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RESEARCH ARTICLE
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Analysis of the Sustainability of Small-Scale Feed Mills in Supporting Poultry Industry in Sidenreng Rappang Regency

Abdul Alim Yamin [1,2*], Muh Ridwan [3], Sri Purwanti [2,4] and Jasmal Ahmari Syamsu [2,4]

[1]Doctoral Study Program, Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia 90245,
[2]Department of Animal Nutrition, Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia 90245
[3]Department of Socio-Economics of Animal Husbandry, Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia 90245
[4]Research and Development Center for Livestock Resources and Tropical Animals, Hasanuddin University, Makassar, Indonesia 90245
*Corresponding author: abdulalimyamin@unhas.ac.id

ABSTRACT

This research aims to determine the scale of sustainability of the small-scale poultry feed industry in supporting the basic needs of the poultry industry in rural areas. The data collection method used in this study through observation and direct interviews with small-scale feed mill business actors, then the program sustainability index coordination was analyzed as a development of the RAPFeed (*Rapid Appraisal Feed*) coordination analysis based on Multidimensional Scaling (MDS) analysis. The results of this study presented sustainability conditions and several obstacles in each dimension used, namely production facilities and infrastructure, raw materials, human resources, capital, business management, marketing, and government support, among the seven small-scale local feed industry units analyzed gave an average result of 49.90% (less sustainable). The sustainability status of MDS in the Small-Scale Local Feed Industry (IPLSK) in Sidenreng Rappang Regency shows performance in the dimensions of facilities and infrastructure at 45.18%, row materials 45.15%, human resources 53.14%, capital 62.20%, management 47.58%, market 55.91%, and government support 40.17%.

Keywords: Small-scale local feed industry, Poultry Industry, Sustainability, RAPFeed (*Rapid Appraisal Feed*)

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INTRODUCTION

Food security is currently a concern for several countries in the world. Based on Global Food Security Index (GFSI) data, Indonesia's food security indicator in 2022 is 60.2 points (The Economict Group, 2022a) and it is recorded that Indonesia ranks 63rd out of 113 qualified countries (The Economict Group, 2022b).

One aspect of food with a sustainable prospect to meet the current food availability is derived from foods that are included in animal proteins such as meat, eggs, and milk. Therefore, the development of the poultry industry in Indonesia is increasingly rapid and this condition has an impact on the community at large to be involved in part of the poultry industry. FAO (2022) stated that in industrialized countries, livestock accounts for about 40% of the total food production, this shows the importance of livestock for the economy and food system. In developing countries, the role of livestock in the economy accounts for 20% of food production.

In line with the increase in livestock production, it currently requires a large amount of resources, but the number is limited. Therefore, the feed industry is under pressure to incorporate sustainable food security. The feed industry must harness this context as a way to evolve towards a more sustainable future, and establish itself as a player in global sustainability efforts. According to Ahuja and Arindam (2007), small-scale poultry businesses have opportunities due to increasing market access and consumer preferences for chicken products. In addition, the main challenges in small-scale poultry production are more organizational than technical.

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The heaviest emphasis faced by the small-scale feed industry is difficult for them to survive when prices and availability of raw materials are unstable. The availability of poultry feed is an important factor in the intensification of sustainable poultry production (Zampiga et al., 2021). Meanwhile, the increasing demand for poultry products, especially in developing countries, has led to the need for alternative feed ingredientsThe largest single cost in livestock production is the cost of feed, which determines a livestock company's feasibility (Dejene et al., 2014). The poultry industry is growing rapidly and feed costs are a major concern.

Feed ingredients are the main issue in most developing countries such as Indonesia. It is due to poultry feed ingredients are mostly imported from abroad. Providing affordable feed by optimizing the local feed ingredient use through appropriate technology is the need of time. Therefore, the need for an innovative approach to overcome the problem of poultry feed availability also faces challenges such as fluctuations in feed prices. Feed source exploration was only carried out by many small-scale feed mill owners thus it can be used as an alternative feed ingredient available in the surrounding area to cope with the increasing demand for poultry feed.

Sidenreng Rappang Regency is the area with the highest source of livelihood conditions in poultry farming in South Sulawesi, according to the Central Statistics Agency (2020), the poultry population, especially laying hens, in Sidenreng Rappang Regency is 5,639,971 heads and the community works predominantly in the livestock and agricultural industries. Small-scale feed mill existence can significantly increase productivity and profitability in small-scale laying hen farms (Susanti et al., 2017). Improvement and efficiency of small-scale poultry farming, development needs to be done (Kulkarni et al., 2021) and around 70-80% the full-scale fabrication value of the livestock venture depends on feed. The optimal quality and quantity of feed are needed to increase poultry growth (Auza et al., 2023), thereby improving sustainability and finding the development strategy for small-scale feed mills in rural areas are the most important factors.

This study was analyzed using Multidimensional Scaling (MDS) modified with the RAPFeed (Rapid Appraisal Feed) approach to assess the sustainability status of small-scale feed industry development in Sidenreng Rappang Regency on the index of poor-scale sustainability to good-scale sustainability.

MATERIALS & METHODS

Study Design

The study on the sustainability of the small-scale local feed industry (IPLSK) is included in the development criteria so that in this study there are seven small-scale local feed industries (IPLSK) located in Sidenreng Rappang district. Seven small-scale feed industries are marked with the names or codes A, B, C, D, E, F, and G for the sustainability analysis used.

Place of Study

The research was carried out in Sidenreng Rappang Regency in South Sulawesi Province which is a breeding center for laying poultry.

Period of Study

The data collection lasted for five months, from May 2021 to September 2021.

Study Population

Observation and direct interviews with research business actors in this study include primary data and secondary data, primary data is the result of observations and interviews with respondents. Interviews were conducted for the observation process, especially on the identification of problems or obstacles and weighting.

Secondary data collection in this study was obtained from the Central Statistics Agency at the Regency/City and Provincial levels, the Regency/City Livestock Service, and the South Sulawesi Provincial Livestock Office.

Inclusion Criteria

Small-scale local feed industry (IPLSK), all dimensions of the facilities and infrastructure, raw materials, human resources, capital, business management, marketing, and government support.

Data Collection Tool and Data Analysis

The analysis used in the study is the coordination analysis of the program sustainability index as a development of the RAP Feed (Rapid Appraisal Feed) coordination analysis which is based on Multidimensional Scaling (MDS) analysis and for testing or estimating error degrees of error Monte Carlo analysis is carried out (Fig. 1). This method is a statistical technique with multidimensional transformation into simpler dimensions (Syamsu et al., 2013).

