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Strategy for the development of agroecologically sustainable cattle slaughterhouse

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Abstract. This paper aimed to formulate strategy for the development of agroecologically sustainable cattle slaughterhouse. This study is needed for the formulation document of the Regional's Medium-Term Plan for the period of 2020-2024. The method used was a prospective analysis and multi-dimensional scaling. This prospective analysis was carried out to analyse the degree of strength and dependency relationships by giving a score of the level of direct or indirect influence between elements of leverage that have been generated from previous research. Prospective analysis results in the form of key factors that form the basis of change scenario that can be achieved in the future. The strategy for the development of agroecologically sustainable cattle slaughterhouse scenario was done by the leverage factors which then formulated as key indicator performance in order to improve system performance by looking at an increase in the sustainability index through the multi-dimensional scaling method.

1. Introduction

Agricultural development including animal husbandry and fisheries is dynamic; which changes happened in stages towards the better future. This can be achieved if the objectives of the agricultural system are consistent, through a long process in an effort to fulfill the human needs. Agricultural development is an applied science and agroecology is the main component of objectives to support the sustainability of an agricultural system.

The government's attention to the sustainability of development, including on agricultural sector, is increasing along with the efforts to accelerate towards a prosperous society. The formulation of the components objective listed in the Strategic Plan includes: (1) specific, (2) measurable, (3) Achievable, (4) relevant, (5) time bound, and (6) continuously improve. One of the matters of agricultural that was delegated to the regions was the matter of livestock affairs. One of the regional directive government agroecological policies is meat produced in Ruminant Slaughterhouse, to support food security program [1]. Therefore, sustainable agriculture is needed for food security program. If food security is achieved by this system, it will improve the economy, people's welfare, and the prosperity of the community. To create sustainable agriculture, there is also a need for natural conservation and balanced use of natural resources.

2. Methods

The study was carried out from October 2017 to April 2018, and conducted in cattle slaughterhouse of Bogor, Semarang, Surabaya, and Malang. Data analysis methods used are: a). Prospective analysis method; (b) Multi-Dimensional Scaling (MDS); c) Leverage analysis; d). Monte Carlo Analysis [2]

2.1. Prospective analysis method

Prospective analysis produces classification of factors related to a problem and is mapped into 4 (four) quadrants, namely: (1) Input; (2) stake; (3) output; and (4) unused. Quadrant Input is the determinant quadrant. This quadrant contains attributes that have a strong influence and low dependencies inter-attribute. Quadrant-II contains attributes that have strong influence and strong interdependence between attributes. Quadrant-III is containing attributes that have low influence and strong inter-attribute dependencies. Quadrant-IV is containing attributes that have low influence and low interdependence between attributes [3]

2.2. Multi-dimensional scaling (MDS) analysis method

To assess the sustainability status of the cattle slaughterhouse, used the Rap-Slaughterhouse method has been modified from the Rapfish program with Multi-Dimensional Scaling techniques [4]. In the MDS attributes to be measured and could be mapped within the distance of Euclidian with the following formula:

$$d_{1,2} = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2 + (Z_1 - Z_2)^2 + ...}$$

where:

$d_{1,2}$ = Euclidean distance

X, Y, Z = Attributes

$_{1,2}$ = Observation

The euclidean distance between these two points ($d_{1,2}$) then in MDS is projected into two-dimensional euclidean distance ($\dot{D}_{1,2}$) based on the regression formula in the following equation:

$$D_{1,2} = a + bD_{1,2} + c$$

where:

a = intercept

b = slope

c = error

MDS analysis, the objects are mapped in one point that is close together. The MDS technique used is ALSCAL algorithm which is easily available in almost every statistical software (SPSS and SAS). Rap-Slaughterhouse in principle makes iterating the regression process in such a way, in order to gets the smallest e value and reaches the equation (a = 0). Iteration stops if stress is <0.25. For attributes as much as m, stress value formulated in the following equation:

$$stress = \sqrt{\frac{1}{m} \sum_{k=1}^{m} \left(\frac{\sum_i \sum_j \left(D_{ijk}^2 - d_{ijk}^2 \right)^2}{\sum_i \sum_j d_{ijk}^2} \right)}$$

The stress value is shown in Table 1

Table 1. The stress values

Stress Value	Conformity
>20.00%	Bad
> (10.00-20.00) %	Enough
> (5.00-10.00) %	Good
(2.50- 5.00) %	Very good

   Source: [5]

2.2.1. Leverage analysis. Leverage analysis to determine the effect of stability if one of the attributes is omitted when ordinated. Leverage analysis results show the percent in the root mean square of each attribute. Attributes that have the highest percentage are the most sensitive attributes to sustainability [5].

