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The Capability of Rice Plant Waste Sourced from the Feed Concentration Index in Farmer Groups in Salo Urban Vilagge

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ABSTRACT

This study aims to determine the characteristics of farmer groups, rice plant waste production, livestock performance, livestock economic density and feed concentration index in Salo Urban Village. This study uses a descriptive cross-sectional research design. Data were analyzed to look at the characteristics of farmer groups according to sex and age, rice plant waste production, livestock performance, livestock economic density and feed concentration index in Salo Urban Village. The results showed 23 farmer groups with 1.077 members, 937 male (87%) and 140 female (13%). There were 2 categories: the productive category for those aged 15 - 64 years old (85,24%) and the unproductive category for those over 65 years old (14,76%). The average harvested area is 39,18 Ha/farmer group; with fresh production of rice plant waste being 465,80 tons; dry production of rice plant waste being 263,65 tons; and dry matter production being 233,49 tons. The livestock performance equation is In (Y) = -348.47 + 0.18t with a growth rate of 18% for cattle and In (Y) = -340.38 + 0.17t with a growth rate of 17% for goats, and has an economic density of livestock in the rarely category. The feed concentration index obtained three categories, namely the high production category (1 farmer group), the medium production category (6 farmer groups) and the low production category (16 farmer groups). Shows that rice plant waste harvested from farmer groups in Salo Urban Village can be used as a ruminant feed source.

Keywords: Feed concentration index, Rice plant waste capability, Farmer groups

Introduction

Indonesia is located in a tropical climate and is very suitable for growing rice plants. The harvested area of rice plants in Indonesia in 2021 will reach 10,41 million hectares, with a total rice production of 54,42 million tons of dry-milled grain (Badan Pusat Statistik, 2022). It will positively correlate harvested area and the amount of waste generated. The by-products of rice plant waste are widely used as animal feed, such as the use of rice straw with *Lactobacillus casei* TH14, molasses, and cellulase as feed for Thai cattle (Cherdthong *et al*., 2021); a combination of paper mulberry silage with rice straw as ruminant feed (Du *et al*., 2022); a combination of rice straw with protein salt as feed for beef cattle (Hoerbe *et al*., 2020); and a mixture of sugar beet pulp and rice straw as feed for dairy cows (Wang *et al*., 2022).

Livestock development cannot be separated from agriculture because agricultural businesses have the potential to provide rural waste that can be well as feed for livestock development in Indonesia. Rice by-products are available in relatively large quantities and have economic value. The abundant availability of rice plant waste provides an opportunity to be used as an energy source for ruminants (Wang *et al*., 2017) like beef cattle (Chuntrakort *et al*., 2014), dairy cows (Khonkhaeng *et al*., 2021; Lunsin, 2018), buffalo (Efendi and Ramon, 2021), sheep (Passetti *et al*., 2020) and goat (Huanca *et al*., 2021; Romero *et al*., 2020; Yuangklang *et al*., 2017). The rice plant waste used as animal feed is the growing stem, which after harvesting the grains of fruit together or not with the stalk, is reduced by the roots and the role of the branch left after being slashed. The provision of rice plant waste as animal feed is carried out during the dry season because the availability of fresh forage feed begins to decline when feed is the most crucial factor in the ruminant livestock business. Utilization of rice plant waste can also be in the form of silage or association with other silage formulations, for example, the association of rice straw silage with Moringa leaves (He *et al*., 2019), the addition of corn steep liquid to rice straw silage (Li *et al*., 2016), fermentation and adsorption of lactic acid bacteria culture broth on rice straw (Liu *et al*., 2015), a mixture of cellulase and *Lactobacillus plantarum* in rice straw silage (Mu *et al*., 2020), the interaction of Silo density and the addition of additives to rice straw silage (Tian *et al*., 2019), and rice straw silage added to lactic acid bacteria inoculants (Zhang *et al*., 2021).

The feed source from rice plant waste can be used as animal feed. The Salo Urban Village area is one of the Villages in Watang Sawitto District, Pinrang Regency, which has the potential for the development of ruminants. Salo Urban Village is one of the top three areas of the eight other villages in Watang Sawitto District and is 3 km from the center of the District (Badan Pusat Statistik Kabupaten Pinrang, 2022). In addition, it is also one of the areas that utilize part of its land for growing rice, thus indicating that in Salo Urban Village, there is rice plant waste in the form of rice straw, which can be used as ruminant livestock feed.