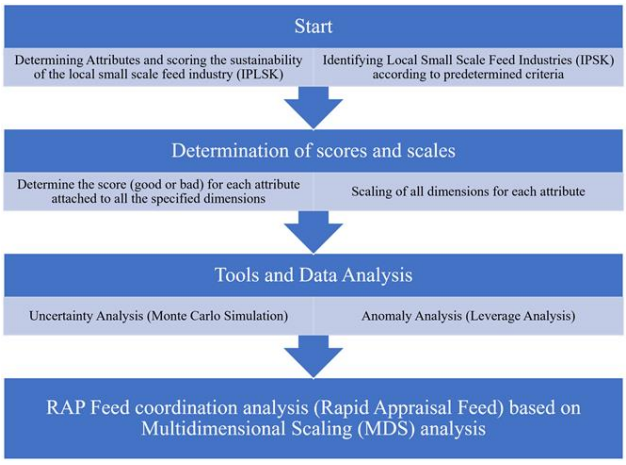

Fig. 1: Flow of Sustainability Analysis of the Small-Scale Local Feed Industry (IPLSK).

Each attribute in the five dimensions is scored between 0–4 which is a reflection of existing conditions with a value of 0 meaning bad and 4 a value of good or vice versa. The assessment of each attribute were then analyzed using the RAPFeed software. RAPFeed software is an Add-Ins in the MO Excel program, ForTran ALSCAL MDS code and Montecarlo Analysis in SPSS have been translated in the form of dynamic link lybrary (DLL) which can be called via VBA in Excel (Pido et al., 1996). In the use of MDS, the position of the sustainability point were

placed on two dimensions or axes. The horizontal axis shows the bad dimension and the vertical axis shows the Good dimension.

RAPFeed works in rotating (rotating & flipped) both dimensions where the bad dimension is rotated 90° and the good dimension is rotated 270° so that the data can be visualized into a single X axis on a scale of 0 to 100. A sustainability index close to 0 means that the sustainability index is poor and vice versa if it is close to 100 (Pitcher & Preikshot, 2001). The score value, which is the value of the sustainability index for each dimension, is found in Table 1.

Table 1: Sustainability index categories

Index Value	Category
0–25	Bad
26–50	Less
51–75	Enough
76–100	Good

RESULTS & DISCUSSION

Multidimensional Sustainability

The goodness-of-fit evaluation (statistical assumptions) used in Multidimensional Scaling (MDS) refers to the monotonicity measured by the S-Stress (Scaled-Stress) value which is also excluded from the RAP-Feed program analysis process. Clarke and Warwick (2001) indicate that the accepted goodness-of-fit Stress value (in this context) is ≤0.25 or 25%. The results of the analysis in this study showed numbers smaller than 0.25 on all dimensions or attributes studied, which means that the assumption of the monotonicity of MDS as a result of the analysis has been dimensional attribute to (at) the scale "Bad"–"Good" (0-100%) can be seen from the value of the determinant coefficient. The determination coefficient (R2) close to the value of 1.0 indicates a correlation between dimensional 184 attributes and the position of sustainability status in each IPLSK (Table 2).

Table 2: S-Stress Value, Quadratic Correlation Coefficients, and Number of Iterations in Analysis of Sustainability of Small-Scale Local Feed Industry Development (IPLSK)

Dimension	S-Stress	R^2	Iteration
Production Facilities & Infrastructure	0.153	0.931	3
Raw Materials	0.169	0.918	3
Human Resources	0.169	0.921	3
Capital	0.203	0.914	3
Business Management	0.173	0.917	3
Marketing	0.186	0.892	3
Government Support	0.204	0.918	3
Average	0.70	0.869	3

The stability of the sustainability index value for each attribute was evaluated through a random error simulation with a Monte Carlo simulation. Randomization simulations (selected in the program) were performed up to 25 times based on the assumption of a normally distributed mean at a 95% confidence interval with a maximum value of 20% for each attribute. The stability of the sustainability status of an attribute is then measured based on the difference between the coordinate value of the sustainability status and the average of the Monte Carlo simulation results (Kavanagh and Pitcher, 2004).

The difference between the MDS coordinate value and the Monte Carlo simulation result (absolute) shows an average of 0.304%, which means that the error factor has an effect in the value of 0.304% on the coordinates of the sustainability status of the MDS result (Receiving area <5%), referring to the 95% confidence interval value with the receiving area of the RSQ value close to 1, then it can be stated that the sustainability position of IPLSK on each attribute is relatively stable between each other; and the coordinate axis its sustainability status (bad-good) (Table 3).

Dimensions of Infrastructure and Production Facilities Latitude Status Coordinates

The dimensions of infrastructure and facilities are composed of six (six) attributes, namely: 1) Land & water availability/condition (Atr-A1); 2) Access, communication, and energy (Atr-A2); 3) Main facility condition (Atr-A3); 4) Condition of supporting facilities (Atr-A4); 5) Variety/completeness of Alsin (Atr-A5), and 6) Capacity and efficiency of Alasin production (Atr-A6). The average sustainability status of IPLSK in this dimension shows a value of 45.2% or is included in the "less" category. In more detail, it can be seen that most IPLSKs are relatively between the "Bad" to intermediate coordinate status (<50%), and there is only one IPLSK with a status that tends to be close to the "Good" status (Fig. 2).

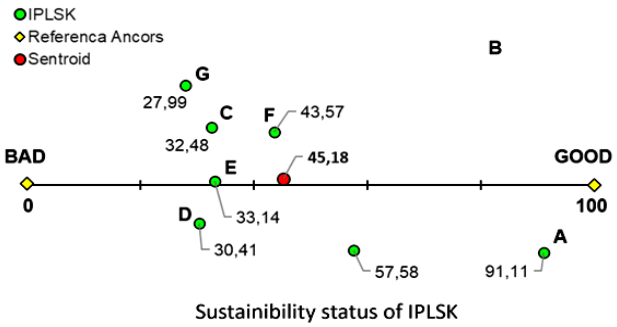

Fig. 2: Consideration of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) on the Facilities and Infrastructure Dimension

The relative position of each IPLSK based on the results of MDS, shows that the sustainability status of IPLSK-A is 91.1% and is included in the category of "good sustainable"; IPLSK-B is 57.58; fall into the "adequate" category; and five other IPLKS are included in the category of "less" sustainable. The stress value in the analysis process showed an S-Stress of 0.153; with a coefficient of determination (R2) of 0.931, with 3 (three) iterations. Statistically, the sustainability status of each IPLKS is acceptable.

