Factor analysis in the adopting of utilization of rice straw waste as feed in South Bontonompo district, Gowa regency

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Abstract. This study aims to analyze the barriers of farmers in adopting the utilization of rice straw waste as feed. The study was conducted in South Bontonompo District, Gowa Regency, South Sulawesi Province, Indonesia. The type of research was a quantitative descriptive research using Factor Analysis tool. The variables measured in this study were 11 variables. Sample was drawn through simple random technique resulting in 55 farmers as respondents. The research data were collected by conducting a survey using the interview technique with a questionnaire. The results showed that the extraction of 11 variables indicated that all of them fulfilled the requirements for Factor Analysis, resulting in 3 formation factors. The variables included in factor 1 are knowledge about waste utilization (X5), waste management skills (X7), land ownership (X8), labor availability (X9), inability to pay for labor (X10) and age (X11). Variables included in factor 2 are difficulties in transporting feed (X3), non-intensive maintenance system (X4) and number of livestock ownership (X6). Meanwhile, the variables included in factor 3 are storage warehouse (X1) and processing equipment (X2). Factor 1 is named the *intrinsic* constraints because it is an internal part of breeders, factor 2 is named *livestock business* constraints because it is related to the situation of cattle farmers in carrying out cattle business activities, while factor 3 is named *infrastructure* constraints because it is a supporting factor in the cattle business.

1. Introduction

Feed is the main component that determines the productivity of beef cattle, in addition to the quality of the seeds and the handling and prevention of diseases in the production system. Feed quality must be able to meet the needs of cattle to achieve optimal productivity because the cost of feed is the highest component (60-70%) of all production costs [1]. Increasing the implementation of feed processing technology is one solution that can be done to overcome feed shortages, especially in ruminants, such as beef cattle. Through feed technology innovation, waste, especially agricultural waste, can be utilized as a potential source of animal feed based on local raw materials. One application of feed processing technology is the utilization of rice straw waste.

Rice straw is a by-product of rice and is used as a feed source for ruminants, especially by small-scale farmers in developing countries, including Indonesia. [2] rice straw is one of the agricultural wastes that are quite abundant and has not been widely used. The Utilization of agricultural waste as

feed could overcome the shortage of grass or other forage [3]. As a feed ingredient, rice straw has a low nutritional content so it needs simple fermentation technology for getting the benefit.

South Bontonompo Subdistrict is one of the sub-districts in Gowa Regency which has abundant rice straw production with an area of 2,118 ha of rice fields and 3,985 ha of rice harvest area [4], making South Bontonompo District one of the highest harvested rice areas in Gowa Regency. Production of dry rice straw in South Bontonompo District reached 23,670.9 tons/year taken from the average calculation [5], namely dry matter 5.94 tons/ha which was calculated using a formula based on data on harvested area (ha) multiplied by dry material production (ton/ha). Rice straw waste in South Bontonompo District is able to serve as feed sources for cattle based on dry material carrying capacity of 10,520 ST and with a beef cattle population of 1,698 ST [4], the potential of rice straw waste as a source of feed is far higher compared to the existing beef cattle population, and could even be used for the next few months if there is a good storage facility. Thus, rice straw waste has a high potential as a source of beef cattle feed in South Bontonompo District.

The problem found was that farmers in the South Bontonnompo district had difficulty obtaining rice straw during the rainy season due to entering the planting season. In the growing season, farmers only rely on grass around the rice fields, which is often sprayed by farmers to clear the land, while the road to the source of rice straw is difficult to go because it is far and muddy. On the other hand, during the dry season, the availability of feed is abundant due to the harvest season. This abundant agricultural waste cannot be utilized by farmers to anticipate difficult times in obtaining feed, in fact, it is often burned to clear paddy fields that will be replanted.

The purpose of this study is to analyze the obstacles faced by farmers in adopting the utilization of rice straw waste as feed.

2. Materials and methods

2.1. Location and research design

This research was conducted in April-June 2019, at South Bontonompo District, Gowa Regency. Determination of research location was based on the consideration that South Bontonompo district is one of the districts in Gowa Regency which produces rice straw and has a high potential to supply raw materials for cattle feeding.

2.2. Population and sample

The Population in this research is all of the farmers who existed in South Bonotonompo, namely 241 farmers who have been utilizing rice straw as feed. Because the population is quite large, then it was necessary to draw samples. The sample for factor analysis was determined by the number of variables multiplied by five. There were 11 variables in this research, so the samples drawn were 55. [6] samples drawn must be at least five times the number of variables.

2.3. Data collection

Data collection techniques were carried out by interview technique using questionnaires contained a list of questions concerning research variables.

