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Technical Efficiency Analysis of Home Industry Kamang Crackers in Kenagarian Kamang Hilir Kamang Magek District, Agam Regency, West Sumatra Province

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Abstract

Technical efficiency is the ability of an industry to use minimum total input to produce maximum output. This research aims to 1) Analyze the level of technical efficiency in the Kamang cracker home industry in Kamang Hilir Kenagarian, and 2) Analyze what factors influencing the level of technical efficiency in the Kamang cracker home industry in Kamang Hilir Kenagarian. This research was carried out deliberately in Kenagarian Kamang Hilir, Kamang Magek District, Agam Regency. Respondents in this study using the Slovin formula, totaling 51 Kamang cracker home industry entrepreneurs using a simple random sampling technique. Using primary and secondary data, while the data analysis used is qualitative descriptive analysis and the Cobb-Douglass production function method which is converted into logarithmic form, then data analysis uses Stochastic Frontier. The analysis results showed that the average level of technical efficiency was 0.5792, proving that the hypothesis in this research was proven correct. Can be concluded that the Kamang cracker home industry is technically efficient and the factors that influence technical efficiency are raw materials, salt, hours people work, age, number of family members while green onions, pertalite and gas fuel, education, business experience are not significant in the Kamang cracker home industry.

Keyword: *kamang crackers, stochastic frontier, technical efficiency.*

1. INTRODUCTION

West Sumatra has an economic structure dominated by the agricultural sector, one of which is Agam Regency. One of the agricultural product commodities that makes Agam Regency the largest after Lima Puluh Kota Regency is cassava (Badan Pusat Statistik Sumatera Barat, 2021). Cassava has high economic value so that it has the potential to be developed (Rahmi, 2014). This condition can be seen from the many new innovations developed by the food industry as a business field, one of which is processed crackers made from cassava. The crackers that are a typical food from Kamang Magek District, Agam Regency are Kamang crackers.

Kamang crackers are a regional specialty food in Kamang Magek District, Agam Regency. During the production process, the Kamang cracker home industry still uses traditional tools, the price of raw materials fluctuates, the price of fuel is increasing, the location of the purchase of auxiliary materials is far away, and the workers come from their own families. All of these factors affect the amount of production and technical efficiency of the Kamang cracker home industry. In everyday practice, manufacturers will only realize that technical efficiencies are visible when their perceived deficiencies result in measurable losses. In general, inefficiency that lasts for a long time is clearly detrimental, due to the waste of resources that are increasingly difficult to obtain (Tajerin, 2004).

The use of optimal production factors is expected to maximize the production of Kamang crackers. However, from the results of the initial survey in this research, the use of 100% cassava raw material on average only produces 40-50% of Kamang crackers which should have a standard yield of >50%. This loss is caused by reduced water content, the process of peeling sweet potatoes which is still manual, the packaging process which still requires cutting the edges of raw crackers. Meanwhile, the cassava variety used is yellow cassava with a chewier cassava texture than other

cassava. This causes the yield of raw material for Kamang crackers to suffer a lot of losses, so it becomes a benchmark for the extent to which production inputs can be used to produce optimal production so assessing technical efficiency becomes important. One way to measure technical efficiency is to use the Cobb-Douglasss stochastic frontier method, which is a method to determine the efficiency and combination of the use of several production factors, as well as analyzing whether the Kamang cracker production factors have been running efficiently with production. variable. factors as influencing factors (Thermolen et al, 2016).

Novelty in research is the object studied, research time and research location. The history of Kamang crackers has been produced since 1940 during the Belada Colonial period (Andini, 2017) but there has been no significant innovation so it is necessary to analyze the technical efficiency of the business. Based on this explanation, it is important to carry out research with the aim of 1) Analyzing the level of technical efficiency in Kamang cracker home industry in Kenagarian Kamang Hilir. 2) Find out what factors influence the level of technical efficiency in the Kamang cracker home industry in Kenagarian Kamang Hilir.

2. RESEARCH METHODS

The location of this research was chosen purposively, namely in Kenagarian Kamang Hilir, Kamang Magek District, Agam Regency. The research time was held on December 21, 2022 - January 21, 2023. The number of Kamang cracker *home industries* in Kamang Hilir Kenagarian totals 103 home industry which are the population in this study. The sample size was determined using the Slovin formula from Sugiyono (2016). There are 51 home industries that will be interviewed and used as sample in this study as respondents. The sample in this study used simple random sampling technique and this sampling was carried out by random sampling technique.

This study uses two types of data, namely primary data obtained through interviews using a questionnaire. Secondary data was obtained through literature study. Technical efficiency was analyzed using stochastic frontier. According to Yoko (2014), technical efficiency can be measured by applying frontier model production efficiency using Cobb-Douglass model. The frontier production function for Kamang cracker production is assumed in the Cobb-Douglass equation made in the following equation:

$$Y = \alpha + \beta_1 BB + \beta_2 BP_1 + \beta_3 BP_2 + \beta_4 BBK_1 + \beta_5 BBK_2 + \beta_6 TK + V_i - U_i \quad (1)$$

To relate production factors, the first equation is converted into logarithmic form (Ln) because it uses the Cobb-Douglass model.

$$LnY = \alpha + \beta_1 LnBB + \beta_2 LnBP_1 + \beta_3 LnBP_2 + \beta_4 LnBBK_1 + \beta_5 LnBBK_2 + \beta_6 LnTK + V_i - U \quad (2)$$

Description:

Y : Kamang cracker production
BB : Raw Material (Kg)
BP_1 : Scallion Auxiliary Materials (Kg)
BP_2 : Salt Auxiliary Material (Kg)
BBK_1 : Gas Fuel (Kg)
BBK_2 : Pertalite Fuel (Kg)
TK : Labor (JOK)
Vi : Error in Production
Vi : Error in Production
B : Estimatedvariable parameter
α : Intercept

The model used to estimate the factors that influence the sources that cause technical efficiency is done with the econometric model approach from Sugiyono (2010) as follows :

$$TE_i = \alpha_0 + \alpha_1 U_i + \alpha_2 LP_i + \alpha_3 PU_i + \alpha_4 JAK_i + \alpha_5 M_i + u_i \quad (3)$$

Description:

TEi		: Technical efficiency
U	(α1)	: Age (year)
LP	(α2)	: Years of Formal Education (years)
PU	(α3)	: Business Experience (years)
JAK	(α4)	: Number of Family Members (person)
M	(α5)	: Cracker size (cm)
Ui		: *Errorterm*

Both models of production factors and technical efficiency are analyzed at once with the one step method. The one step method is a method of analyzing variables of production factors and variables of technical efficiency factors simultaneously (Darmawan, 2016). Meanwhile, according to Wang (2002) Consider a stochastic frontier model with one-sided efficiency suppose that the scale u depends on several variables (characteristics of a business) or variables Zs called the "one step" model determines the stochastic frontier and the way u depends on z, and can be estimated in one step simultaneously. In this research, the size of Kamang crackers is one of the production factors that is estimated to influence time efficiency.

3. RESULTS AND DISCUSSION

Kamang crackers are prepared with two additional ingredients, leek and salt. According to Geivanni (2017) the processing process for Kamang crackers is as follows:

1) Preparation of raw cassava, leek and salt.
2) Peeling and cutting, cassava is peeled and cut into pieces then rinsed until clean.
3) Boil the cassava which has been cleaned and then boiled.
4) Pounded, cassava that has been put into the machine.
5) After grinding, the cassava that has been ground slightly is then separated from the fiber, then put into a grinding machine, and mixed with all the additional ingredients, namely leek and salt.
6) Printing, when printing the dough, print it using a milk can or you can also use a plastic cup.
7) Drying, the material that has been printed is then placed on the samia to be dried or dried.
8) The drying process is carried out traditionally by heating directly under sunlight.
9) Packaging, after the mixture is dry, the crackers are ready to be packaged.

The characteristics of Kamang Crackers Home Industry Business Actors in Kamang Hilir Kenagarian can be explained as follows.

Table 1. Characteristics of Kamang Crackers Home Industry Business

No.	Description	Number (person)	Percentage (%)	Average
1.	Age (Year)			
	a. < 15	-	-	48.72
	b. 15 – 64	49	96.08	
	c. > 64	2	3.92	
2.	Years of Formal Education (Years)			
	a. 0 – 5	3	5.88	
	b. 6 – 10	14	27.45	10.41
	c. 11 – 15	33	64.71	
	d. 16 – 20	1	1.96	
3.	Business Experience (Years)			
	a. < 10	11	21.57	
	b. 10 – 20	29	56.86	15.29
	c. > 20	11	21.57	
4.	Number of Family Members (people)			
	a. 1 – 5	45	88.23	4
	b. 6 – 10	6	11.77	

Source: processed primary data (2023)

The characteristics of the Kamang cracker home industry business actors studied in this study in the form of the age of business actors. The average age of business actors is 48.72 years. There are no Kamang cracker home industry business actors under the age of 15, because at that age they fall into the less productive category and have not been able to consistently carry out the Kamang cracker home industry business. Age that is still productive will affect the physical condition, and labor in carrying out work activities. The higher the age of the business actors, the less efficient they are in running their farms, because the older the age, the work ability and technical ability will decrease and have a negative impact on technical efficiency (Maryanto et al, 2018). The results of this study are in line with the research obtained by Andini (2017) where the majority of kamang crackers business actors in Kamang Hilir Kenagarian have a productive age with a percentage (90%) of the total business actors.

The education of most Kamang cracker home industry business actors is at the level of 11 - 15 years as many as 33 people (64.71%) with an average of 10.41 which means high school level The average education of all business actors is 10.41 or the equivalent of the second grade of high school, however, it can be assumed that the education of Kamang cracker home industry business actors graduated from formal education at the junior high school level. The level of education is not significant or has no effect on the Kamang cracker home industry business. The results of this study are different from the research obtained by Primalasari et al (2019) where a high level of education will have a positive impact on the ability of smoked skipjack fish craftsmen to run their business.