Although the overall MDS results show conformity with statistical assumptions, it is also necessary to know the extent of the stability of IPLSK according to the Monte Carlo simulation results. Table 4 shows that the difference between the ordinal values of MDS and Monte Carlo varies greatly to more than 1%. Large margins or relatively low instability (>1%; receiving area <5%) can be seen in IPLSK-

Table 3: Differences in MDS results and Monte Carlo analysis on sustainability analysis of small-scale local feed industry development

Sustainability Dimension	MDS	Status	Monte Carlo	Difference [ABS]
Production Facilities and Infrastructure	45.181	Less	45.522	0.336
Raw Materials	45.50	Less	45.564	0.414
Human Resources	53.141	Enough	52.576	0.564
Capital	62.199	Enough	62.050	0.149
Business Management	47.581	Less	47.378	0.204
Marketing	55.908	Enough	55.618	0.290
Government Support	40.171	Less	40.737	0.565
Multi Dimension	**45.431**	**Less**	**45.302**	**0.304**

Note: MDS is Multi-Dimensional Scaling; ABS is Absolute Value.

Table 4: IPLSK Sustainability Status in Infrastructure and Facilities Dimensions

Infrastructure and Facilities	Industrial Units						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	91.11B	57.58C	32.48K	30.41 K	33.14 K	43.57 K	27.99 K
Monte Carlo (MC)*	91.97	57.06	32.93	33.54	32.06	43.60	27.45
Difference [MDS-MC]	0.86	0.51	0.45	3.13	1.07	0.03	0.54

Note: Sustainability Status Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval.

D and IPLSK-E. The standard error in the 95% median consensus estimation graph of Rapfish coordinates shows an average value of 9.130 for IPLSK-D; and 2,304 on IPLSK-E; while in other IPLSK in the range of 1,258 to 1,501. Bias that occurs in the two IPLSK.

Based on Monte Carlo, the scatter plot shows a distribution that tends to move vertically in the range of 10.31 to 29.58% in IPLSK-D; and 10.42 to 27.55% in IPLSK-E. In simple terms, the results of this simulation indicate that the two sustainability status coordinates of IPLSK oscillate in the "Up and Down" range (the Y axis is insignificant to its current position); and are still in the range of coordinates that tend to be in the "Bad" position.

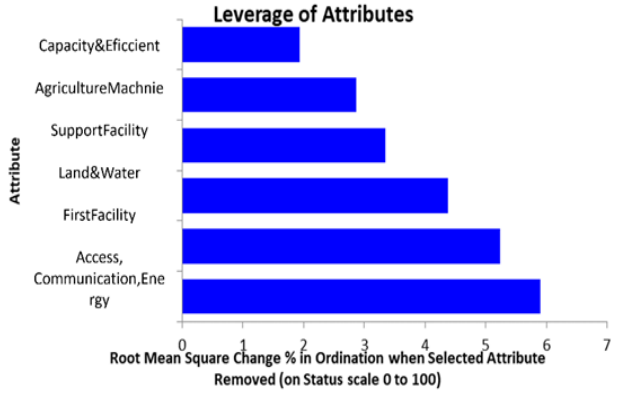

Fig. 3: Leverage Value of IPLSK Sustainability Status on Infrastructure and Facilities Dimensions.

Leverage/Sensitivity (Leverage) Attributes

The leverage value in the dimensions of Infrastructure from highest to lowest, in succession, were access, communication, and energy (Atr-A2); main facility condition (Atr-A3); land and water availability/conditions (Atr-A1); condition of supporting facilities (Atr-A4); equipment type (Atr-A5); and capacity, and production efficiency of equipment (Atr-A6) (Fig. 3). The Leverage value (in RapFeed analysis) was the answer to how much each attribute affects the coordinate score in each IPLSK. In the process, leverage calculates the difference between the standard error value (SE 95%) of the IPLSK coordinate position with the condition SE-95% when one of the attributes results from the analysis. Based on this assumption, the greater the leverage value, the higher the error value in the IPLSK coordinates obtained when the attribute is removed from the analysis.

In reality, the access, communication, and energy (Atr-A2) attributes on all IPLSKs have the same score, where all of them meet the score ("3") on the following conditions: a) Road access to and from the location that ensures smooth supply of raw materials (*in*) and marketing (*out*): b) Smooth access to mobile and internet communications; and b) the use of balanced fuel or electricity (as an energy source) and even have an alternative (generator set) in an emergency. The three conditions (in Atr-A2) are important conditions that ensure the stability of IPLSK business, if they lose one of them, then the influence will have a very significant impact.

Of course, feed production will not be able to continue if there are transportation constraints, communication is interrupted, and the ability to use alternative energy sources is also limited. According to Khalifah et al. (2023), all parts of the circular chain must be optimized, connected, and matched with each other. Thus, a circular livestock industry system can be economically successful.

Condition of main facilities (Atr-A3); Land and water availability/conditions (Atr-A1); condition of supporting facilities (Atr-A4); equipment variety and its completeness (Atr-A5); and capacity and production efficiency of equipment (Atr-A6). Feed mill is crucial part to assure food security. Implementing good manufacturing practices in procurement, handling, storage, and distribution is one of ways to obtain safe and quality feed (FAO & WHO, 2008).

Raw Material Dimensions

Latitude Status Coordinates

There were 6 attributes that make up the dimensions of raw materials, namely: 1) Processing (Atr-B1); 2) The level of need and availability of certain raw materials (Atr-B2); 3) Diversity, alternatives, and accessibility of raw materials (Atr-B3); 4) Quality of raw materials (Atr-B4); 5) Raw material price dynamics (Atr-B5); and; 6) Independence of certain raw materials (Atr-B-6).

The average value of sustainability status in the Raw Material dimension is 45.150 ("Less"), with the distribution

of IPLSK sustainability status coordinates that are relatively close to each other and located around the centroid (average) (Fig. 4). The S-stress value in the analysis process showed a value of 0.169; with a coefficient of determination (R2) of 0.918, and an iteration of 3 times, statistically, the status of sustainability in each IPLSK is acceptable.

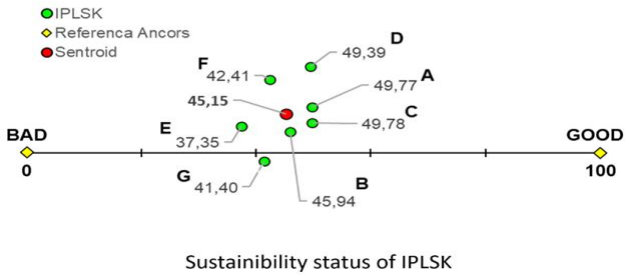

Fig. 4: Consideration of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) on the Raw Material Dimension.