Optimization of the utilization of rice plant waste in Salo Urban Village can be seen based on the capability of rice plant waste sourced from the feed concentration index in the farmer group because one of the determinants of livestock success is the availability of feed resources. Rice plant waste produced by farmer groups requires a feed concentration index to calculate the production of animal feed availability so that feed availability during the dry season can fulfil. The feed concentration index value is the ratio of the feed production of an area to the overall average feed production (Fuah *et al*., 2023). There are several studies related to the feed concentration index in several locations, such as in Pare-Pare City (Rauf and Rasbawati, 2015), and Gowa District (Mariam and Syamsu, 2021).

A farmer group is one of the actors involved in using rice plant waste as ruminant feed. Several studies have been carried out regarding farmer groups that use rice plant waste as animal feed, namely in the Nek'to Noapala Farmer Group in Kiuola Village, which utilizes rice plant waste fermentation in Bali Cattle (Nahak *et al*., 2019), integration of rice plant waste with cattle in the Bina Karya Farmer Group, Nagari Koto Hilalalng, Kubung District (Murnita *et al*., 2019), fermented rice straw for cattle feed in the Ukhawah Sejahatera Farmer Group (agriculture) and Sapue Pak at (livestock sector) in Reuleut Timu Village, Muara Batu District, North Aceh (Handayani *et al*., 2019). Thus, the feed concentration index is one way to determine the level of production of the availability of rice plant waste produced by the farmer group. So actual data will be obtained and can be the basis for improving and developing ruminants in the Salo Urban Village, Watang Sawitto District, Pinrang Regency.

Based on the description above, the author aims to provide a study of the capability of rice plant waste sourced from the feed concentration index in farmer groups in Salo Urban Village.

Materials and Methods

This type of observational research uses a descriptive-analytic research design in Salo Urban Village, Watang Sawitto District, Pinrang Regency, South Sulawesi Province, in January 2021.

Data on sex and age in each farmer group were obtained through surveys and interviews using cluster random sampling based on farmer groups in Salo Urban Village (Sugiyono, 2016), while the performance analysis of ruminants in the last five years for Salo Urban Village by calculating the growth rate, namely the livestock population for each ruminant livestock using a population development model using asimple linear regression model in the form of an equation (Suyono, 2015), by formula:

$$\ln (Y) = a + bt$$

Information:

In (Y) : Livestock performance is the number of livestock population
a : Constant variable
b : Coefficient of linear regression direction
t : Period of year

Furthermore, the economic density of livestock can be measured based on the number of ruminant livestock populations in the Salo Urban Village (AU) in 1000 inhabitants (Ashari *et al*., 1995):

$$\text{The Economic Density} = \frac{c}{d} \times 1000$$

Information :

c : The number of ruminant livestock population (AU)
d : The total population in the Salo Urban Village

The criteria used for ruminants in livestock units are very dense >300, dense 100-300, moderate 50-100, and rarely <50. The FCI (Feed Concentration Index) data uses rice straw conversion values based on dry matter production in each region (Mariam and Syamsu, 2021). The Feed Concentration Index (FCI), according to Mariam and Syamsu (2021) calculated using the following formula:

$$\text{FCI} = \frac{e}{f}$$

Information :

e : Production of rice plant waste (dry feed) in each farmer group
f : Average production of rice plant waste (dry matter) in farmer groups

The criteria for calculating the Feed Concentration Index (FCI) are high production categories (> 2), medium (1 – 2), and low (< 1).

Results and Discussion

Characteristics by gender and age in farmer groups

Data were collected from as many as 23 farmer groups in Salo Urban Village. The characteristics by gender and age can see in Figures 1 and 2.

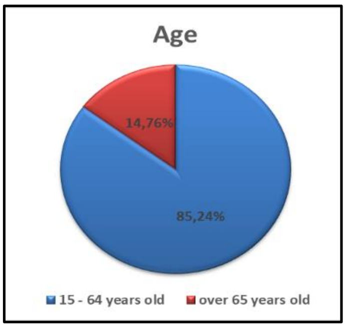

Figure 1. Characteristics by gender in farmer groups in Salo Urban Village.