The business experience of business actors in making Kamang crackers is ranging from 10 to 20 years as many as 29 people (56.86%). The results of the study are in line with the research obtained by Triana et al (2017) where the majority of Kamang crackers business actors in Kamang Magek District have business experience ranging from 10-20 years (58%) of the total respondents with an average business experience of 15.29 years. Experience is the most important capital in a business. The longer a business person has experience in the Kamang cracker business, the higher the knowledge and technical skills in making Kamang crackers which will later influence the technical success of the business.

The number of family members of each business actor mostly ranged from 1 to 5 people / family as many as 45 people (88.23%) with an average family size of 4 people. The results of this study are the same as those obtained by Andini (2017) where the average number of family members of kamang crackers business actors in Kamang Hilir Kenagarian is 1 to 3 people (75%) of the total respondents. According to Ukpong and Idiong (2013), the number of family members will significantly affect technical efficiency.

Technical Efficiency Level of Kamang Crackers Home Industry in Kamang Hilir Kenagarian Technical efficiency is defined by being able to systematically calculate deviations or measurements in the quantity of inputs used and the quantity of outputs produced by an industry (Lamusa, 2009). Based on the output results of the Frontier 4.1c software, it was found that the estimation results of the technical efficiency level of the Kamang cracker home industry in Kamang Hilir Kenagarian used 51 business respondents.

The level of technical efficiency of the frontier production function in the Kamang cracker home industry from each respondent of the Kamang cracker home industry business actors can be categorized, so that the lowest efficiency level to the highest efficiency level achieved by each Kamang cracker home industry business actor can be known. In accordance with the opinion of (Coelli, 1998), that estimating efficiency using the frontier production function allows the level of efficiency that has been achieved by each individual business actor in the Kamang cracker home industry to be known.

Information about the estimation results of Frontier 4.1c software obtained from the Maximum Likelihood Estimation (MLE) of the distribution of the level of efficiency achieved by the Kamang cracker home industry *is* presented in graphical form in Figure:

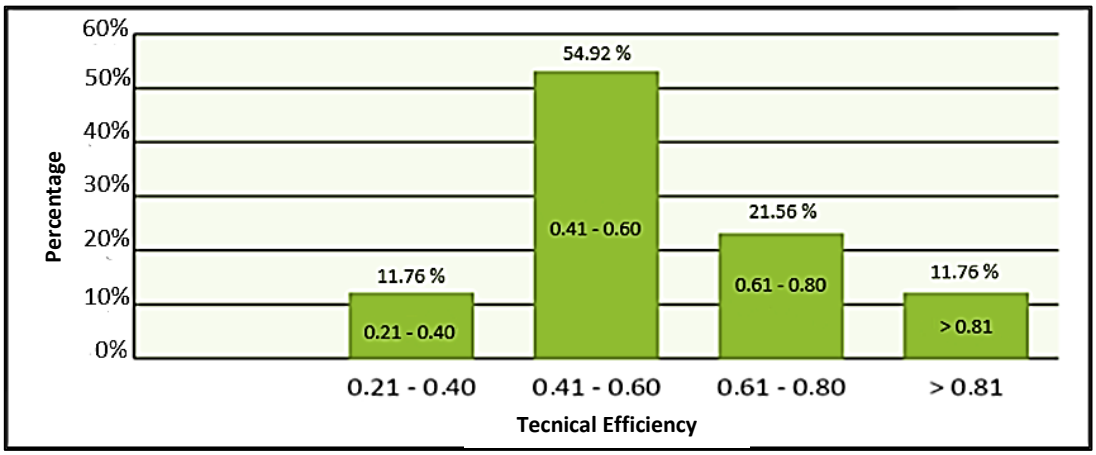

Figure 1. Technical Efficiency Level

Based on the figure above, the level of efficiency that can be achieved by respondents in the research area ranges from 0.21 - 0.99 with the highest proportion in the category of efficiency level > 0.41 - 0.60 with a percentage of 54.92% as many as 27 business people. The average technical efficiency level is 0.5792. This proves that the hypothesis in this study, namely the efficiency level of the Kamang cracker home industry *is* efficient, has been proven correct. So it can be concluded that the Kamang cracker home industry *is* technically efficient. However, in this case, the Kamang cracker home industry which produces crackers with an average of 465 kg / month has a potential production of an average of 802.83 kg / month with a proportion of 83.25% with a difference of 25.25% increase. The results of this study are in line with the results of research obtained (Primalasari et al., 2019) on the Smoked Skipjack Fish business which has an average technical efficiency level of 96.17% which is very technically efficient.

3.1 Factors Affecting the Level of Technical Efficiency

The Kamang cracker production process has several production inputs including: raw materials cassava, supporting materials consisting of: salt and green onions, fuel consisting of gas and pertalite, and worker's jam. There are several production factors that influence the production of Kamang crackers, including: age, education, experience, number of family members and management. The estimation results can be explained in the following table.

Table 2. Technical Efficiency Estimation Results

No	Variables	Parameters	Coefficient	Standard Error	T-count
1	Kostanta	(β0)	5.555	0.262	21,.149***
2	Raw material requirements (X1)	(β1)	-0.000	0.000	-10.561***
3	Salt (X2)	(β2)	0.202	0.085	2.375**
4	Leek (X3)	(β3)	0.000	0.000	0.604 ns
5	Gas Fuel (X4)	(β4)	0.926	0.133	0.691 ns
6	Pertalite (X5)	(β5)	0.000	0.000	0.015 ns
7	Working hours/month (X6)	(β5)	0.502	0.155	3.229***
8	Age (Y1)	(Δ1)	-0.000	0.000	-4.303***
9	Education (Y2)	(Δ2)	-0.152	0.096	-1.590 ns
10	Business experience (Y3)	(Δ3)	-0.000	0.000	-0.581 ns
11	Number of Member K (Y4)	(Δ4)	-0.294	0.104	-2.819***
12	Management (Y5)	(Δ5)	-0.000	-0.000	-2.624**
	log likelihood function OLS= -1.9247				
	log likelihood function MLE = 0.1668				

Source: processed primary data (2023)

Table = 1% = 2.70,
5% = 2,02,
10% = 1,68

Notes: *** = significant at α = 1% * = significant at α = 1%
** = significant at α = 5%
ns = non-significant

The following is an explanation of the level of technical efficiency in the Kamang cracker home industry in Kamang Hilir Kenagarian:

3.2 Raw Materials

The level of technical efficiency of the raw material variable, from the processed frontier results, shows that the use of cassava raw materials has a level of technical efficiency at the 99% confidence level or at a significant α 1% on the Kamang cracker home industry business with a negative coefficient (-). This shows that the addition of raw material inputs has a maximum limit used in the Kamang cracker production process. If the addition of raw materials exceeds the maximum limit, it will cause a decrease in efficiency. This is different from the research obtained by (Primalasari et al., 2019) if there is an increase in raw materials, it will increase the production output of smoked skipjack fish business. This is different from the research obtained by Susanto, et al (2014) that raw materials are the main component so that if there is no supply of raw materials, it will interfere with the production process.

3.3 Auxiliary Materials

The technical efficiency level of the auxiliary material variable consists of 2 materials, namely salt auxiliary materials and leek auxiliary materials. The amount of use of salt auxiliary materials has a level of technical efficiency at a confidence level of 95% or at a significant α 5% with a positive coefficient (+). This means that if there is an addition of a certain amount of salt, it will increase the technical efficiency of the Kamang cracker home industry. Meanwhile, the use of leek auxiliary materials has a non-significant technical efficiency level for the Kamang cracker home industry. This shows that the addition of leek auxiliary materials will not increase the efficiency of the Kamang cracker home industry. The leek variable is in line with the research obtained by (Primalasari et al., 2019) on the use of woka leaves as an auxiliary material, if there is an addition of leek auxiliary materials, it will not increase the production output of smoked skipjack fish business.

3.4 Fuel

The technical efficiency level of fuel consists of 2 materials, namely gas fuel and pertalite fuel. The processed frontier results show that the use of gas fuel has a non-significant efficiency level for the Kamang cracker *home industry* business with an estimation result of 0.691. This shows that if there is an increase in gas fuel or will not increase the efficiency of the Kamang cracker home industry business. This shows that the gas variable is in line with the research obtained by (Primalasari et al., 2019) on fuel use, if there is an increase in fuel, it will not increase the production output of smoked skipjack fish business.

The use of pertalite has a non-significant technical efficiency level for the Kamang cracker home industry with an estimation result of 0.015. This shows that if there is an addition of pertalite material, it will not increase the efficiency of the Kamang cracker home industry business. This shows that the gas variable and the pertalite variable are in line with the research obtained by (Primalasari et al., 2019) on the use of fuel, if there is an increase in fuel, it will not increase the production output of smoked skipjack fish business.

3.5 Working Hours

Man-hours for each month have a significant effect on the technical efficiency of Kamang crackers, with an efficiency analysis value of 3.229, which means that Thit is higher than Ttab, so the variable of man-hours has a significant effect on the amount of Kamang cracker production. The more labor used, the less time it takes to produce Kamang crackers per production period or the longer the production time, the more Kamang crackers can be produced. The results of the research on the number of people working are closely related to working hours which are not in line or different from the results of the research obtained by Primalasari, et al (2019) that labor as an auxiliary material has no effect on increasing the production output of smoked skipjack fish business. Based on field phenomena, the labor that is widely used comes from their own families, such as the children of business actors who help the Kamang cracker production process after school to streamline time.

3.6 Age

Age has a significant effect on the level of technical efficiency of the Kamang cracker home industry at a significant level of 1% with a value of -4.303, which means that Thit is higher than Ttab, so the variable hours of work has a significant effect on the amount of Kamang cracker production, because age affects a person's maximum ability to work at a certain age and will decrease skills at a certain age because the older a person is, the less energy in carrying out an activity in the production of the Kamang cracker production process. The results of this study are in line with the results of research obtained by Sukiyono and Romdhon (2016) that the age variable has a real influence on the capture fisheries industry in Bengkulu Province. Tinaprilla (2013) stated that the older a person's age will cause efficiency to be low.