The sustainability status coordinates of all IPLSK are in the "Less" category (25-50%). The difference between the coordinates of the sustainability status of MDS and the Monte Carlo simulation shows a relatively stable state ([MDS-MC]<1%) in all IPLSKs. The standard error in Table 5 of the 95% confidence interval estimation of the Rapfish ordinance median and the Monte Carlo scatter plot shows the distribution of the simulated ordinate that tends to move insignificantly at the midpoint of the MDS ordinate.

Table 5: Sustainability Status of MDS, Monte Carlo, and Their Differences in Each IPLSK in the Raw Material Dimension

Dimension of Feed Raw Materials	Business Unit						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	49.77K	45.94K	49.78K	49.39K	37.35K	42.41K	41.40K
Monte Carlo (MC)*	50.00	45.83	49.75	49.46	38.12	42.74	42.25
Difference [MDS-MC]	0.23	0.11	0.03	0.07	0.77	0.33	0.85

Note: Sustainability Staus Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval

Leverage/Sensitivity (Leverage) Attributes

In order of the leverage value from the highest to the lowest in the Raw Material dimension, is: Raw material price dynamics (Atr-B5); Diversity, alternatives, and accessibility of raw materials (Atr-B3); The level of need and availability of certain raw materials (Atr-B2); Quality of raw materials (Atr-B4); Independence of certain raw materials (Atr-B-6); and Processing process (Atr-B1) (Fig. 5).

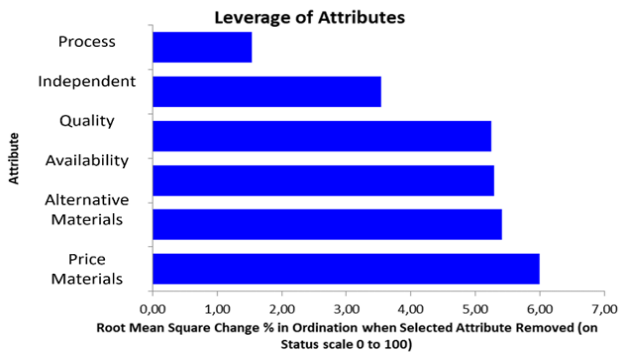

Fig. 5: Leverage Value of IPLSK Sustainability Status on Raw Material Dimensions.

In general, the scores of all IPLSK in the Raw Material Price Dynamics attribute (Atr-B5) are low, the scores are "1" and "2" with benchmarks: "unstable" raw material price stability; at the same time, the frequency of procurement depends on the need ("As needed"). All IPLSKs have experienced where the price of feed raw materials is very dynamic, both the influence of the harvest season of corn and rice commodities (rice for bran), unfriendly climatic conditions that cause crop failure (puso); market games by large-scale business actors; export/import policies for food commodities, and so on. The bargaining position of raw materials also becomes lower due to the fluctuating demand position according to the needs of IPLSK, so that there is often an increase in demand when the availability of raw materials is relatively difficult.

The above conditions are in line with the attributes of "Diversity, alternatives, and accessibility of raw materials (Atr-B3)" which has the next high leverage value. The diversity of raw materials has a positive value when it assumed efforts to optimize existing resources, but in reality, most IPLSK only has low access to alternative materials, especially for the main products produced. According to Afodu et al. (2024), in their research, it is emphasized that the large-scale livestock industry has an advantage in purchasing raw materials due to better financial and technical resources. Thus, the small-scale feed industry could only benefit from alternative feeds derived from agro-industrial by-products at affordable prices. Then, of the state Feed carrying capacity is the ability of an area to produce and provide fodder that can accommodate the needs of a number of livestock populations without going through processing (Syamsu, 2006; Muhammad et al., 2023).

Human Resources Dimension

Latitude Status Coordinates

The attributes that compile the Human Resources Index in the analysis were 1) The number of workers owned (Atr-C1); 2) Suitability of labor and business management organization (Atr-C2); 3) Potential sustainability of the availability of labor (Atr-C3); 4) production/skill training and equipment maintenance training by labor (Atr-C4); 5) Assistants/human resources and business management (Atr-C5); and 6) Insights of surrounding farmers related to the correct management of livestock production/cultivation (Atr-C6). The position of the centroid and each IPLSK can be seen in Fig. 6.

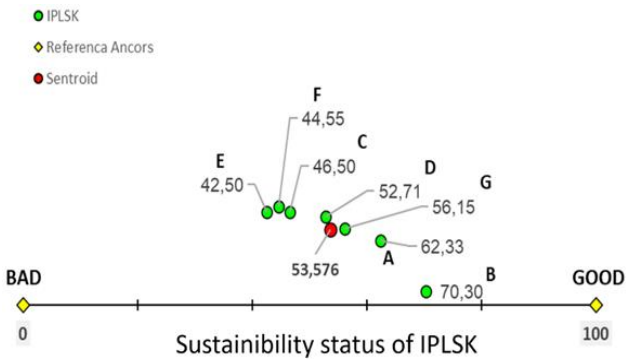

Fig. 6: Verification of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) on the Human Resources Dimension.

The IPLSK coordinates on the X axis of sustainability can be seen to be spread into 4 groups, the first is the three IPLSK that are closest to the "Bad" ordinate, namely IPLSK-C, E, and F; then IPLSK D and G; and IPLSK A, and IPLSK B which are respectively at a separate distance and tend to be closer to the "Good" point. The centroid value or the average coordinate is 53.6 or tends to be in the middle (Fig. 6).

Based on the criteria for the coordinate value, there are four IPLSK that are included in the category of "Quite sustainable" (51-75%); and three that fall into the category of "Less sustainable" (26-50%). The simulation of the sustainability status of each IPLSK based on the absolute difference between the MDS coordinate value and the Monte Carlo simulation result shows that there are several IPLSK with less stable positions ([MDS-MC]>1%); namely in IPLSK-A, B, C, D and E; while others show a difference of less than 1% (Table 6).

It is necessary for feed mill to prepare sufficient funds and well-trained human resources for data collection including livestock and farmer technical support (feed storage and feeding management). Moreover, training should be carried out for large- and small-scale farmers (Molina, 2009; Robb and Crampton 2013; Bondad-Reantaso and Subasinghe, 2013; O'Keefe and Campabadal, 2015).