Based on Figure 1, the farmer groups in Salo Urban Village are 1.077 members of the 23 existing farmer groups, where the number of males is 937 people (87%) and females 140 people (13%). The highest number of members was in the Sipatokkong II farmer group, with as many as 116 people (consisting of 97 males and 19 females), and the lowest was in the Tepo I Baru farmer group (composed of 18 males and one female). It shows that male members of farmer groups dominate more than females. According to Burton (2014), that studies related to the influence of gender in agriculture, especially in agricultural mechanization and decision makers or direct descent (physical factors) as workers on agricultural land, are more dominant carried out by male farmers than female farmers. The male farmer as the head of the household significantly impacts the socio-economic economy of agriculture, thus providing sufficient space for farmers to follow the direction of changes related to agricultural strategies, which belief to increase agricultural land production. According to (Nurmayasari *et al*., 2019), men generally dominate access and control in paddy rice farming activities. Another research (Mulyaningsih *et al*., 2018) show significant participation differences between male and female farmers in planning and implementation, where male farmers are in the high category while female farmers are in the low category. According to Mara *et al*. (2020), several factors influence farmers' behaviour: age, gender, education level, use or non-use of certain areas, life experience, and environment.

Farmers are implementers in the agricultural sector (Zhou *et al*., 2022) and the decision-makers in the agricultural chain (Burli *et al*., 2021) who have implemented a membership system with farmer groups as their unit (Tan *et al*., 2022) to encourage sustainable agriculture that contributes to the farmer's economy (Paulus *et al*., 2022), where farmers have the opportunity to improve the economy by processing their agricultural products independently (Rahmat *et al*., 2021). So that with the existence of farmer groups, farmers can run their farming businesses together to improve and develop farming businesses that members and their farmer groups run (Octafany *et al*., 2021).

Farmer groups in Salo Urban Village range in age from 22 to 77 years. The distribution of respondents according to age characteristics shows that most of the respondents are in the productive category. The relationship between agricultural land and farmer age on agricultural production (Kreft *et al*., 2020) is a study of agricultural land ownership and governance in reviewing farmers' characteristics as decision-makers. One of the variables that have an impact on productivity is the age factor, where the productive age generally has a higher level of productivity compared to old age, where this by physical limitations that begin to decline and are limited (Aprilyanti, 2017). Badan Pusat Statistik (2022) categorizes age into three categories, namely 0 - 14 years old (not yet productive category), 15 - 64 years old (productive category), and age over 65 years old (unproductive category).

Based on Figure 2, it is that the characteristics according to age in the Salo Urban Village farmer group consist of 2 categories, namely the productive category for those aged 15 - 64 years old (85,24%) and the unproductive category for those aged over 65 years old (14,76%). This is by Novita *et al*. (2016) opinion that farmers of productive age will more easily understand the latest things in farming to advance the production of lowland rice managed by these farmers. According to Leite *et al*. (2019), that different age groups will have different views as well. The productive age category has a better physical and workforce in managing agricultural businesses and relatively influences the growth and development of competence and better and advanced agricultural understanding (Mahananto *et al*., 2021). While, the unproductive age category still exists in the Salo Urban Village farmer groups, although the number is relatively small because these farmers still have to work to earn income, and there is no regeneration of farmers to shift their duties as farmers.

Understanding the productive age factor is related to physical characteristics, motivation, expertise, and level of adoption so that it can provide a reference for farmers as policymakers to increase productivity on managed agricultural land. The age of the farmer correlate with the sustainability of farming and productivity at work (Anwar and Prasetyowati, 2021; Hapsari *et al*., 2019). Research by Sulistijo and Rosnah (2022) related to age is an important factor in determining the success of a farming business, where age will affect the efficiency of a business. As actors in the agricultural sector, farmers influence by various variables, namely the individual level, such as gender and age.

The livestock performance

Analysis of the performance value of ruminants (cattle and goat) in the last five years in Salo Urban Village by calculating the growth rate of the ruminant population, as shown in Figure 3.