2.4. Data analysis

Analysis of the data used in this study is Factor Analysis. The steps for using the Factor Analysis tool are as follows [7]: Problem formulation, Develop a correlation matrix, KMO MSA (Kaiser-Meyer-Olkin Measure of Sampling Adequacy), Determination of analysis procedures, Extracting factors, Rotating factors and Interpretation (looking at the loading factor and if the goal is to reduce the data then name the factor and calculate the factor score).

3. Result

3.1. Characteristic of respondents

3.1.1. Age of breeders

Table 1. Age classification and percentage of beef cattle farmers in South Bontonompo District, Gowa Regency

No.	Age Classification (years)	Number (people)	Percentage (%)
1	20 - 33	7	12.72
2	34-47	35	63.64
3	48-60	13	23.64
	Total	55	100

Table 1 shows that the majority of respondents were still in their productive age. Age is grouped into 3 namely (1) ages 0-14 years is called young age / not yet productive age, (2) ages 15-64 years is called adult age / productive age, and (3) ages 65 and above is called old age / non-productive age. In this productive age, the majority of breeders in South Bontonompo District, Gowa Regency are in the age range of 34-47 years.

3.1.2. Gender

Table 2. Classification of respondents by gender in South Bontonompo District, Gowa Regency

No	Gender	Amount (person)	Percentage (%)
1	Man	42	76.36
2	Girl	13	23.64
	Total	55	100

Source: Research Results Data After Processing, 2019.

Table 2 shows the number of male gender respondents totaling 42 people (76.36%) and women totaling 13 people (23.64%). This is because the Bali cattle breeding business requires more energy and generally men are more powerful to work than women, but it does not rule out the possibility for women to be able to do it.

3.1.3. Education level

Table 3. Classification of respondents by education level in Bungaya District, Gowa Regency

No	Education Level	Amount (person)	Percentage (%)
1	No school	13	23.64
2	Primary School/Equivalent	16	29.09
3	Junior High School/Equivalent	8	14.55
4	Senior High School/Equivalent	18	32.72
	Total	55	100

Table 3 shows that the education level of farmers in South Bontonompo Subdistrict, Gowa Regency, which is at the highest level of education is senior high school with 18 respondents (32.72%)

and the lowest is junior high school with 8 people (14.55%). However, there were still respondents who did not go to school or did not graduate from elementary school. This shows that the level of education of farmers is still low. This will affect the mindset in making financial decisions for the business.

3.1.4. Ownership of livestock

Table 4. Classification of beef cattle farmers by number of livestock ownership in South Bontonompo District, Gowa Regency.

No	Number of Livestock	Number (person)	Percentage (%)
1	1 - 2	19	34.55
2	3 - 5	35	63.64
3	6 - 7	1	1.81
	Total	55	100

Table 4 shows that the beef cattle business in South Bontonompo District, Gowa Regency is a small-scale community farm. In general, the number of livestock that farmers have is ranging from 1-7.

3.2. *Factor analysis*

3.2.1. First step output (variabel selection)

Table 5. First Step Output (Variable Selection) Based on MSA, Chi-Square and Significance KMO Values

No	Output First Step	Acquisition Value	Terms and Conditions
1	KMO MSA	0.747	≥0,5
2	Chi-Square	291,070	≥0,5
3	Significance	0,000	<0.05

Table 5 shows the KMO measure of sampling adequacy (MSA) value of 0.747. Because the MSA number is ≥0.5, the set of variables can be further processed. [7] suggested that general criterion for level of significance is <0.05 and the number of KMO MSA ≥0.5, so the Factor Analysis conducted shows that the sample is worth factoring and the factors can be further analyzed.

Table 6 shows that the warehouse variable (X1) has an MSA value of 0.595, the processing equipment variable (X2) has an MSA value of 0.643, the difficulty of transporting waste (X3) is 0.700, the variable of the non-intensive maintenance system (X4) is 0.723, the knowledge variable is processing waste (X5) 0,722, variable number of livestock ownership (X6) 0,821, variable of waste processing skills (X7) 0,784, land ownership variable (X8) 0,853, labor availability variable (X9) 0,635, variable inability to pay labor (X10) 0,885 and value MSA for age variable (X11) is 0.748. With the MSA value of all existing variables ≥0.5, the extraction process is then feasible for Factor Analysis.