Table 6: Sustainability Status of IPLSK in the human resources dimension

Human Resources	Business Unit						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	62.33C	70.30C	46.50K	52.71C	42.50K	44.55K	56.15C
Monte Carlo (MC)*	61.16	68.59	45.12	52.23	43.68	43.78	55.17
Difference [MDS-MC]	1.16	1.71	1.38	0.48	1.18	0.77	0.97

Note: Sustainability Status Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval.

Leverage/Sensitivity (Leverage) Attributes

There are three attributes with relatively large leverage values, namely: ALSIN production/skill training and ALSIN maintenance training by the workforce (Atr-C4); Conformity with labor specifications and business management organizations (Atr-C2); and Potential sustainability of the availability of labor (Atr-C3) (Fig. 7).

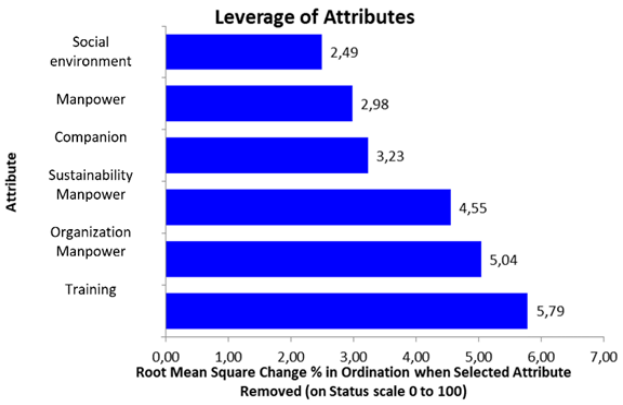

Fig. 7: Leverage Value of IPLSK Sustainability Status on the Human Resources Dimension.

The field conditions showed that all IPLSKs experiences, skills, and training in using equipment and machinery maintenance concerning feed production were limited. Generally, the training obtained is only from the manual guide to the equipment, about operating procedures, and a little related to emergency handling. Maintenance knowledge does not even exist. They only obtained the basic knowledge depending on the results of sharing safety with other people (generally mechanics) or other workers. Many parameters and various types of equipment skills training and maintenance, especially those related to feed production, are certainly needed to ensure the continuity of feed industry production, besides affecting the efficiency/productivity of machines, this is also necessary for longer equipment uses.

Vasile et al. (2020) emphasized the importance of implementing an automatic control system for more efficient and effective performance until post-production for tool maintenance, thus increasing labor productivity. These studies collectively highlight the need for increased efficiency and productivity in feed mills, which have the potential to benefit workers.

The form and work of the organization in IPLSK management is quite diverse, however, most of them already have a workforce that has the appropriate skills and/or administration to apply an industrial management business organization by the correct application. Meanwhile, the potential for sustainability of labor availability is measured by the remaining productive age of the workforce (65 years–current age), and whether or not there is a casual or willing to be used when needed and/or when they need work (filling time); Including the use of unpaid family labor.

Capital Dimension

Latitude Status Coordinates

The sustainability status of IPLSK in the Capital dimension is evaluated on 6 attributes, namely: 1) Business capital independence (Atr-D1); 2) Ease of access and acquisition of capital at financial institutions to start a business (Atr-D2); 3) Ease of access and acquisition of capital in financial institutions for business development (Atr-D3); 4) Allocation of funds (loans) for fixed capital and/or working capital financing (Atr-D4); 5) Availability of capital guarantee (Atr-D5); and 6) Access to alternative funding providers during urgent conditions (Atr-D6).

The average value of the sustainability status attribute of the Capital Dimension (centroid) is 62.2%, which means that the permodeep dimension in the IPLSK system is included in the category of "Adequate" sustainable. The relative position of IPLSK on the sustainability status axis can be seen to have three groups of distances, IPLSK-B is located at the coordinates closest to the "Bad" coordinate; then IPLSK-C, D, E, F, and G which tend to be in the same vertical line around the centroid coordinates; and IPLSK-A which is closest to the "Good" coordinates (Fig. 8).

Based on the sustainability criteria, IPLSK-B is included in the criteria of "less" sustainability; while other IPLSK are included in the category of "adequate" sustainable. Evaluation of sustainability status stability based on the difference between MDS and monte carlo simulated

coordinates showed a fairly small difference (<5%); and only IPLSK-G shows a difference value of >1% (Table 7).

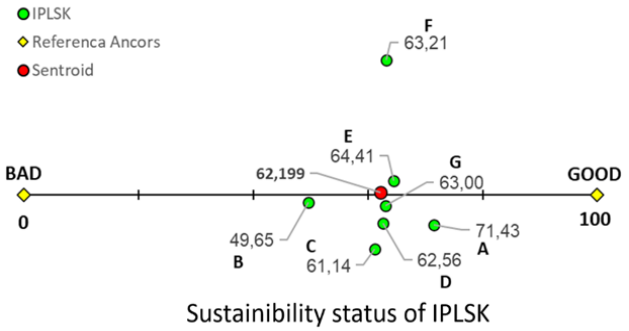

Fig. 8: Consideration of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) in the Capital Dimension

Table 7: Sustainability Status of IPLSK in the capital dimension

Capital	Business Unit						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	71.43C	49.65K	61.14C	63.00C	64.41C	63.21C	62.56C
Monte Carlo (MC)*	71.34	49.33	61.19	62.19	64.21	62.28	63.81
Difference [MDS-MC]	0.09	0.31	0.05	0.81	0.20	0.94	1.25

Note: Sustainability Status Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval.

Leverage/Sensitivity (Leverage) Attributes

The value of leverage attributes from high to low in succession were allocation of funds (loans) for fixed capital or working capital financing (Atr-D4); ease of access and acquisition of capital in financial institutions for business development (Atr-D3); ease of access and acquisition of capital at financial institutions to start a business (Atr-D2); availability of capital guarantees (Atr-D5); business capital independence (Atr-D1); and 6) access to alternative funding providers in times of urgency (Atr-D6) (Fig. 9).