It appears that the increase in the number of ruminant livestock populations (cattle and goat)

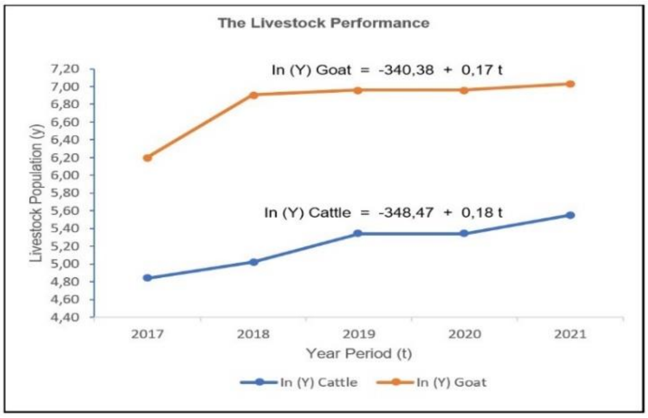

Figure 2. Characteristics by age in farmer groups in Salo Urban Village.

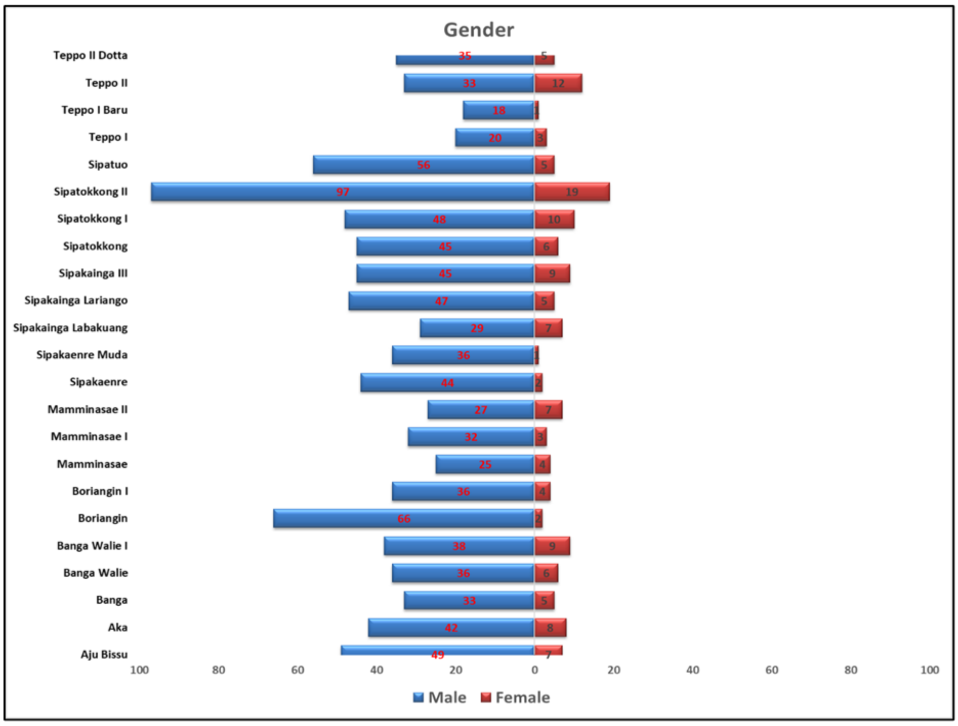

Figure 3. The growth rate of the ruminant livestock population in Salo Village.

follows the livestock performance equation, namely In (Y) = -348.47 + 0.18t with a growth rate for cattle of 18% and In (Y) = -340.38 + 0,17t with a growth rate of 17% for goat. During the last three years, the cattle population has grown by 19,29% and goats by 4,22% in Watang Sawitto District, Pinrang Regency (Badan Pusat Statistik Kabupaten Pinrang, 2022), so it has the potential to be developed (Thinnabut *et al*., 2023) and become one of the contributors to livelihoods in rural areas as producers of meat, milk and leather (King *et al*., 2022).