3.7 Education

Education has an insignificant influence on the efficiency level of the Kamang cracker home industry. Education has an analysis value of -1.590, which means that Thit is lower than Ttab, so the

education variable has no real effect on the technical efficiency of Kamang crackers. This is because the level of education of business actors in the research location does not affect their ability to produce Kamang crackers. The results of this study are in line with Sukiyono and Romdhon (2016) that the education variable has no real influence on the capture fisheries industry in Bengkulu Province. In line with Tinaprilla's research (2013), it states that education has no real effect on efficiency. Education has a non-significant level of efficiency with a negative coefficient (-) on the Kamang cracker home industry business. This shows that the education of Kamang crackers home industry business actors if there is an increase in the level of education will not increase the efficiency of the Kamang crackers home industry business.

3.8 Business experience

The technical efficiency level category of the business experience variable, the processed frontier results show that business experience has a non-significant technical efficiency level for the Kamang cracker home industry business. Experience has an analysis value of -0.581, meaning that Thit is lower than Ttab, so the business experience variable does not significantly affect the technical efficiency of Kamang crackers. This shows that the business experience of the Kamang cracker home industry business actors if there is an increase in the length of business experience will not increase the efficiency of the Kamang cracker home industry business. The business experience of the Kamang cracker home industry business actors is long enough but does not have an impact on the level of efficiency because the work done from time to time is the same. The results of this study are the same as the results of the research obtained by Primalasari et al., (2019) that business experience has no effect on increasing the production output of smoked skipjack fish businesses. While the results of this study are not in line with the research obtained by Sukiyono and Romdhon (2016) that the skipper's experience should improve his ability to manage fishing vessels, which in turn will increase technical efficiency.

3.9 Number of Family Members

The number of family members has a significant effect at 1% alpha with an analysis value of -2.819 which means that Thit is higher than Ttab, so the number of family members has a real effect on the technical efficiency of Kamang crackers. This is because the average number of family members obtained at the research location is 3-4 people. This is different from the research obtained by Primalasari et al., (2019) which states that the more the number of family members of smoked skipjack fish craftsmen, the higher the level of technical efficiency. Because the more the number of family members the more labor can be involved in processing smoked skipjack fish. Penambahan jumlah anggota keluarga memiliki batas maksimal dalam proses produksi kerupuk Kamang. If the addition of family members exceeds the maximum limit, it will cause a decrease in efficiency. This means that the number of family members of Kamang cracker home industry business actors in a certain amount has an impact on the decision making of business actors

3.10 Management

The technical efficiency level of management variables. Management has a significant level of efficiency at 5% alpha with a value of 2.624, which means that Thit is higher than Ttab, so the management variable has a real effect on the technical efficiency of Kamang crackers. Management in the production process of Kamang crackers is the proportion of cracker sizes measuring 8 cm and 15 cm. This will certainly affect the time efficiency in the production process of Kamang crackers. If home industry businesses produce 8 cm Kamang crackers, the process will take quite a long time because the process of transferring Kamang crackers that have been printed to samia by manual process, namely moving one by one Kamang crackers that have been printed. If home industry businesses produce 15 cm Kamang crackers, it will be more time efficient.

4. CONCLUSIONS AND SUGGESTIONS

Based on the research results above, it can be concluded that the technical efficiency level of the Kamang cracker home industry ranges between 21% - 99% with an average technical efficiency level of 57.92%. This level shows that the Kamang cracker home industry is technically efficient but still needs to be increased by 83.25%. With an increase difference of 25.25%, it still needs to be improved further and the factors that influence technical efficiency in the Kamang cracker home industry are raw materials, salt supporting materials, labor, age, number of family members and management. Where the T-table value is greater than T-count so that this factor has a real influence on the technical efficiency of the Kamang cracker home industry. Meanwhile, the variables of supporting materials in the form of spring onions, fuel such as gas and pertalite, education and business experience do not have a significant effect on the Kamang cracker home industry.

Suggestions that researchers can give after conducting research as consideration for overcoming this problem are to increase technical efficiency in the Kamang cracker home industry, technology is needed in peeling cassava so that the contents of the cassava are not wasted in the peeling process, and improving the method of moving Kamang crackers to the drying place (samia). to be of better quality. In the packaging process, there are no Kamang crackers that need to be cut so they are the same size. The government should organize a cassava planting program by utilizing empty land to overcome the scarcity of raw materials.

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Assessing the Quality of Organic Fertilizer Products Made from Cow Dung in Wonogiri Regency, Indonesia

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Abstract

Kebonagung Sub-district, Sidoharjo District, Wonogiri Regency is the Wonoagung Wonogiri Organic Farming Association (PPOWW) location. Mitra is an organization engaged in organic rice and cattle cultivation. The conversion of bovine dung into organic fertilizer, particularly liquid fertilizer containing biological agents, is one of the waste elimination strategies employed to prevent environmental contamination. The nutrient content of organic fertilizer material sources varies. Organic fertilizer of high quality conforms to the Standard for Organic Fertilizers established by the Ministry of Agriculture of the Republic of Indonesia. Only some producers are aware of the standard quality requirements for organic fertilizer. It is necessary to analyze the nutrient content of organic fertilizer products to determine whether the quality of organic fertilizer is excellent. A preliminary survey of partner conditions, preparation of materials (organic fertilizer), and analysis of fertilizer content are among the activities performed. The C/N ratio of organic fertilizer is 8.41, and its pH is 7.6. The analysis results indicate that the Wonoagung Wonogiri Organic Agriculture Association's organic fertilizer products meet the liquid organic fertilizer quality standards. This condition demonstrates that the raw materials used in organic fertilizer production are of high quality and that the appropriate procedures have been followed. Adding biological agents to the production of organic fertilizer can enhance the quality of the finished product.

Keywords: *biological agency, organic matter, quality control, quality of fertilizer*

1. INTRODUCTION

The Wonoagung Wonogiri Organic Farming Association (PPOWW) is located in Kebonagung Hamlet, Kebonagung Village, Sidoharjo District, Wonogiri Regency, where it engages in organic farming and cultivates rice, dragon fruit, pineapple, and pepper. In addition to maintaining a livestock farm, cow dung has not been optimally utilized. Using cow dung residue optimally can lead to environmental pollution (Iwuozor et al., 2022). Creating organic fertilizer from bovine dung is one way to reduce environmental pollution (Tallou et al., 2020). Produced by the PPOWW, sufficient dung can minimize production expenses. The availability of adequate dung will facilitate the cultivation of PPOWW-developed products. Mujiyo et al. (2018) cite efforts to produce organic fertilizer as a component of livestock-plant integration in the context of community empowerment through enterprises in the agricultural sector.

Utilizing cow dung to produce organic fertilizer is a concrete example of implementing waste elimination in cattle farming (Malolan et al., 2021). Using cow dung as a constituent in making organic fertilizer with biological agents will yield organic fertilizer of comparable quality to that obtained from commercial sources (Romadhon et al., 2023). However, Dewi et al. (2023) state that most producers disregard standard guidelines for the quality of organic fertilizer. Analyzing the nutrient content of organic fertilizer products as part of the quality control process (Mujiyo et al., 2022) is necessary to determine whether the quality of organic fertilizer meets industry standards (Dewi et al., 2023). Organic fertilizers containing acceptable biological agents will enhance soil quality and promote soil productivity (Dewi et al., 2022).

The nutrient content of organic fertilizer products can be used to evaluate their quality (Herawati et al., 2021). The nutrient content is determined through laboratory analysis. The analysis procedure refers to Eviati and Sulaeman's (2009) method, include the parameters are water content, total nitrogen (N Total), phosphorus (P), potassium, carbon (C), carbon per nitrogen ratio (C/N ratio), and pH. The results of the organic fertilizer analysis are compared to the organic fertilizer standards established by the Indonesian Ministry of Agriculture (2011). The physical composition of organic fertilizer is related to its water content. Organic (solid) fertilizer with a high water content will solidify the substance (Istiqomah et al., 2023). High water content impacts the availability of soil nutrients and oxygen to the soil (Romadhon and Aziz, 2022). Especially for those beneficial microorganisms in organic fertilizer (Dewi et al., 2023).

Nitrogen, phosphorus, and potassium are essential macroelements that influence soil fertility and plant growth, so their availability must be considered (Sanyal et al., 2015). Concerning the ability to introduce nutrients to the soil, it is crucial to know the C/N ratio. The ratio of carbon to nitrogen in fertilizer affects the rate of decomposition and mineralization of organic matter (Mujiyo et al., 2017). A low C/N ratio indicates that organic fertilizer decomposes into plant-available nutrients more rapidly (Liu et al., 2018). A C/N ratio below 20 will accelerate the decomposition of organic fertilizer (Truong and Marschner, 2018), making nutrients more readily available. The degree of acidity (pH) of the constituents is another crucial factor. The rate at which organic fertilizer decomposes is affected by pH. The degree of acidity (pH) will impact the activity of microorganisms during the decomposition process and the mineralization of nutrient content in organic fertilizer. The pH influences nutrient solubility (Mujiyo et al., 2021).

Organically grown agricultural products typically have higher prices because they are grown without chemical fertilizers and pesticides (Irianto et al., 2023). Standard-compliant bio-based organic fertilizer will increase soil quality, boost soil productivity, and enhance the quality of agricultural products (Kurniawan et al., 2023). Improving quality will also increase the competitiveness of agricultural products on the market, enabling farmers' income (Abate and Yohannes, 2021).

With increasing knowledge, it is anticipated that farmers will be able to independently perform quality control of organic fertilizer products to preserve fertilizer quality, soil quality, and agricultural product quality. This partnership will aid producers in accessing information regarding organic fertilizer quality testing. Through this endeavor, it is anticipated that partners will be able to produce high-quality fertilizer that adheres to industry standards.

Testing the quality of organic fertilizer needs to be carried out to analyze the levels of nutrients in organic fertilizer by the standard organic fertilizer standards of the Indonesian Ministry of Agriculture (2011). With increased knowledge, farmers can independently control the quality of organic fertilizer products to maintain fertilizer, soil, and agricultural product quality (Yu et al., 2023). It is hoped that quality organic fertilizer can improve soil quality to support sustainable agriculture (Brempong and Addo-Danso, 2022). The PPOWW partners' organic fertilizer quality analysis results can be used to evaluate the organic fertilizer produced. Partners can make fertilizer by local standards and land characteristics in the long term. The advantage of PPOWW partners is that they can have their organic fertilizer with high quality and by regional land characteristics so that the results obtained are optimal.