2.2.2. Monte carlo analysis. To evaluate the effect of error on ordination value, Monte Carlo analysis is used to evaluate the effects of random errors in the estimation process, and to evaluate the actual value [5].

3. Results and discussions

The results of a prospective analysis of sustainability agroecological Cattle Ruminant-Slaughterhouse (RC-S) are presented in Figure 1. There are four factors: (1) availability of water, (2) animal health status, (3) hygiene and sanitation, and (4) availability of animal, have the characteristics strong influence and low dependence (driving variables) on the sustainability agroecological of CR-S. These determinants are feasible formulated on the Government Planning Document for 2020-2024 through components of objectives, as Key Performance Indicators.
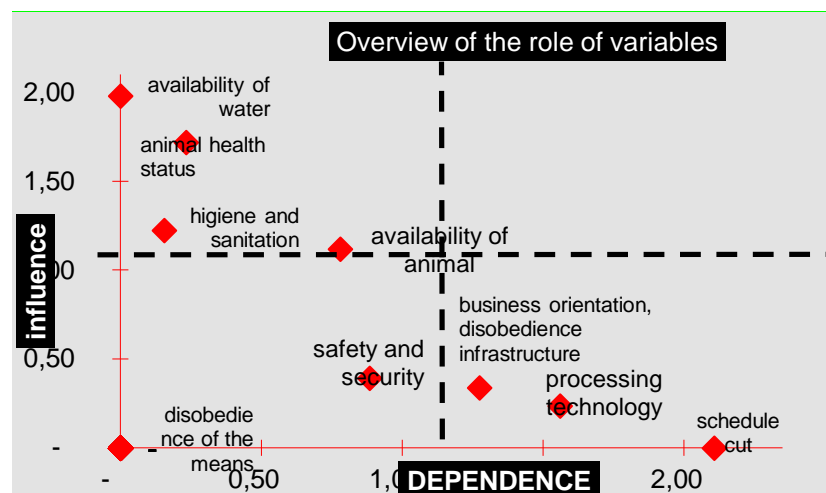

Figure 1. The results of a prospective analysis of sustainability agroecological of cattle slaughterhouse

Figure 1 shows that the abiotic component of water availability has a high influence so that animal health status can be achieved. The factor of water availability will drive the availability of animals to be cut, so that the CR-S manager is able to produce meat that is healthy and suitable for consumption. This will affect sanitation hygiene requirements at the service business scale level which must be met by the management of the CR-S.

The condition of water uses in the observed CR-S (<1.50 meters3/animal/day) is still below the standard [6]. The use of water in CR-S in Surabaya amounted to (0.10-0.30) meters3/animal/day, Bogor in 2015-2017 according to standards, but in the following year it began to decline.

According to [7], zoonotic Query (Q) caused by Coxiella burnetti was found CR-S Bogor. The capability of the CR-S manager in the use of water and the discovery of zoonotic disease cases is estimated to cause food from animals not feasible. Risk analysis action is needed as a basis for veterinary scenario strategy which continued to be the scenario strategy for development of sustainability agroecological of CR-S.

Business orientation factor, the time schedule of cutting, processing technology and according [8] disobedience of the use of infrastructure facilities had a low influence, but the dependence on other factors was quite strong. These factors are in the III quadrant (output variables) classification.

Furthermore, disobedience of the means, the safety and security of workers included in the IV quadrant classification. The meaning is the two factors above are marginal variables, have a low influence and low dependence on the development of sustainability agroecological policies of CR-S.