Agricultural and livestock development is a priority to stimulate overall economic growth and play a role in food security. Livestock populations can increase or decrease due to the effects of death from disease (Brock *et al*., 2021) or the sale or slaughter of livestock. This, of course, has a significant impact on the animal needs of society (Quan *et al*., 2021).

The economic density of livestock

The economic density of ruminants in Salo Urban Village is in the rare category, namely 37.67 ST for beef cattle and 29.27 ST for goats per thousand inhabitants (Table 1). These results indicate that the economic density of beef cattle and goats in Salo Urban Village is rare compared to the population. According to Mariam and Syamsu (2021), if the economic density of livestock in an area is in the sparse category, it means that there is no competition between livestock and residents in an area that is in the moderate and sparse category in terms of providing food, so the cost of feed for livestock needs is relatively cheap.

Knowing the economic density of livestock will provide an overview of the number of livestock owned by breeders in the area, making it possible to develop populations. The nature of livestock production significantly influences the economy (Wetlesen *et al*., 2020) in the economic index to present livestock value (Souza *et al*., 2022).

Livestock economics refers to the many actors, organizations and processes that form a complex and interrelated network from production to consumption and waste treatment. Raised livestock directly affects costs and income (Amaya *et al*., 2020). It correlates with a food system derived from animal protein (Pizarro *et al*., 2016) concerning humans, livestock and the environment, which includes several factors, namely the socio-economic condition, population structure, science and technology (Whatford *et al*., 2022).

The production of rice plant waste

Rice plant waste is one of the wastes widely used as animal feed in the form of rice straw. The production of rice plant waste in the Salo Urban Village farmer group can see in Tabel 2.

Rice derived from rice plants is the essential food crop in terms of area harvested, production and consumer preferences (Kumar *et al*., 2021). The harvested area of rice plants in 23 farmer groups in Salo Urban Village is 861,87 Ha, with an average of 39,18 Ha/farmer groups. Rice fields are semi-natural land designated as rice planting land (Osawa *et al*., 2021). The factors that affect the harvested area of rice include varieties, climatic conditions, handling before and after harvest, and technical maintenance integrated management (Muller *et al*., 2022).

The results showed that the fresh production of rice plant waste in the Salo Urban Village farmer group was 10.247,63 tons with an average of 465,80 tons; the dry production of rice plant waste was 5.800,39 tons with an average of 263,65 tons; and dry matter production of rice plant waste was 5.136,75 tons with an average of 233,49 tons. In maximizing agricultural and livestock production simultaneously, an integrated collaboration need where this method consolidates livestock and crops such as rice plant waste or other crops based on the potential of each region. Furthermore, agricultural waste has more value as a potential raw material as animal feed (Babu *et al*., 2022). According to Kleinpeter *et al*. (2023), that is, the integration of livestock with agricultural waste as animal feed must consider system efficiency, process efficiency, and circularity parameters, which also strengthen the integration component of livestock and agricultural waste. Therefore, the systematic development of technology in selecting the best feed formulation from rice plant waste is crucial to overcome the design of livestock-agriculture integration systems globally through multi-objective approaches in terms of economic, social, environmental, and so on.

Table 1. The economic density of livestock in Salo Urban Village

Livestock Type	Livestock Population (AU)	Number of Population (Person)	The Economic Density of Livestock	Category
Cattle	197.9	5245.00	37.67	Rarely
Goat	153.54	5245.00	29.27	Rarely

Source: Primary data processed (2021).