2. MATERIAL AND METHODS

Research activities were carried out in February – September 2023. Organic fertilizer production was done in Kebonagung Sub-district, Sidoharjo District, Wonogiri Regency, the PPOWW location. Organic fertilizer content was analyzed at the Soil Science Study Program Laboratory, Faculty of Agriculture, Universitas Sebelas Maret. This research is a descriptive laboratory research based on assessing the quality of nutrients in fertilizer base on organic materials, which use cow dung. This research was carried out by assisting PPOWW-assisted farmers in processing cow dung into organic fertilizer. This product will be in the form of organic fertilizer, which can meet the minimum technical requirements based on the Decree of the Minister of Agriculture of the Republic of Indonesia (RI) Number 261/KPTS/SR.310/M/4/2019. Details of research activities are listed in Fig 1. The stages of this research consist of: (1) Pre-Survey; (2) Survey; (3) Post Survey. Pre-survey is the initial survey, namely conducting visits to farmer group partners and coordinating cooperation regarding sampling times and

locations. The survey stage is taking fertilizer samples, and the post-survey is carrying out sample preparation and analysis of fertilizer samples in a chemical laboratory.

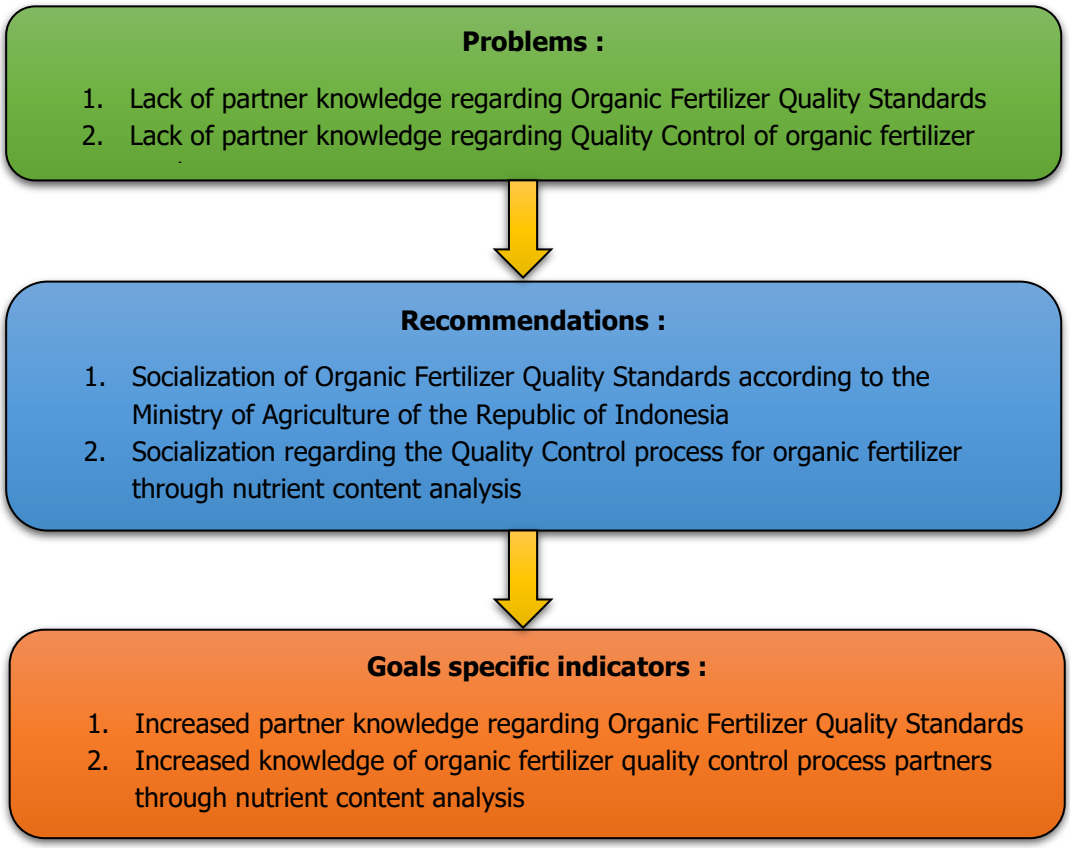

Figure 1. Flowchart of problems faced by partners and recommended solutions

2.1 The Initial Survey

The initial survey was done to determine partner knowledge, environmental conditions, and licensing processes. The initial coordination aims to explain the main objective of the Quality Control of Organic Fertilizer Products service activities. This activity also describes the actions of partners and determines their implementation schedule. PPOWW partners make organic fertilizer using cow manure as the main ingredient mixed with organic materials in the local area, such as banana fronds, coconut fronds, dry leaves, and fruit remains. The percentage of organic materials used needs to be measured precisely and consistently because, so far, they use locally available organic materials.

(a) (b)

Figure 2. Organic paddy field owned by PPOWW

2.2 Survey Preparation

The materials tested are solid and liquid organic fertilizers produced by partners. Sufficient solid organic fertilizer is taken (sampled) to analyze its nutrient content. The samples taken consisted of 3 replications representing all organic fertilizer products. The sample tested was liquid organic fertilizer produced by partners. Sample collection was carried out at the PPOWW Partner organic fertilizer production house, totaling three samples representing all organic fertilizer products.

Figure 3. PPOWW's cattle farm

2.3 Laboratory Analysis to Determine The Quality of Organic Fertilizer

The analysis procedure refers to the procedure from Eviati and Sulaeman (2009) with analysis parameters of total N, P_2O_5, K_2O, Organic-C, C/N ratio, and pH. The results of the organic fertilizer analysis are then assessed using the standard standards for organic fertilizer by the Indonesian Ministry of Agriculture (2011) and the Decree of the Minister of Agriculture of the Republic of Indonesia (RI) Number 261/KPTS/SR.310/M/4/2019 (Table 1).

Table 1. Standard Standards for Solid and Liquid Organic Fertilizers

Parameters	Methods	Standards	
		Solid	Liquid
N total (%)	Kjeldhal	N total + P2O5 + K2O 4% minimum	N total + P2O5 + K2O 2-6 %
P_2O_5 (%)	Extraction HNO_3 and $HClO_4$	N total + P2O5 + K2O 4% minimum	N total + P2O5 + K2O 2-6 %
K_2O (%)	Extraction HNO_3 and $HClO_4$	N total + P2O5 + K2O 4% minimum	N total + P2O5 + K2O 2-6 %
C-organik (%)	Walkley and Black	15% minimum	6% minimum
C/N ratio	Comparison	15 – 25	-
pH	Electrode glass	4 – 9	4 – 9

Source: Indonesian Ministry of Agriculture (2011) and Indonesian Ministry of Agriculture (2019)

The analysis results of liquid organic fertilizer samples were adjusted to the liquid organic fertilizer standard table based on the Minister of Agriculture's regulations (Table 1). The main elements analyzed are total N, P_2O_5, K_2O, Organic-C, C/N ratio, and pH. Features that meet the standards have a range of values in Table 1. If the laboratory analysis results are still below the average, evaluation, and improvements, need to be carried out to increase compliance with the standards.

3. RESULTS AND DISCUSSION

Organic farming is a potential alternative production system where organic fertilizer guarantees safe agricultural production without harming humans, land, and the environment because of its organic content (Gamage et al., 2023). Organic fertilizer is an essential element in developing organic and sustainable agriculture. Organic fertilizer protects soil health, increases nutrient content, and encourages the activity of soil microorganisms. Organic fertilizer can also improve soil structure and increase soil fertility and water-holding capacity (Yang et al., 2023). Applying organic fertilizer as a soil amendment can restore soil fertility and reduce the use of chemical fertilizers and pesticides to create more efficient agricultural practices (Garbowski et al., 2023).

The PPOWW is a community of several farmer groups engaged in organic farming. The commodities produced consist of organic rice (Fig 2). The supply of organic fertilizer is obtained from cattle farms managed by PPOWW (Fig 3). Mitra has implemented livestock-crop integration through businesses in the agricultural sector. The service activity aims to provide information regarding standard organic fertilizer standards so that the fertilizer quality is maintained to produce better agricultural products.

According to Indonesia Ministry of Agriculture Regulation, number *70/Permentan/SR.140/10/2011* concerning Organic Fertilizers, Biological Fertilizers, and Soil Improvers, organic fertilizers produced and distributed for agricultural activities must meet standard standards. Standard standards or quality standards are the parameters set by the National Standardization Agency in the form of SNI or set by the Indonesian Ministry of Agriculture in the form of Minimum Technical Requirements (Indonesian Ministry of Agriculture, 2011). Standard organic fertilizer standard means the composition and content of organic fertilizer determined by the National Standardization Agency in the form of SNI or the Indonesian Ministry of Agriculture in the form of Minimum Technical Requirements (Indonesian Ministry of Agriculture, 2011).

The PPOWW has partner farmers who manage organic rice fields in several sub-districts in the Wonogiri Regency. Most of these farmers have cattle whose manure has not been utilized optimally. PPOWW and the Research Group are jointly assisting partner farmers in Jatipurno District in processing cow dung into organic fertilizer in both solid and liquid form to meet the minimum technical requirements based on Decree of the Minister of Agriculture of the Republic of Indonesia number *261/KPTS/SR.310/M/4/ 2019* (Indonesian Ministry of Agriculture, 2019). This research activity evaluates the quality of liquid organic fertilizer by analyzing samples in the Soil Science Study Program, Faculty of Agriculture, UNS laboratory. The analysis showed that the organic C content parameters were 22.46%, total N 2.67%, P2O5 1.34%, K2O 1.86%, and pH 7.6. All parameters meet the quality standard requirements for liquid organic fertilizer. The recommendation to ensure that the quality of liquid

organic fertilizer is maintained is by adding fermented solutions of organic materials rich in P and K, such as household waste in the form of leftover vegetables and fruit. Another effort that can be made is by adding an inoculum of P-fixing microbialsuch as bacteria (genus Pseudomonas, Bacillus, and Escherichia) and fungi (genus Aspergillus, Penicillium, and Humicola). Inoculating phosphate solubilizing bacteria as a biological agent into organic fertilizer has been proven to reduce the use of chemical fertilizers and provides the advantages of economic strategies related to agricultural production activities (Bargaz et al., 2021; Zeng et al., 2022). The mechanism of the usefulness of phosphate solubilizing bacteria and their incubation in organic fertilizer was explained in general, as mentioned in Fig 4.

