructure dimensions: (a) feed technology, (b) feed industry, and (c) availability of supporting infrastructure.
5. Legal-institutional dimension: (a) agricultural institutions and (b) existence of copression.

The assessment of direct influence between factors identified six key factors that influence the system. These factors consist of seven key factors that substantially impact a low level of dependence and two key factors that have a strong influence and a high dependence level. These factors are: (1) availability of supporting infrastructure, (2) feed technology, (3) consumer dependence, (4) conflict resolution, (5) agricultural institutions, (6) feed industry, (7) waste processing plants, (8) egg price and (9) feed price.

The combination of essential factors from the prospective analysis of the existing conditions and the need analysis resulted in 18 factors affecting the laying poultry farming system (9 factors came from the current situation and 9 factors came from the need analysis). Some of these factors have similarities and can be combined to affect the system into 15 factors (Table 2).

Table 2. Influencing Factors on the Livestock System Resulting from the Combination of Existing Conditions and Need Analysis Factors

No	*Existing Condition*	*Need Analysis*
1	feed technology	availability of supporting infrastructure
2	institutional livestock business input	agricultural institutions
3	frequency of conflicts related to the laying poultry business	conflict resolution
4	Level of consumer dependence	
5	the intensity of livestock business activities that violate the law	
6	utilization of agricultural waste for animal feed	waste treatment plant
7	availability of feed	feed industry
8	availability of feed	
9	egg prices for the last 5 years.	feed prices

Six essential factors influencing the laying poultry farming system need to be appropriately managed. Various states may occur to achieve the goal of creating a sustainable laying poultry farming system.

To build an agropolitan area based on advanced laying hen farms, cooperatives' presence is needed to make it easier for people to seek cash/capital injections, accommodate livestock agro-industrial products and market them, and make it easier to finance microeconomic activities for local communities. Cooperatives that are formed should be an effort of awareness and community participation in carrying out development programs for their interests. In this pattern, the community has the initiative. It plays a full role in their activities so that its success is primarily determined by the sense of responsibility of the community itself. The first step in the formation of this cooperative must be assistance, organization, and community empowerment.

IV. CONCLUSION

Analysis of the area's sustainability status based on laying hens in five sustainability dimensions shows that four sizes show sustainability, namely from the ecological, socio-cultural, infrastructure, legal, and institutional dimensions. In contrast, the economic dimension is classified as less sustainable. The multidimensional status of sustainability is classified as reasonably sustainable. Based on the results of a prospective analysis of 16 sensitive attributes, it was found that 7 (seven) key/determinants had a strong influence and a low level of interdependence.

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