Table 2. The production of rice plant waste in the Salo Urban Village

Farmer group name	Rice plant harvest area (Ha)	Fresh production of rice plant waste (Ton)	Dry production of rice plant waste (Ton)	Dry matter production (Ton)
Aju Bissu	57.70	686.05	388.32	343.89
Aka	50.00	594.50	336.50	298.00
Banga	30.15	358.48	202.91	179.69
Banga Walie	27.12	32246	182.52	161.64
Banga Walie I	35.07	416.98	236.02	209.02
Boriangin	49.65	590.34	334.14	295.91
Boriangin I	28.35	337.08	190.80	168.97
Mamminasae	25.55	303.79	171.95	152.28
Mamminasae I	23.90	284.17	160.85	142.44
Mamminasae II	23.80	282.98	160.17	141.85
Sipakaenre	35.64	423.76	239.86	212.41
Sipakaenre Muda	27.45	326.38	184.74	163.60
Sipakainga Labakuang	30.75	365.62	206.95	183.27
Sipakainga Lariango	52.15	620.06	350.97	310.81
Sipakainga III	46.17	548.96	310.72	275.17
Sipatokkong	31.25	371.56	21031	186.25
Sipatokkong I	33.75	401.29	227.14	201.15
Sipatokkong II	80.50	957.15	541.77	479.78
Sipatuo	56.15	667.62	377.89	334.65
Teppo I	27.20	323.41	183.06	162.11
Teppo I Baru	28.10	334.11	189.11	167.48
Teppo II	34.90	414.96	234.88	208.00
Teppo II Dotta	26.57	315.92	178.82	158.36
Total	861.87	10.247.63	5.800.39	5.136.75
Average	39.18	465.80	263.65	233.49

Source: Primary data processed (2021).

The feed concentration index

The value of the Feed Concentration Index (FCI) of rice plant waste in the Salo Urban Village Farmers Group can see in Table 3. Table 3 shows that the feed concentration index in the 23 farmer groups in Salo Urban Village consists of 3 categories, namely the high production category (1 farmer group), the medium production category (6 farmer groups), and the low production category (16 farmer groups). The feed concentration index is related to the production of agricultural waste originating from available agricultural residues, easily and cheaply obtained by farmers, such as rice straw, which is very abundant in the harvest season.

Table 3. The Feed Concentration Index in Farmer Groups in Salo Urban Village

Farmer group name	FCI	Category
Aju Bissu	1.47	Medium
Aka	1.28	Medium
Banga	0.77	Low
Banga Walie	0.69	Low
Banga Walie I	0.90	Low
Boriangin	1.27	Medium
Boriangin I	072	Low
Mamminasae	0.65	Low
Mamminasae I	0.61	Low
Mamminasae II	0.61	Low
Sipakaenre	0.91	Low
Sipakaenre Muda	0.70	Low
Sipakainga Labakuang	0.78	Low
Sipakainga Lariango	1.33	Medium
Sipakainga III	1.18	Medium
Sipatokkong	0.80	Low
Sipatokkong I	0.86	Low
Sipatokkong II	2.05	High
Sipatuo	1.43	Medium
Teppo I	0.69	Low
Teppo I Baru	0.72	Low
Teppo II	0.89	Low
Teppo II Dotta	0.68	Low

Source: Primary data processed (2021).

The capacity of rice plant waste as an alternative feed can be used as a solution regarding the availability of feed to increase the population of ruminants (Eoh and Kayadoe, 2021). However, the provision of rice plant waste as animal feed is not optimal because of the low crude fiber content of 32% - 40%, the low crude protein content ranging from 3% - 4%, and the low digestibility rate of 35% - 37% (de Lima and Latupeirissa, 2020). Therefore, feed technology is needed in animal feed formulation to produce good-quality feed (Widyanti *et al*., 2019).

The results obtained on rice plant waste's production capability are insufficient for ruminant animal feed needs because the dominant feed concentration index value is in a low category. For this reason, it is necessary to use other local ingredients as an alternative to ruminant animal feed.

Conclusions

There are 23 farmer groups in Salo Urban Village, Watang Sawitto District, Pinrang Regency, South Sulawesi Province, which are dominated by men and are generally in the productive age category. The average harvested area is 39,18 Ha/farmer group; with fresh production of rice plant waste being 465,80 tons; dry production of rice plant waste being 263,65 tons; and dry matter production being 233,49 tons. Then the growth rate of ruminants increased by 18% for beef cattle and 17% for goats and has a very dense livestock economic density. The feed concentration index obtained 3 categories, namely high production category (1 farmer group), medium production category (6 farmer groups) and low production category (16 farmer groups). Shows that rice plant waste harvested from farmer groups in Salo Urban Village can be used as a ruminant feed source. For this reason, the development of ruminant livestock in Salo Urban Village can be carried out by looking at the potential of rice plant waste in the area. In addition, it is also necessary to take advantage of the potential of other agricultural wastes, such as corn plant waste, as an alternative to ruminant animal feed.

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