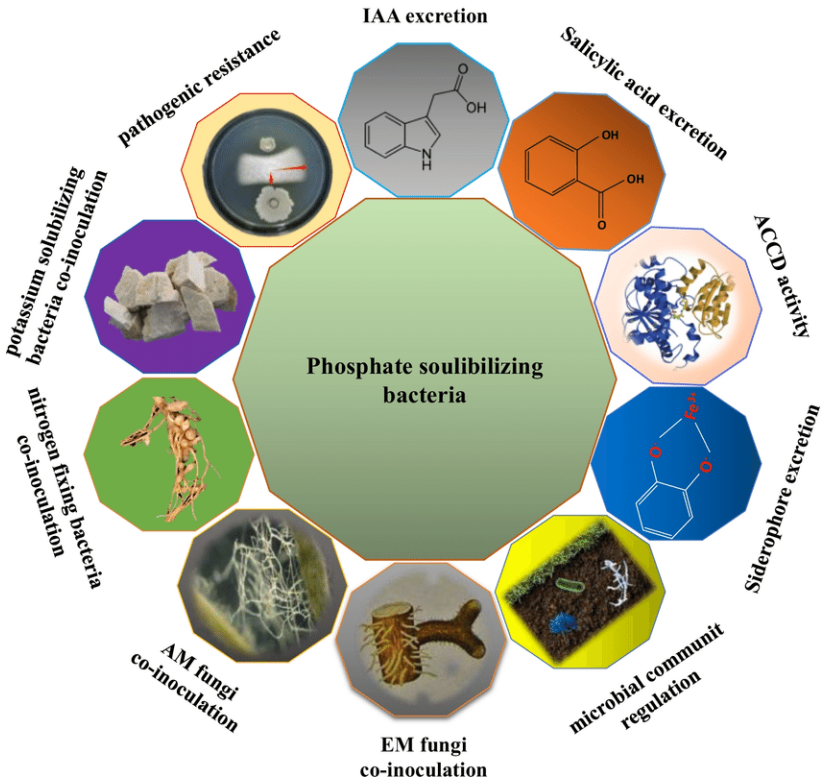

Figure 4. Phosphate solubilizing bacteria and their incubation mechanisms in organic fertilizer (Zeng et al., 2022)

The total N + P2O5 + K2O content of liquid organic fertilizer is 5.87%, which meets the standards. Organic fertilizers from cow dung contain large amounts of nitrogen, phosphorus, and potassium (Chen et al., 2023). Nitrogen, phosphorus, and potassium are essential macronutrients that many plants need. Fertilizers that contain high levels of macronutrients can provide sufficient nutrients for plant growth. The Organic-C content in organic fertilizer is 22.46%, which meets standards. Fertilizer provides carbon and other nutrients for plants. Organic material from manure forms a stable humus fraction through humification and is responsible for the nutrient cycle in the soil (Guo et al., 2022). Animal waste steadily releases macro and micronutrients into the soil during the growing period (Kabasiita et al., 2022). Manure can balance soil organic carbon (Yan et al., 2022). Soil organic carbon can balance nutrient availability, increase soil aeration, increase water infiltration rate, and the soil's ability to store water (Bhattacharyya et al., 2022). Soil organic carbon is essential in improving soil health and sustainability in agriculture (Pambayun et al., 2023).

The C/N ratio in solid organic fertilizer is 8.41, which meets the standards (Table 2). The C/N ratio is related to the decomposition and mineralization process, where the lower the value, the faster the decomposition process of fertilizer into nutrients in the soil. The initial C/N ratio in cow manure is relatively higher, reflecting the cellulose-rich material. The C/N ratio then gradually decreases during composting, indicating a decomposition process (He et al., 2023). A C/N ratio lower than 25 indicates that the compost is mature (Chan et al., 2016). Environmental factors such as C/N ratio, temperature,

humidity, and pH change during the composting process can influence microbes' community and metabolic activity (Wang et al., 2018). C/N ratio and pH also impact microbial community dynamics (Yu et al., 2015, Wang et al., 2015).

Table 2. Liquid organic fertilizer content

Analysis	Result	Annotation
Total N (%)	2.67	Meet the quality aspects of fertilizer
P_2O_5 (%)	1.34	Meet the quality aspects of fertilizer
K_2O (%)	1.86	Meet the quality aspects of fertilizer
Organic C (%)	22.46	Meet the quality aspects of fertilizer
Organic matter (%)	38.72	Meet the quality aspects of fertilizer
C/N ratio	8.41	Meet the quality aspects of fertilizer
pH	7.6	Meet the quality aspects of fertilizer

The pH value of solid organic fertilizer is 7.6, which meets the standards. The pH value will increase during the composting process related to increasing temperature and decomposition of nitrogen-containing organic materials by microorganisms, which produce large amounts of ammonium-nitrogen to raise the pH level (Yang et al., 2019). The final pH value of compost is widely used to evaluate the quality of compost products because it affects soil pH and nutrient bioavailability for plants (Wang et al., 2015). The research results have been conveyed to stakeholders and farmers around the partner areas. Description of the fertilizer quality analysis results is also conveyed directly to organic fertilizer producers as a PPOWW's.

4. CONCLUSIONS

The organic fertilizer products produced by the Wonoagung Wonogiri Organic Agriculture Association meet the standard as well as standards for organic fertilizer by Ministry of Agriculture. The chemical properties of this organic fertilizer derived from cow dung are classified as good, including neutral pH, total N + P2O5 + K2O 5.87 %, C organic is 22.46%, organic matter 38.72%, and C/N ratio 8.41%. The raw materials for cow dung are of good quality, and the manufacturing process is good, creating liquid organic fertilizer products of good quality and meeting standards. The use of biological agents helps to improve the quality of organic fertilizer. The findings of our research have been given to farmer groups and local stakeholder partners so that the production process of organic fertilizer can be evaluated and improved in the future. Farmers and stakeholders embrace this type of collaborative study and hope that it will be sustainable. An assessment of the fertility and quality of soil on land, given organic fertilizer, needs to be carried out to determine the effect of fertilizer on the production of cultivated plants.

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Eco-Innovation for Sustainability in Traditional Herbal (Jamu) Agroindustry: OGSM-Gap Analysis Based on Employee Perception

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Abstract

This research is motivated by the importance of eco-innovation in traditional herbal medicine agroindustry by using local ethnobotanical raw materials to support sustainability and answer increasingly stringent market demands. This research aims to identify gaps between objectives, goals, strategies, and performance measurements related to eco-innovation in the traditional herbal medicine agroindustry based on employee perceptions. The data analysis method used is the OGSM-Gaps model, which collects data through questionnaires distributed to traditional herbal medicine agroindustry employees at the research location, namely Solo Raya. The research population was employees of the traditional herbal medicine agroindustry. This research uses a basic case study method. The research sample was taken using a simple random sampling method of 100 respondents. The research results highlight the need for improvement in several aspects of the organization. First, organizations need to focus on providing education and training for salespeople or store staff so that they can provide accurate information about traditional herbal medicine products. Second, increasing the promotion and branding of traditional herbal medicine products is needed to broaden public understanding. Furthermore, increasing the competitiveness of traditional herbal medicine products in the market is a priority, with an emphasis on market research and product innovation. Finally, operational efficiency needs to be improved through operational audits, adopting more efficient technology, and the involvement of employees in these improvement efforts. These improvement efforts will support the organization in achieving sustainability goals and sustainable business growth.

Keywords: *agroindustry, eco-innovation, gap analysis, OGSM analysis, sustainability*

1. INTRODUCTION

The production of traditional herbal medicine by agroindustry in the Solo Raya area faces serious problems threatening its sustainability. The POM Agency recorded only 62 standard herbal medicines and 24 phytopharmacies in Indonesia, which is still far from the great potential of herbal research results in this country (Herma, 2020). First, the lack of innovation in developing traditional herbal medicine products makes it difficult for this industry to compete with modern products. Second, the lack of standardization in production creates product quality and safety uncertainty. Third, the lack of competitiveness makes it difficult for traditional herbal medicine producers to market their products widely, especially in the face of competition from pharmaceutical products. Fourth, the lack of knowledge and empowerment for business actors in this sector limits the potential for developing the traditional herbal medicine industry. Fifth, lacking adequate and targeted marketing hinders more comprehensive market access. Lastly, the minimal use of eco-friendly raw materials is an obstacle to efforts to maintain the sustainability of the surrounding environment, which is essential in a sustainable context.

The sustainability problem of traditional herbal medicine production, especially in Solo Raya, is related to the lack of eco-friendly raw materials, which can harm the surrounding environment and damage the business reputation. In this context, according to research by Barbieri and Santos in 2020, the technical aspect states that there needs to be eco-innovation in production that prioritizes

environmental sustainability by using raw materials that are more friendly to nature (Najib et al., 2022). From an economic aspect, maintaining food safety for consumers by adopting more eco-friendly production practices (Nam, 2020) for the social aspect of traditional herbal medicine agroindustry can not only maintain natural sustainability but also improve the positive image of their business in the eyes of consumers who are increasingly concerned about environmental issues (Sadiq et al., 2021). In the environmental aspect, by adopting eco-innovation, traditional herbal medicine agroindustry can reduce their environmental footprint (Chin et al., 2022), minimize adverse impacts, and at the same time, create opportunities to increase their competitiveness and business reputation in an era where sustainability is a significant concern for both consumers and other interested parties (Bhardwaj et al., 2023).