The qualitative model for the development of sustainable agroecological policies of CR-S (D-CRS) is a function of water availability (WA), animal health status (AHS), hygiene and sanitation conditions (HS) [9], and availability of animals (AA) can be described in the function relationship:

$$D\text{-}CRS = f\ (WA,\ AHS,\ HS,\ AA)$$

The development of sustainability agroecological of the CR-S is based on the scenarios that prepared, scenario I (pessimistic), II (moderate), and III (optimistic). Some determinants in the sustainability of CR-S have the possibility in the future changes through intervention scenario strategy agroecological with increasing the sustainability index value of CR-S. The determinants that will be included in the development of sustainable agroecological of the CR-S are presented in Table 2.

Table 2. The state of the determinants and possible changes future of the sustainability of the CR-S

Key factor	Possibility of change		
	Existing and pessimistic	**Moderate**	**Optimism**
Water availability (WA)	Low (little available, below 500 liters/animal/day)	Medium (available range from 500 to 1,000 liters/animal/day)	High (there are 1,000 to 1,500 liters/animal/day available)
	Low	**Moderate increase**	**Rising high**
Animal health status (AHS)	Decrease	moderate increase (number of types of animal diseases handled up)	Increasingly high (the number and type of animal diseases handled is increasing high)
	Less	**Increased, medium**	**Increased, high**
Hygiene and sanitation (HS)	Less	approaching ideal	Ideal
	Declining, high	**Moderate declining**	**Go up**
Animal availability (AA)	Enough (available under 30 animal/day)	Medium (available 30-50 animal/day)	Height (according to plan that is more than 50-200 animal/day)
	Not ideal	**Approaching ideal**	**Ideal**

Performance improvements were made by increasing the score on the key or determinant factors and the results are presented in Table 3. The scenario was then simulated through MDS analysis with the Rap-Slaughterhouse software to reassess its sustainability index.

Table 3. Sustainability index and status values resulting from scenario strategy for development of sustainability agroecological RC-S scenario I (pessimistic), II (moderate), and III (optimistic)

Dimension	Scenario I		Scenario II		Scenario III	
	Index Values	Weighted Value	Index Values	Weighted Value	Index Values	Weighted Value
Ecology	53.11	3.19	54.66	21.49	54.66	9.13
Economy	54.17	2.71	55.20	8.61	55.20	24.69
Social	54.62	2.73	55.62	13.69	55.62	14.85
Technology	30.37	14.06	39.37	5.45	40.00	6.16
Regulation	46.86	16.40	46.86	4.28	50.00	4.71
Total	47.83	39.09	50.34	53.52	50.86	59.54

Scenario I (pessimistic) is a policy scenario based on existing conditions without intervening on the dominant factor with a sustainability index value of 39.06 or a less sustainable category. Regulatory dimensions have the highest weighted value of 16.40 which is a priority over other dimensions, although the index value is smaller than the other dimensions of 46.86, but still above the technology index value. The regulation dimension is more interpreted as the duty and responsibility of the government in regulating, directing and protecting various conflicts of interest.

Scenario II (moderate) is carried out through improving the performance of the determinants of the dimensions ecological, economic and technology so that it can improve the index of ecological sustainability 54.66, the economy 55.20, and social 55.62 (quite sustainable). Similarly, the technology index value of 30.37 in scenario II has been able to increase the index value to 39.37 (less sustainable). Scenario III (optimistic) is carried out through improving the performance of the determinants of the ecological and economic dimensions so that it can increase the ecological sustainability index 54.66 and economy 55.20, social 55.62 (quite sustainable). Similarly, the technology and regulation index value of 30.37 and 46.86 (less sustainable) in scenario III has been able to increase the index value to 40.00 and 50.00.

4. Conclusion

Based on the purpose of the research, then the conclusions to be drawn as follows: Qualitative Model for Development of Sustainability Agroecological CR-S (D-CRS) = f (WA, AHS, HS, AA). The development of sustainability agroecological of CR-S can be built with 3 (three) scenario strategy, i.e the scenario I (pessimistic); II (moderate), as well as III (optimist). The scenario II is specially designed to be the most realistic option as well as being able to increase sustainability index from 39.09 (less sustainable) 53.52 (quite sustainable).

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