3.2.2. Total explained variance

Table 6. Value of Anti-Image Matrices on All Variables

		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
Anti-image Correlation	Warehouse	.595 [a]	-.470	-.126	-.004	-.073	.005	.039	.087	-.189	.96	.136
	Processing Equipment	-.470	.643 [a]	-.123	-,045	-,062	-.066	.135	.082	-.102	-.063	.477
	Difficult to Transport Waste	-.126	-.123	.700 [a]	-.578	102	-094	.046	.054	.007	-,024	-.236
	Non-Intensive Maintenance	-.004	-,045	-.578	.723 [a]	-.224	-.139	.019	.095	.039	-192	.183
	Knowledge	-.073	-,062	102	-.224	.722 [a]	-.169	-.573	-191	.355	.477	-.591
	Livestock Ownership	.005	-.066	-094	-.139	-.169	.821 [a]	-.316	-279	.228	.015	.173
	Processing Skills	.039	.135	.046	.019	-.573	-.316	.784 [a]	.50	-.467	-.119	.077
	Land Ownership	.087	.082	.054	.095	-191	-279	.50	.853 [a]	-249	-.096	.50
	Labor Availability	-.189	-.102	.007	.039	.355	.228	-.467	-249	.635 [a]	-310	-356
	Labor Wages	.96	-.063	-,024	-192	.477	.015	-.119	-.096	-310	.885 [a]	-.063
	Age	.136	.477	-.236	.183	-.591	.173	.077	.50	-356	-.063	.748 [a]

Table 7. Total Explained Variance

Total Explained Variance									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cum.%	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%
1	4,364	39,671	39,671	4,364	39,671	39,671	3,376	30,687	30,687
2	2020	18,361	58,032	2020	18,361	58,032	2,349	21,354	52,041
3	1,223	11,115	69,147	1,223	11,115	69,147	1,882	17,105	69,147
4	.846	7,691	76,838						
5	659	5989	82,826						
6	.483	4,389	87,215						
7	452	4,108	91,324						
8	348	3,164	94,488						
9	.301	2,736	97,224						
10	.207	1,882	99,106						
11	.988	.894	100,000						

Table 7 shows the Total Explained Variance which reveals the value of each variable analyzed. In this study there were 11 variables, meaning there were 11 components analyzed. There are two types of analysis to explain a variance, namely Initial Eigenvalues and Extraction Sums of Squared Loadings. In the Initial Eigenvalues, variance indicates the factors formed. If all the factors added together then it will indicate the number of variables (i.e. 4.364 + 2.020 + 1.233 + 0.846 + 0.659 + 0.483 + 0.452 + 0.348 + 0.301 + 0.207 + 0.098 = 11 variables). The arrangement of the Initial Eigenvalues is always sorted from the largest to the smallest, with the criterion that the number of eigenvalues <1 is not used in calculating the number of factors formed. Whereas the Extraction Sums of Squared Loadings section shows the amount of variance or the number of factors that can be formed.

3.2.3. Matrix component

Table 8. Value of Matrix Components

	Component		
	1	2	3
Warehouse	-.002	.036	.808
Processing Tool	-.005	.115	.813
Difficult to Transport Waste	.081	661	.483
Non-Intensif Maintenance	.111	.797	.321
Knowledge	.655	. 593	-.143
Livestock Ownership	.318	.749	-.154
Processing Skills	.779	.436	-.128
Land Ownership	.633	.222	-.270
Labor Availability	853	-.166	.249
Labor Wages	.711	.137	.182
Age	.765	.254	-.048

Table 8 shows 3 (three) factors obtained from the analysis in which all of the 11 (eleven) variables are clustered. The first factor consists of 6 variables i.e. knowledge of waste utilization, skills in treating waste, land ownership, availability of labor, inability to pay for labor and age. The second factor consists of 3 variables namely the difficulty in transporting waste, non-intensive maintenance systems and the number of livestock ownership. The third factor consists of 2 variables namely the storage warehouse and processing equipment).

4. Discussion

After conducting a series of extraction processes, out of the 11 (eleven) variables that have been extracted, 3 factors are obtained, then the process of naming the factors that have been formed is then performed. The naming of this factor depends on the names of the variables that form one group, thus the actual naming is subjective, and there are no definite provisions regarding the naming.

According to farmers in South Bontonompo District, the existence of a warehouse can help minimize the time consumed by farmers to utilize rice straw waste because it can accommodate as much as needed without having to go to the rice fields again to take it repeatedly. Then the breeder does not have to store/accumulate the waste around the house or under the house for fear of fire. [8] several factors cause farmers not to use food crop waste as feed because of the unavailability of food crop waste storage.

Farmers in South Bontonompo District do not want to adopt waste utilization because the tools used to process the waste are not available, especially chopper to cut waste because farmers cannot continuously have to cut manually because it takes a long time. With this machine, it can help speed up the farmer's work time without having to manually. [9] a chopper machine (mini chopper) is a machine that can help farmers in meeting animal feed needs. Manual cutting is very different from cutting using a combustion engine, which can speed up the cutting process so that the time can significantly be saved.