Although traditional herbal agroindustry offers various benefits in the context of sustainability, significant challenges and obstacles remain. Therefore, ecological innovation (eco-innovation) is needed to optimize resource management, minimize environmental impacts, and improve production efficiency in this business (Cherifi et al., 2019). This article attempts to raise the critical topic of eco-innovation in the traditional herbal agroindustry. It explores a gap analysis approach using the Objective, Goals, Strategies, and Measures (OGSM) framework to achieve sustainability in this sector (Z. Chen et al., 2023; Herkenrath et al., 2022). Paryontri et al. (2022) research emphasizes enhancing expertise and capabilities among players in the herbal medicine industry, focusing on refining product processing, packaging, and marketing strategies.

This research aims to introduce the critical context of the traditional herbal agroindustry, highlight the problems and opportunities facing this sector, and explain why eco-innovation is the main focus of this research. The novelty of the research lies in its unique focus on "eco-innovation for sustainability" within the realm of traditional herbal (jamu) agroindustry. Incorporating OGSM-Gap Analysis, specifically based on employee perceptions, adds a distinct dimension by offering a comprehensive understanding of how eco-innovation strategies are perceived and implemented within this industry, contributing valuable insights for sustainable practices and growth. We will also introduce the OGSM framework as an analytical tool used in this research to identify and fill gaps in sustainability efforts. Thus, this manuscript aims to provide deeper insight into how eco-innovation can play a crucial role in supporting the sustainability of traditional herbal agroindustry.

2. MATERIAL AND METHODS

2.1 Basic Research Methods

This research uses a basic case study method to deepen understanding of employee perceptions regarding eco-innovation in the traditional herbal medicine agroindustry. Cases that focus on employee perceptions enable the identification of barriers, problems, and opportunities that may be missed in broader research. In addition, analytical descriptive methods are used to provide a detailed picture of the organization's objectives, goals, eco-innovation strategies, and sustainability measurements in the business while detailing employee perceptions of these initiatives (Ain et al., 2019). The advantage of the case study method lies in an in-depth understanding of a more focused situation, while the analytical descriptive method provides a clear, holistic picture (Quintão et al., 2020). Combining these two methods will provide comprehensive insight into eco-innovation and employee perceptions in achieving sustainability in the traditional herbal medicine agroindustry.

2.2 Location Determination Method

This research deliberately selected 20 traditional herbal medicine agroindustries in the Solo Raya area, which includes Surakarta, Boyolali, Sukoharjo, Wonogiri, Sragen, Karanganyar, and Klaten, as research locations using a purposive location determination method. The reason behind choosing this area is that Solo Raya is known as a center for the traditional agroindustry of herbal medicine, which is rich in local wisdom and herbal medicine traditions (Mayasari & Sunariya, 2023). The advantage lies in the ability to gain deep insight into eco-innovation practices within the traditional herbal medicine sector in a region that explicitly emphasizes local herbs' ethnobotanical use. Research can identify challenges and opportunities that may not arise in other areas by focusing on the Solo Raya area. The results of this research can provide more relevant and applicable guidance for traditional herbal

medicine agroindustry in the region and contribute to the understanding of eco-innovation in the context of ethnobotanical use of traditional herbs.

2.3 Population and Sampling Methods

The population of this study consisted of all employees who worked in 20 traditional herbal medicine agroindustries in the Solo Raya area. A simple random sampling method was used to get a representative group (Jilcha Sileyew, 2020). Five employees from each agroindustry were chosen at random from their staff. Simple random sampling is a sampling method that gives each member of the population an equal opportunity to be sampled. In this context, the respondent selection process is carried out without regard to certain positions or characteristics so that every employee has the same opportunity to be part of the sample. The advantage of the simple random sampling method, according to Etikan & Babtope (2019), is to reduce bias in sampling and ensure that the research results are more representative of the variations in the population of employees of the traditional herbal medicine agroindustry in Solo Raya. Thus, this method provides a solid basis for analyzing employee perceptions and views regarding eco-innovation in the context of traditional herbal agroindustry in the region.

2.4 Data Collection Methods

This research collected data through various methods, including surveys, in-depth interviews, and direct observation. Surveys are used to collect quantitative data from respondents using structured questionnaires (Carpino et al., 2019). In addition, in-depth interviews were used to gain deeper insight from some selected respondents (Thompson et al., 2019). This method allows researchers to explore employee perspectives and experiences in detail. Direct observations were carried out to understand eco-innovation practices and the work environment dynamics in the traditional herbal medicine agroindustry in the Solo Raya area directly. Combining these three methods provides a comprehensive approach to collecting relevant and diverse data, allowing for deeper and richer analysis in the context of this research (Farquhar et al., 2020).

2.5 Data Analysis Methods

This research applies a unique approach by combining two methods, namely Organizational Objectives, Goals, Strategies, and Measures (OGSM) and the gap analysis method. The OGSM framework identifies and measures critical elements related to goals, targets, strategies, and sustainability measurements in the context of the traditional herbal medicine agroindustry in Solo Raya. According to Kunonga et al. (2010), this method is a strategic management concept used to plan and direct organizational goals and involves four main components:

1) Objectives are associated with the overarching vision that the organization aspires to accomplish. These objectives should be linked to the company's mission and show how to get the desired results.
2) Goals are related to specific targets that must be achieved to achieve goals. Goals must be measurable and directly related to the objectives set. Goals provide concrete steps that must be taken to achieve objectives.
3) Strategies related to action plans used to achieve goals and objectives. The strategy describes the approach or method to achieve the desired result. The strategy must match market conditions, available resources, and organizational strengths.
4) Measures related to performance indicators are used to measure progress and success in achieving goals and objectives. Measures must be objectively measurable and provide relevant information about the achievements achieved.

Table 1. Cross-tabulation formulation of OGSM-Gaps Analysis

OGSM Analysis	Statement	Gap Analysis			
		E (Expectation)	R (Realities)	R-E	Rank
Objectives					
Goals					
Strategies					
Measures					

Table 1 presents the cross-tabulation formulation of OGSM-Gaps Analysis, utilizing a Likert scale ranging from 5 (highest) to 1 (lowest). This scale captures the divergence between the perceived reality and the expected outcomes in the studied context. Respondents provided ratings for both expectation and reality for each OGSM component—Goals, Objectives, Strategies, and Measures. The scoring for the OGSM-Gaps Analysis is derived by calculating the difference between the expectation and reality scores. A positive gap indicates that the perceived reality exceeds expectations, while a negative gap signifies a shortfall in realization compared to expectations. This scoring methodology allows for a nuanced understanding of the alignment or misalignment between anticipated and actual organizational performance, shedding light on areas where strategic goals and objectives may need refinement or improvement within the traditional herbal (Jamu) agroindustry.

This research uses a gap analysis method to measure the disparity between expectations and reality in employee perceptions regarding eco-innovation in the traditional herbal medicine agroindustry in Solo Raya (Haming et al., 2019). Combining these two methods provides significant benefits by presenting data that can be analyzed comprehensively. It assists in producing rankings that provide in-depth insight into the extent to which sustainability goals and strategies have been achieved, as well as where improvements can be made in the context of the traditional herbal medicine agroindustry (Ismail et al., 2022). With two methods, this research can explore the dimensions in which differences occur in more depth. These methods can help identify areas that require improvement or change to increase sustainability in the traditional herbal agroindustry sector. The combined OGSM-Gaps analysis method becomes essential for understanding and improving employee perceptions and participation in eco-innovation to achieve sustainability goals (Lu et al., 2022).

3. RESULTS AND DISCUSSION

The analysis results using the Organizational OGSM (Objectives, Goals, Strategies, and Measures) method and the Gaps method reveal a comprehensive view regarding ecological innovation (eco-innovation) in the traditional herbal medicine agroindustry in Solo Raya. The OGSM method provides an in-depth understanding of the organization's goals and objectives, implementing strategies, and existing sustainability measures in this sector. On the other hand, Gap analysis allows for measuring the mismatch between employee expectations and the reality they experience, providing insight into where improvements are needed. The combined results of these two methods provide a holistic view that combines company perspectives and employee perceptions regarding eco-innovation, helps in detailing efforts to achieve sustainability, and identifies steps that can be taken to improve sustainability practices in the traditional herbal agroindustry sector.

Table 2. Cross-tabulation of employee perceptions using OGSM-Gaps analysis

OGSM Analysis	Statement	Gap Analysis			
		E	R	R-E	Rank
Objective	Improve the quality and safety of traditional herbal products (van Wyk & Prinsloo, 2020) (technical aspect)	3.01	4.47	1.46	1
	Increase accessibility and availability of quality traditional herbal medicine (Sorokina & Steinbeck, 2020) (economic aspect)	3.95	4.10	0.15	4
	Increase the added value of traditional herbal products (Saha & Basak, 2020) (economic aspect)	3.49	4.45	0.96	2
	Increase the competitiveness of traditional herbal products in the market (Tu & Wu, 2021) (economic aspect)	3.54	3.04	-0.50	5
	Encourage the sustainable use of local raw materials (Astutik et al., 2019) (social and environmental aspects)	3.35	4.01	0.66	3
Goals	Improve the quality of traditional herbal products to compete with similar products in the market (Guiné et al., 2020) (technical aspect)	3.45	4.60	1.15	3
	Increase the promotion and branding of traditional herbal products to be better known by the public (Mahardhika & Nurmahdi, 2023) (economic aspect)	4.03	3.51	-0.52	5
	Expanding the reach of the traditional herbal medicine market through online and offline marketing (Li et al., 2019) (economic aspect)	4.01	4.45	0.44	4
	Developing eco-friendly traditional herbal products to attract environmentally conscious consumers (Nguyen et al., 2020) (environmental aspect)	2.50	4.53	2.03	1
	Maintaining the genuineness and authenticity of traditional herbal medicine raw materials to maintain eco-product quality (Parveen et al., 2020) (technical and environmental aspects)	2.91	4.61	1.70	2
Strategies	Improve product quality and consumer experience through continuous research and development (J.-S. Chen et al., 2021) (technical aspect)	3.47	4.58	1.11	3
	Increase brand visibility through effective marketing strategies, including the use of social media, online advertising, and collaboration with influencers (Hendry et al., 2021) (economic aspect)	3.02	4.46	1.44	2
	Partnering with health stores, pharmacies, and alternative health centers to expand distribution networks (A. K. Shen & Peterson, 2019) (economic and social aspect)	2.56	4.45	1.89	1
	Conduct promotional activities such as discounts, product bundling, or loyalty programs to attract and retain consumers (Ofosu-Boateng, 2020) (economic aspect)	4.13	4.45	0.32	4
	Provide education and training to salespeople or store staff so that they can provide accurate information	3.50	2.90	-0.60	5