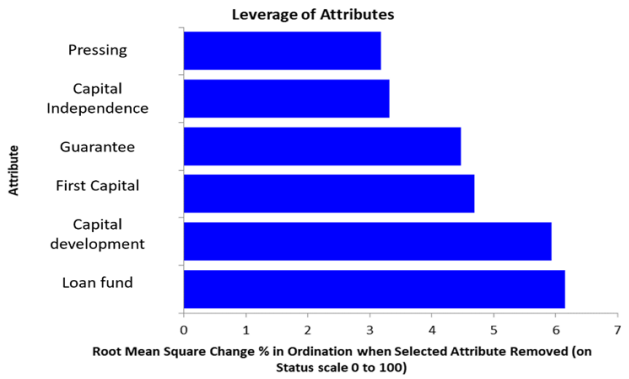

Fig. 9: Leverage Value of IPLSK's Sustainability Status on the Capital Dimension

The conditions that occur in the field related to the capital dimension showed that the attribute (Atr-D4) is the highest among other attributes. This has a bad impact on the sustainability of the feed mill business in the future if conditions continue and do not return to normal conditions. This industry will be further hampered due to less feed supply, inefficient marketing, and higher feed prices (Negash, 2018). To overcome these challenges, the industry must adapt to new market conditions, including technological advancements, globalization, and demographic changes (Baourakis et al., 2010).

Business and Production Management Dimensions

Latitude Status Coordinates

The Business and Production Management dimensions include, attributes: 1) Business scale and licensing (Atr-E1); 2) Business planning and experience (Atr-E2); 3) Business organization and placement of human resources (Atr-E3); 4) Variety of products that can be produced (Atr-E4); 5) Implementation of production and business control/control (Atr-E5); 6) Packaging, labeling and licensing (Atr-E6).

Based on the coordinates of the results of the MDS analysis, it can be seen that the dimensional centroid is at 47.58 ("less"). IPLSK-F and G have relatively similar distances; then IPLSK-E and C; next IPLSK-D which is alone in the middle; and IPLSK-A and B with the position relatively closest to the "Good" coordinate (Fig. 10). Based on the class of sustainability criteria, from the resulting coordinate position, it can be seen that IPLSK-A is in the category of "Good"; IPLSK-B and D are included in the "Adequate" category; and IPLSK-C, E, F, G are included in the "Less" category.

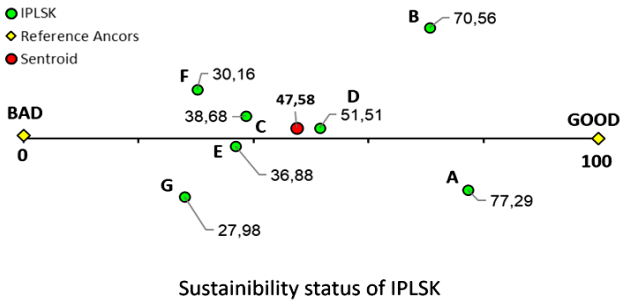

Fig. 10: Verification of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) in the Business Management Dimension.

The difference between the coordinates of the MDS results and the coordinates of the monte carlo simulation shows relatively good stability in all IPLSKs, although there are still 4 with a difference value of >1%; at most 3.11 in IPLSK-A, but the difference obtained is still less than 5%, so in general the results of the analysis are considered quite stable against errors or errors (Table 8).

Table 8: Sustainability Status of IPLSK in production and business management

Business and Production Management	Business Unit						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	77.29B	70.56C	38.68K	51.51C	36.88K	30.16K	27.98K
Monte Carlo (MC)*	74.18	68.66	39.37	51.66	37.08	31.40	29.29
Difference [MDS-MC]	3.11	1.91	0.69	0.15	0.20	1.24	1.31

Note: Sustainability Status Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval.

Leverage/Sensitivity (Leverage) Attributes

The leverage values of attributes from highest to lowest, in order, are: Business organization and HR

placement (Atr-E3); Implementation of production and business control/control (Atr-E5); Variety of products that can be produced (Atr-E4); Business planning and experience (Atr-E2); Business scale and licensing (Atr-E1); and Packaging, labeling and licensing (Atr-E6).

Business organization and HR placement (Atr-E3) is an overview of the condition of business organizations and human resources that play a role in organizational components. There are two conditions of IPLSK found, namely an organization that is still fairly simple which even though there is already a mandatory for employees from the owner, but does not have clear work tools, duties, and specifications (Score 2). The second condition was the complete organizational components, the structure and human resources had been fulfilled, but they have not been able to run well (Score 3). No IPLSK has yet obtained an optimal score (Score 4) with a measure that the organization and human resources are appropriate and running well; However, it is not entirely controlled and done by one or two people.

The implementation of production and business control/control (Atr-E5) is part of the support system that must be prepared for small-scale local feed mill business actors to manage factory resources and production products that have quality by livestock demand standards. The variety of products produced (Atr-E4) is still an obstacle for IPLSK to survive continuously, this greatly affects customer trust to provide production results to their farms.

Marketing Dimensions

Latitude Status Coordinates

The attributes that make up the Marketing dimension were 1) The type of customer based on their needs (Atr-F1); 2) Market/competitor competition (Atr-F2); 3) Quality assurance and after-sales service (Atr-F3); 4) Choice of payment mechanism (Atr-F4); 5) Promotion and bonus efforts (Atr-F5); and 6) Balance and sustainability of supply to demand (Atr-F6) (Fig. 11). The sustainability coordinates of the MDS IPLSK analysis based on these six attributes show that three IPLSK are located under the centroid or tend to the "Bad" attribute, and the other three lie at the greater coordinates of the centroid and tend to be at the "Good" ordinate. The best position is in IPLSK-A, and the worst in IPLSK-G (Fig. 12).

Referring to the interval scale of sustainability status criteria, IPLSK-A, B, C, D, and F are included in the category of "adequate" sustainability; while IPLSK-E and G are included in the category of "less" sustainable. The error test of the MDS analysis results referring to the Monte Carlo simulation results, showed the largest difference seen in IPLSK-D of 1.34; and others showed a very small difference (<1%), in general, the simulation results indicated that the status of IPLSK was relative stable with a difference value of less than 5% (Table 9).

Leverage/Sensitivity (Leverage) Attributes

Leverage analysis shows attributes with sensitivity from highest to lowest value, namely: Choice of payment mechanism (Atr-F4); Quality assurance and after-sales service (Atr-F3); Market/competitor competition (Atr-F2); 5) Promotion and bonus efforts (Atr-F5); Balance and sustainability of supply to demand (Atr-F6); and Customer type based on their needs (Atr-F1) (Fig. 13).