Farmers in South Bontonompo District find it difficult to transport the waste because access to remote locations and road infrastructure is not available make it difficult for farmers to transport it. Farmers must carry the waste up to the nearest road to be transported by vehicles so that farmers do

not adopt the utilization of agricultural waste as feed. [10] states that the construction of farm road infrastructure has brought quite a lot of changes in the economy of the community, especially on smooth transportation access.

The absence of intensive cages makes farmers not adopting the use of waste. According to farmers, with the non-intensive breeding system, it is difficult to control their cattle so they do not utilize the agricultural waste. [11] states that beef cattle breeding systems are categorized into three, i.e. intensive care systems, namely cattle being kept in cages, semi-intensive breeding systems, in which the cattle kept at night and released in the pasture fields in the morning and extensive maintenance systems namely the cattle released in the pasture fields. An intensive maintenance system can help in the success of a livestock business.

Farmers assume that dry waste can no longer be given to cattle. Moreover, the information dissemination on the utilization of waste as feed has never been carried out and has made the farmers less knowledgeable about agricultural waste. [12] knowledge occurs when a person is exposed to information about the existence of an innovation and gains an understanding of how the innovation functioned.

Farmers do not use rice straw waste if the number of cattle raised is small because the costs incurred are not proportional to the income that farmers get, assuming the cost of farmers to use rice straw waste as an expensive feed. [13] the number of livestock kept determines the scale of business, the more the number of livestock, the greater the scale of business. Increasing the scale of the business being managed will reduce the unit cost of livestock production.

Farmers' skills in processing rice straw waste as feed are still relatively low due to the absence of a demonstration to make feed. The ability of farmers to make feed from rice straw waste material is still lacking, farmers do not know the ways and procedures in making feed from these waste materials that make farmers not adopt the utilization of rice straw waste as feed. [12] one of the processes of acceptance/application in technological innovation is implementation, which means someone uses or implements the innovation in real activities.

Farmers who do not have agricultural land tend to be hesitant to take waste because it does not belong to them. Farmers must ask permission to take the waste from the landowner. The situation will be different if the lands are their own because they can utilize the waste without permission. So land ownership is a barrier for farmers to use agricultural waste. In line with what was said by [14] that one of the obstacles in the use of agricultural waste as animal feed is the low ownership of agricultural land.

The husband as the head of the family cannot collect feed ingredients because besides raising livestock also has other work to supplement family income. Usually the wife or other family helps to take care of the livestock by providing food and drink, but not always the family member must take care of the cattle because they also have other activities. [15] suggested that the role of women in aspects of access to information, control aspects, and aspects of decision making is quite large in beef cattle business that is integrated with plants.

There is no fixed time from family members to collect waste and farmers are also unable to provide labor costs because of financial factors. According to them, it is better for farmers to work on their own than to find workers to collect waste as feed. [16] economists argue that the economic factor is the main driver of people in adopting technology. Resources managed optimally and correctly which is economically beneficial and increasing profits and wealth is one of the reasons people adopt technology.

Farmers in South Bontonompo District assume that getting older makes ranchers less able to collect waste as feed. Increasing age prevents farmers to engage in strenuous activities, unlike when they were young when farmers were still quite energetic in their activities. As the age continues to increase, farmers are more focused on the survival of their family without regard to the development of their livestock. [17] the age of a farmer influences a person's ability to accept something new or adopt innovation.

This study obtained 3 factors resulting from the clustering of 11 variables. Factor 1 is called the *intrinsic* barriers which consists of variables as follows: knowledge of waste utilization, skills in treating waste, land ownership, availability of labor, inability to pay for labor and age. Factor 2 is called a *livestock business* barriers consisting of three variables namely the difficulty in transporting waste, non-intensive maintenance systems and the number of livestock ownership. Factor 3 is called the constraints in *infrastructure* consisting of two variables namely the storage warehouse and processing equipment.

5. Conclusions and recommendation

The conclusion of this study is the barriers to farmers in adopting the utilization of rice straw waste as feed divided into 3 factors, namely factor 1 is a characteristic obstacle consisting of six variables i.e. knowledge of waste utilization, skills in processing waste, land ownership, availability of labor, inability to pay for labor work and age. Factor 2 is obstacles to livestock business consisting of three variables i.e. variable difficulties in transporting waste, non-intensive maintenance systems and the number of livestock ownership. Factor 3 is the constraints of infrastructure consisting of two variables i.e. warehouse storage and processing equipment.

The suggestions from this research are: (a) It is better for the government to be intensive in conducting counseling related to rice straw waste processing technology as feed and also the government should make a warehouse for storing waste in an expanse unit so that farmers can store the waste and procure processing equipment to process waste. (b) Further research should be carried out on the extent of how much land should be provided to supply adequate rice straw waste for building a waste storage warehouse so that farmers are easier to utilize the waste.

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