OGSM Analysis	Statement	Gap Analysis			
		E	R	R-E	Rank
	about the uses and benefits of traditional herbal products (Yao et al., 2020) (environmental aspect)				
Measures	Revenue growth (Rejeb et al., 2008) (economic aspect)	4.12	4.56	0.44	3
	Customer satisfaction (Oppong, 2021) (economic aspect)	2.51	4.57	2.06	1
	Product availability (Rahayu et al., 2020) (economic and social aspects)	4.47	4.53	0.06	4
	Operational efficiency (Calín-Sánchez et al., 2020) (technical and economic aspects)	3.54	3.39	-0.15	5
	Number of eco-product innovations (Ariana, 2019) (technical and environmental aspects)	3.49	4.45	0.96	2

Source: Primary data (2023)

3.1 Objective

Information from Table 2 shows that the traditional herbal medicine agroindustry organization in Solo Raya, in employees' perception, aims to implement green innovation (eco-innovation) in producing traditional herbal medicine using local ethnobotanical raw materials. Traditional herbal medicine agroindustry organizations strongly focus on improving the quality and safety of their products. These objectives are reflected in their efforts to improve the quality of the traditional herbal medicine they produce and ensure the product is safe for use by consumers.

Through steps such as selecting quality raw materials, implementing good production processes, and regular product testing, the traditional herbal medicine agroindustry aims to increase employee perceptions by 1.46 regarding aspects of the organization's eco-innovation objectives. This result aligns with research by Phu et al. (2020), which states that improving the quality and safety of traditional herbal medicine products has essential meaning for organizations because this shows the organization's commitment to providing quality and safe products for consumers. This effort can strengthen the organization's image in the market as a producer of traditional herbal medicine that has high-quality standards. From an employee perspective, improving product quality and safety can be a source of pride and motivation. Seeing their products continue to develop into better products, employees will feel that their contributions positively impact the organization's reputation and success.

The organization's aim to increase the added value of traditional herbal medicine products with a gap of 0.96 has a significant meaning in the traditional herbal medicine agroindustry. By focusing on increasing added value, organizations strive to increase the attractiveness of their products in the market. This action can be done in various ways, including increasing the health benefits traditional herbal medicine offers from eco-friendly production. This action certainly makes herbal medicine products more attractive to consumers. This result aligns with research by Wen et al. (2022), which states that increasing product-added value can increase product competitiveness in the market, help organizations achieve better profit margins, and strengthen their position in the herbal medicine industry. From an employee's perspective, achieving these goals can open up opportunities for new product development, innovation, and product updates that can increase job satisfaction. In addition, regular product updates can open up career opportunities for employees involved in the innovation process. As a result, achieving these objectives benefits the organization regarding competitiveness and profitability and positively impacts the motivation and development of employees who contribute to achieving these objectives.

The organization's objective of encouraging sustainable local raw materials with a gap value of 0.66 is essential in the sustainability strategy of the traditional herbal medicine agroindustry organization. These objectives emphasize the need to adopt sustainable raw materials that directly support the environment and local communities (in this case, farmers). This result is in line with Astutik

et al. research in 2019, which states that using sustainable local raw materials can create better relationships between organizations and local communities. This action includes collaboration with local farmers or producers, which can benefit both parties by creating local economic opportunities. In addition, using sustainable raw materials also contributes to environmental protection efforts because fewer negative impacts result from procuring eco-friendly raw materials. From an employee's perspective, this can increase a sense of pride because they feel they are contributing to the company's sustainability and social responsibility aspects. Employees feel more connected to the organization's objectives and perceive that their work positively impacts their community and environment.

The objective to increase accessibility and availability of quality traditional herbal medicine with a gap value of 0.15 is significant in the context of the traditional herbal medicine agroindustry. This objective aims to focus on increasing the availability of quality products in the market to ensure more people can access these products. This result aligns with research by Thakkar et al. (2020), which states that organizations can expand their market share by creating wider availability and presenting quality products to more consumers. The impact of this objective is significant, as increased accessibility can result in substantial business growth. From an employee perspective, this can significantly increase product distribution and sales, affecting job stability. Increased business can also open up opportunities for company growth and employee career development. Achieving these objectives can positively impact the organization and the employees working to achieve them by providing stability and growth opportunities.

3.2 Goals

According to information from Table 2, traditional herbal medicine agroindustry organizations in Solo Raya have goals related to green innovation (eco-innovation) by adopting local ethnobotanical raw materials in their traditional herbal medicine production. The aim is to support sustainability in the traditional herbal medicine industry. This approach reflects the organization's commitment to responsibly using local natural resources. This goal aligns with research by Surya et al. (2020), which states that using local raw materials supports flora conservation and ecosystem sustainability and creates social and economic benefits for local communities and farmers. In the context of green innovation, the organization acts as a change agent that aims to reduce negative environmental impacts and produce eco-friendly products. Thus, the organization seeks to actively support sustainability in the traditional herbal medicine industry through local ethnobotanical raw materials, creating ecological, economic, and social benefits and engaging local communities in these efforts.

Employees positively perceive the organization's goal to develop eco-friendly traditional herbal products with a gap score of 2.03, which is evidence of their strong commitment to green innovation and sustainability. The meaning behind this goal is to focus on creating products that consider environmental issues, aiming to attract consumers who are increasingly concerned about these issues. The impact of this goal is significant, as by achieving it, organizations can increase the appeal of their products in the market. This goal aligns with research by Duong (2021), who states that this action can attract a segment of consumers who are increasingly concerned about environmental issues and tend to look for more environmentally friendly products. Success in achieving this goal can also help create a positive image for the organization in the eyes of consumers and the wider public, which can bring long-term benefits in terms of reputation and customer relations. From an employee's perspective, achieving this goal can lead to a sense of pride as they feel they are contributing to a product that cares about environmental issues. This action can increase employee motivation and job satisfaction, which supports the organization's sustainability vision.

The organization's goal to maintain the authenticity of traditional herbal raw materials with a gap value of 1.70 indicates its focus on maintaining the integrity of its products. This result means it is essential to maintain the authenticity and authenticity of traditional herbal raw materials to maintain product quality. The impact of this goal is significant, as the authenticity of raw materials directly affects product quality and consumer satisfaction. This impact aligns with research by El-Dahiyat et al. (2020), which states that by maintaining authenticity, organizations can ensure that their products remain in line with the standards and tastes expected by customers. Employees feel that maintaining the authenticity of raw materials is essential to maintaining the product's image and reputation. Achieving

this goal can also affect customer loyalty, as they will feel more confident in the product. In terms of credibility, the organization can gain an edge in the market with reliable and high-quality products. In conclusion, maintaining the authenticity of traditional herbal ingredients is essential in maintaining product quality and supporting the organization's positive image.

The organization's goal to improve the quality of traditional herbal products with a gap value of 1.15 indicates the organization's determination to face an increasingly tight market. This result means there is a drive to improve the quality of traditional herbal products to compete effectively in an increasingly fierce competitive environment. The impact of achieving this goal is significant, resulting in better products and more substantial competitiveness in the market. This achievement aligns with research by Shen et al. (2019), which states that agro-industrial companies can attract more consumers and maintain market share by improving product quality. From an employee's perspective, this goal may create a drive to innovate, improve product quality, and contribute to the company's long-term success. These goals can create a passionate and innovative work environment where employees feel they have an essential role in improving product quality and organizational competitiveness. Success in achieving these goals will not only affect the organization's business growth but also strengthen the role of employees in achieving these goals.

The organization's goal is to expand the market reach of traditional herbal medicine through online and offline marketing, with a gap value of 0.44, indicating the organization's desire to grow and reach more consumers. This result means involving various marketing channels, both online and offline, to reach a broader market (N. C. Irawan et al., 2023). The impact of achieving this goal is the opportunity for increased revenue and business growth. This agroindustry goal aligns with research by Faqih et al. (2020), which states that agroindustry can reach more consumers and increase product sales by expanding market reach. From an employee's perspective, achieving this goal can lead to a drive to actively participate in marketing and expansion efforts, positively impacting job stability and career opportunities. Employees may feel involved in the company's growth and feel that their contributions to expansion efforts are meaningful. Success in achieving this goal will positively impact business growth and career development and increase employee engagement in achieving these goals.

3.3 Strategies

Table 2 provides information on the organizational strategies of traditional herbal medicine agroindustries related to green innovation using local ethnobotanical raw materials to support sustainability. Employee perceptions and involvement are critical in implementing eco-innovation strategies in traditional herbal medicine agroindustries. This strategy aligns with research by Ababneh (2021), which states that employees are essential in carrying out various initiatives and positively impacting the organization's sustainability. Employee support in green innovation strategies includes understanding eco-friendly practices, using local ethnobotanical raw materials, and reducing negative environmental impacts. In addition, employee motivation also plays an essential role in driving change and creating a work culture that supports green innovation. Active participation of employees in decision-making and solution development can increase their sense of belonging, provide additional motivation, and strengthen their involvement in the organization's goals and vision. With employee support, motivation, and participation, traditional herbal agroindustry organizations can achieve success in achieving sustainability goals and sustainable business growth.

The organization's strategy to partner with health shops, pharmacies, and alternative health centers in employee perception has positive results, with a gap value of 1.89, highlighting the organization's efforts to expand the distribution reach of traditional herbal medicine products. Research by Raus et al. (2020) states that consumers looking for health solutions will find it easier to access goods if they are distributed in collaboration with organizations in the health sector that align with this effort. The positive impact of implementing this strategy includes increased market share and sales. From an employee perspective, this can be seen as an opportunity to contribute to business expansion that positively impacts company growth and job stability. They feel proud and motivated to be part of this initiative that will expand product coverage and reach more consumers through relevant healthcare partners.