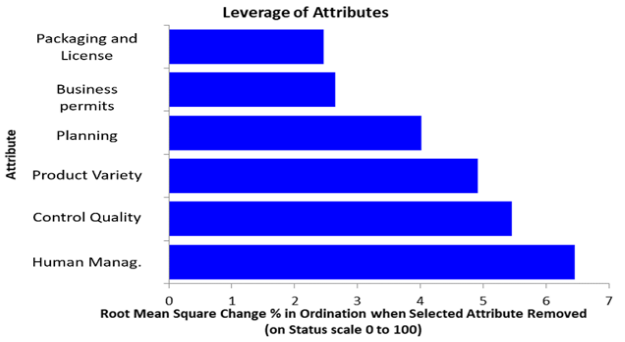

Fig. 11: Value of Leverage IPLSK Sustainability Status in the Business and Production Management Dimension.

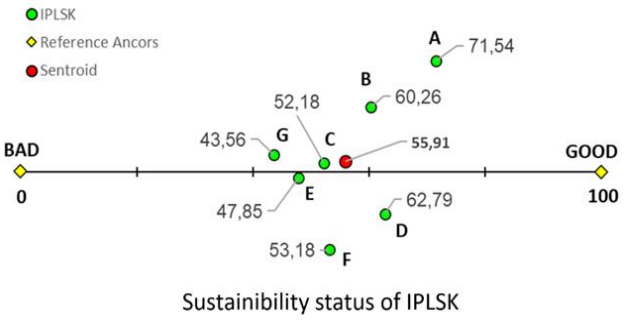

Fig. 12: Verification of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) in the Marketing Dimension.

Table 9: Sustainability Status of IPLSK in the marketing dimension

Marketing	Business Unit						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	71.54C	60.26C	53.18C	62.79C	47.85K	52.18C	43.56K
Monte Carlo (MC)*	70.62	59.92	53.42	61.45	47.94	52.12	43.85
Difference [MDS-MC]	0.92	0.34	0.24	1.34	0.09	0.06	0.29

Note: Sustainability Staus Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval

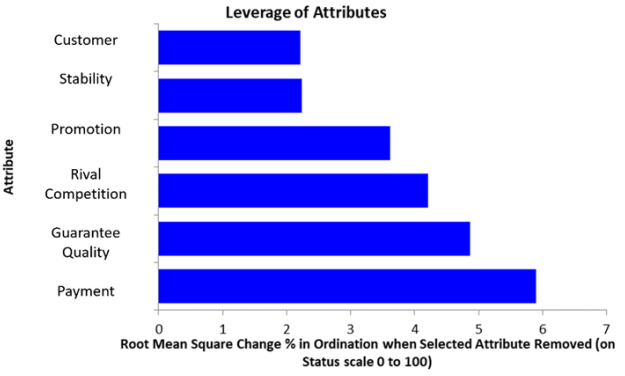

Fig. 13: Value of Leverage IPLSK Sustainability Status in the Marketing Dimension.

The choice of payment mechanism (Atr-F4) is the convenience provided by entrepreneurs to customers in terms of the choosing of "payment method", whether payment must be made in cash, or given flexibility by

accepting payment by credit/installment, or customers (farmers) make payments after harvest. Not all IPLSKs can provide all payment methods on their subscriptions, only two IPLSKs provide a slack on payment methods; While most only apply two ways of payment, namely cash + credit; and or after harvest. The payment methods applied by IPLSK are an accumulation of several factors, including market segment (large target population holder/customers); and the type of feed produced/sold.

Quality assurance and after-sales service (Atr-F3), is IPLSK's effort to strive to produce uniform (consistent) product quality and several forms of entrepreneur responsibility for products that have been sold (after-sales service). Two IPLSKs can convincingly offer the guarantee of standard quality and after-sales service, while the others are still limited to a certain number of customers. The specific customers in question are regular customers, with a large demand capacity, and after-sales service is one of the efforts to maintain customer trust.

Low trust in feed nutrition information offered by suppliers means that buyers (farmers) do not receive high-quality assurance. This shows that the industry is still underdeveloped due to the very young growth of the industry. In addition, periodic quality control rarely occurs both production site and at the point of sale (Kurwijila et al., 2011). This situation creates a lack of trust between various stakeholders.

The Market/Competitor Competition Attribute (Atr-F2) has a leverage value in third position, in this study the competitors identified are other local feed entrepreneurs, and feed from multinational (large) companies that have/are widely circulated. In other words, the size of the market competition/competition identified depends on price, quality, facilities, and targets. Most IPLSK believes that it already has the quality and prices of feed compared to competitors who are quite competitive, besides that IPLSK also provides a choice of payment models for customers, and most of the customers come from their market segment (Score 4). Besides the quality and price being quite competitive, the manufacturer offers a choice of payment methods that are acceptable to both parties (Score 3).

Dimension of Government Support

Latitude Status Coordinates

The dimension of government support (policies and regulations) consists of 6 attributes, namely: 1) Regulations and policies related to the position of feed in the region and nationally (Atr-G1); 2) Lack of market mechanism for local feed entrepreneurs (Atr-G2); 3) Positive intervention (encouragement) of local/national governments in the provision of capital (Atr-G3); 4) Coaching, training, business assistance, and business administration from the government (Atr-G4); 5) Government equipment assistance/grant for the development of local feed factories (Atr-G5); and 6) Ease of conveying aspirations/problems and access to the government (Atr-G6).

The results of the MDS analysis showed that the IPLSK coordinates were in a smaller range of 50% with an average coordinate (centroid) of 40.17%. There are three IPLSKs with smaller coordinates than the centroid value, namely IPLSK-A, B, and F; while four IPLSKs with larger positions than the centroids are IPLSK-C, D, E, and G (Fig. 14). With such a position of ordinance, all IPLSK are included in the category "Less" sustainable, or lack of government support.

The difference between the MDS coordinates and the Monte Carlo simulation results was greater than 1% in IPLSK-C, D, E, F, and G. However, the difference is still less than 5%, so the position of the sustainability status of the results can be considered quite stable (Table 10).

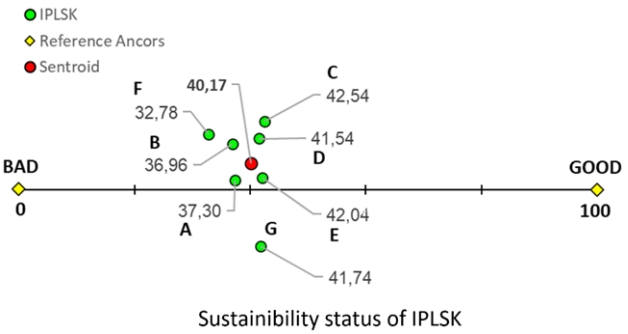

Fig. 14: Verification of the Sustainability Status of the Small-Scale Local Feed Industry (IPLSK) in the Government Support Dimension.

Table 10: Sustainability Status of IPLSK in government support

Government Support	Business Unit						
	A	B	C	D	E	F	G
Status Multi-Dimensional Scaling (MDS)	37.30K	36.96K	42.54K	41.54K	42.04K	32.78K	41.74K
Monte Carlo (MC)*	37.95	37.92	44.00	43.52	44.09	34.20	43.48
Difference [MDS-MC]	0.65	0.96	1.45	1.98	2.05	1.42	1.75

Note: Sustainability Staus Criteria, B= Good; C=Enough; K=Less. *Rapfish Ordination Monte Carlo with Error Bars of Median at 95% Confidence Interval.

Leverage/Sensitivity (Leverage) Attributes

The feasibility analysis showed the highest Leverage value in the following attributes: Positive intervention (encouragement) of the local/national government in the provision of capital (Atr-G3); then the attributes of the government's ALSIN assistance/grant for the development of local feed factories (Atr-G5); Relaxation of market mechanisms for local feed entrepreneurs (Atr-G2); Coaching, training, business assistance, and business administration from the government (Atr-G4); Regulations and policies related to the position of feed in the region and nationally (Atr-G1); and the lowest in the attribute of Ease of conveying aspirations/problems and access to the government (Atr-G6) (Fig. 15).

Positive intervention (encouragement) of the local/national government in the provision of capital (Atr-G3) is an intervention in the form of policies that can encourage the initiation (business start-up) and development of local feed factory businesses. The perception of district, provincial, and national government support in business development mostly shows that policies/regulations are not felt directly (in fact, there is no strong legal basis for strengthening capital for IPLSK) (Score 1); Nevertheless, the district government still

provides direction/assistance if there are new regulations that are considered necessary for local feed entrepreneurs (Score 2). The strong association's existence is essential in protecting the interests of the animal feed industry in the country and is also responsible for ensuring the quality and safety of compound feed, which is achieved by establishing clear regulations and good production guidelines that guarantee self-sufficiency, regulations and increased government regulations throughout the supply chain (Louw et al., 2013).

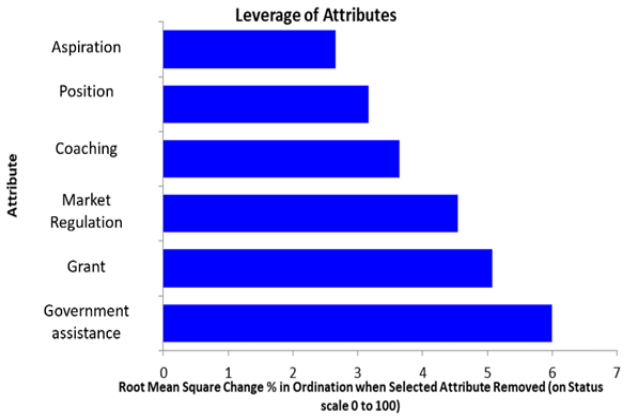

Fig. 15: Leverage Value of IPLSK Sustainability Status Attribute on the Government Support Dimension

The attributes of the government's equipment assistance/grant for the development of local feed factories (Atr-G5) are measured based on whether or not IPLSK has received grant assistance (eg. Alsin) from the government. The government has given working capital to five ILPSKs (Score 2); while the other two never received assistance/grants.

Fig. 16 shows the diversity of MDS sustainability status in the Small-Scale Local Feed Industry (IPLSK) with several dimensions as reinforcement in reviewing the sustainability of IPLSK.

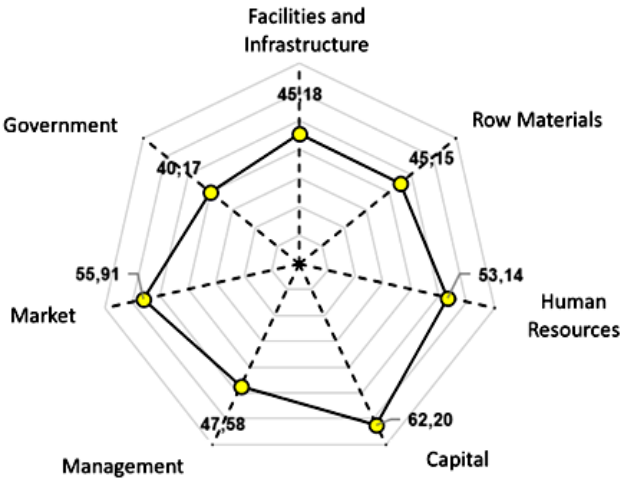

Fig. 16: Kite Diagram (Status) of Multi-Dimensional Sustainability Status of Small-Scale Local Feed Industry (IPLSK).

It has been described in some dimensions and its sustainability levers in small-scale feed industry. Adugna et al. (2012) stated that disadvantages and expensive feed ingredient, imported feed additive and supplement, taxes in various steps of feed processing, high distribution cost, insufficient storage capacity, and less market information were issues for small-scale feed mill. In feed manufacturing, low consideration and awareness of high-quality feed, low quality of ingredients, lack of quality control services or poor implementation of feed standards, low market demand, and problems related to ration formulation are challenges faced by IPLSK in Sidenreng Rappang Regency to support the productivity of the poultry industry and as an economic income.

The future of these challenges leads to the demand for innovation in several areas related to animal nutrition including feed technology. Poel et al. (2020) argued that economic opportunities for more advanced diets, both technologically and nutritionally, will increase in the future. The major predictions suggest that feed prices will increase in the future because technology does not depend on the cost of the feed raw materials, meanwhile, the economic potential of technology and expected nutritious feed will grow fast.

Conclusion

In conclusion, the program sustainability index is a development of the RAPFeed (Rapid Appraisal Feed) coordination analysis based on Multidimensional scaling (MDS) analysis. Furthermore, this study considers factors that affect sustainability in seven dimensions, namely the dimensions of facilities and infrastructure, raw materials, human resources, capital, business management, marketing, and government. The sustainability index based on RAPfeed analysis is estimated at 49.90% (less sustainable), therefore, the results of the findings of obstacles or constraints in each leverage factor in each dimension can be improved and gradually this local feed industry has the potential for progress so that it can develop sustainably if the leverage factors described in each dimension are considered.

Conflict of Interest: All authors declare no conflict of interest.

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Author's Contribution: AAY, Research, analysis of result, original draft preparation, and conceptualization, JAS, SP and MR, Supervision of research, validation, methodology.

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