Employees' perceptions are positive towards the company's increasing brand visibility through effective marketing strategies, with a gap value of 1.44. This value reflects the importance of marketing strategies in developing traditional herbal brands and products. This strategy aligns with research by Carpio et al. (2019), who state that implementing practical strategies to increase the brand's presence and its products in the market, such as utilizing social media platforms and establishing partnerships with influential organizations. The positive impact of implementing this strategy includes increased brand awareness, attracting more consumers, and increased product sales. From an employee perspective, this can be interpreted as their essential contribution to strengthening the brand and product image. They take pride in actively participating in creative and effective marketing campaigns and feel involved in the company's success. Employees' awareness of their role in strengthening the brand and attracting consumers can provide additional motivation in marketing efforts and create a work atmosphere that supports the growth of the brand and the business.

Employees' positive perceptions are related to the company's strategy of improving product quality and customer experience through continuous research and development, with a gap value of 1.11. This strategy indicates an appreciation of continuous innovation and improving product quality and customer experience. This strategy aligns with research by Jakovljevic et al. (2021), which states that the organization's commitment to continuous innovation is to improve products and meet consumer expectations. Implementing this strategy has the potential to produce higher quality products, which in turn will increase customer satisfaction and strengthen the organization's reputation. From an employee perspective, this strategy reflects the organization's commitment to innovation and quality, which can motivate them to participate actively in product research and development. In addition, it also opens up opportunities for employees for career development in product research and development so that they feel involved in achieving the long-term success of the company and strengthen their sense of ownership in achieving these goals.

A gap value of 0.32 shows that employees have good views about the company's strategy to attract and keep customers through promotional activities like discounts, product bundling, or loyalty programs. This strategy aligns with research by Lin et al. (2021), which states that this strategy reflects recognition of the organization's efforts in retaining and attracting customers. This strategy also involves various promotions to retain and attract new customers, such as discount offers, product bundling, and loyalty programs. The implementation of this strategy has the potential to increase sales, maintain positive relationships with existing customers, and attract new customers, all of which support sustainable business. From an employee perspective, this strategy demonstrates the organization's efforts to maintain positive consumer relationships and a sustainable business. Employees feel involved in these efforts and realize their essential role in supporting the company's growth and maintaining customer loyalty. This strategy can provide additional motivation and strengthen their ownership in achieving these goals.

3.4 Measures

Table 2 includes organizational performance measures of traditional herbal medicine agroindustries related to green innovation using local ethnobotanical raw materials to support sustainability. Employees' perceptions of these performance measures can influence their motivation, commitment, and participation in efforts to achieve the organization's green innovation and sustainability goals. Success in these performance indicators, such as customer satisfaction and revenue growth, can motivate employees. In contrast, needed improvements in indicators such as operational efficiency can inspire employees to contribute to improvement efforts. Thus, employee perceptions are critical in achieving organizational success in green innovation and achieving sustainability goals.

Customer satisfaction, which scores 2.06 in Table 2, is a significant leading indicator in measuring the performance of traditional herbal medicine agroindustry organizations. It reflects the extent to which the products and services provided by the organization meet or even exceed customer expectations. These products and services align with research by Garai & Sarkar (2022), which states that a high customer satisfaction score indicates that the organization has successfully created traditional herbal medicine products that consumers want and appreciate. The positive impact of achieving high customer satisfaction can include increased customer loyalty, positive recommendations

that can expand the consumer base, and growth in market share. From an employee's perspective, this achievement can be a vital source of motivation, as they see the positive results of their efforts and dedication in creating products that satisfy customers. It can also create a sense of pride and a deeper understanding of the employee's role in the organization's success. It encourages them to continue working hard to meet customer needs and expectations with quality traditional herbal products.

The number of product innovations, which scored 0.96 in the table, is an indicator that reflects the extent to which traditional herbal agroindustry organizations are active in creating new or improving existing products. A positive score on the number of product innovations indicates that the organization has been successful in its efforts to develop new or better traditional herbal medicine products. This effort aligns with research by Guiné et al. (2020), which states that this indicator creates opportunities for product portfolio diversification that can support business growth by offering more choices to consumers. From an employee's perspective, a high score in the number of product innovations can provide an opportunity to be involved in developing exciting new products. This indicator can motivate employees by providing space to create, innovate, and actively participate in formulating products that meet customer needs and wants. Involvement in new product development can provide a strong sense of belonging and opportunities to expand employees' skills and knowledge. Thus, the number of positive product innovations can drive employee motivation and development and contribute to sustainable business growth.

Revenue growth, which scored 0.44 in the table, is a highly relevant indicator in measuring the performance of traditional herbal agroindustry organizations. It measures how much the organization has increased its revenue over time. A positive score in revenue growth indicates that the organization has been successful in its efforts to increase sales and revenue generated. This effort aligns with research by Vardhan and Gupta (2022), which states that achieving positive income growth can significantly impact employee job stability and career development opportunities. From an employee perspective, positive revenue growth creates favorable conditions. Business growth generally requires more labor, which means more excellent job stability. In addition, growing organizations tend to offer more opportunities for career development, training, and advancement on the job. Employees may see revenue growth as a sign of organizational success and feel motivated to contribute further to achieving company goals. Thus, positive revenue growth has a positive impact on employees and has the potential to create a dynamic and opportunity-filled work environment.

Product availability, with a score of 0.06 in the table, is an indicator that assesses the extent to which traditional herbal products are always available to consumers. A positive score in product availability indicates that the organization has succeeded in ensuring its products are always available in the market, thus meeting consumer needs (Suswadi et al., 2022). This indicator aligns with research by Otto et al. (2019), which states that the impact of profitable product availability includes increasing customer satisfaction because they can quickly get the products they need and maintain a stable market share. From an employee perspective, a positive score in product availability can mean more stable employment. Employees do not have to worry about significant business fluctuations or uncertainty in their jobs because products are always available to consumers. In addition, it also creates positive relationship maintenance with customers, as consistently available products can increase customer trust and loyalty to the brand and company. Therefore, favorable product availability positively impacts employees by offering stability in work and strengthening the company's relationship with customers.

3.5 Improvement of Agroindustry Negative Performance

Improving the negative performance of the OGSM-Gaps analysis based on employee perceptions is critical as it reflects imperfections in the organization's strategy and execution. Low scores in "providing education and training to salespeople or store staff" indicate that product information may lack accuracy, potentially harming brand image and customer satisfaction. Therefore, corrective actions are needed to ensure that the information provided to consumers is accurate and relevant.

In addition, low scores on "improving product promotion and branding" and "improving product competitiveness" indicate that traditional herbal products may be less recognized in the market and have limited competitiveness. Improvements in promotion and branding are needed to increase brand awareness, while increased competitiveness is needed to maintain business growth. Finally, a negative

"operational efficiency" score indicates that the organization's internal processes are not optimal, which may hinder productivity and sustainability. Therefore, improvements in operational efficiency are necessary to reduce costs and improve overall organizational performance. Through these corrective actions, the organization can achieve its goals and increase employees' positive perceptions, supporting business sustainability and growth.

The information in Table 3 shows that the improvement action of providing education and training to salespeople or store staff to provide accurate information about the uses and benefits of traditional herbal products has a positive impact on the agro-industrial organization. Employees agree with the action, reflecting their support for the organization's efforts to improve performance in education and training. Organizing regular training is the first step received with high agreement (67%). This result indicates that employees see the value of a regular approach to improving salespeople's and store staff's knowledge of traditional herbal products (N. Irawan, 2023).

Furthermore, providing educational materials and practical guides on traditional herbs received support (59%). This result provides additional resources for salespeople to provide more comprehensive information to consumers. Although competency testing and knowledge updating received lower approval (34%), ensuring the information provided by salespeople or store staff remains accurate and up-to-date is still essential. With these improvements, organizations can enhance the ability of salespeople to provide correct information to consumers, which will support customer satisfaction and sustainable business growth (Aqmala & Ardyan, 2019).

Harmful performance improvements in improving the promotion and branding of traditional herbal medicine products to be better recognized by the public received support and approval from most employees. The steps taken reflect the organization's earnest efforts to strengthen its brand image and increase the visibility of its products. Designing an effective marketing strategy is the first step that received high support (89%). With this approach, the organization can leverage social media, advertising, and promotional campaigns, considering the advantages and benefits of traditional herbal products. This strategy will help reach a wider audience and provide a better understanding of the product (Vial, 2019).

Table 3. Percentage of approval of action plans and corrective actions on negative performance

Actions	Description	Gaps	%
S	Provide education and training to salespeople or store staff so that they can provide accurate information about the uses and benefits of traditional herbal products (strategies problem)	-0,60	
1.	Conduct regular training for salespeople or store staff, including knowledge about traditional herbal products' uses, benefits, and potential side effects.		67
2.	Provide educational materials and practical guidance on traditional herbs used in herbal products.		59
3.	Implement competency tests and knowledge updates regularly to ensure the information provided by salespeople or store staff remains accurate and up-to-date.		34
G	Increase the promotion and branding of traditional herbal products to be better known by the public (goals problem)	-0,52	
1.	They are designing effective marketing strategies, including social media, advertising, and promotional campaigns highlighting the advantages and benefits of traditional herbal products.		89
2.	Collaborate with influencers or figures who have an interest in traditional herbal products to get wider attention from the public.		42
3.	Participate in health exhibitions and relevant events to unveil traditional herbal medicine products to a discerning target audience.		57
O	Increase the competitiveness of traditional herbal products in the market (objectives problem)	-0,50	
1.	Conduct market research to understand consumer trends and preferences related to traditional herbal products.		38

Actions	Description	Gaps	%
2.	Innovate products by developing new variants, combining traditional ingredients with modern trends, or creating more attractive product packages.		54
3.	Ensure product quality and safety in processing, including relevant certifications and regulations.		78
M	Operational efficiency (measurements problem)	-0,15	
1.	Conduct operational audits to identify areas for improvement in terms of efficiency, such as energy use, waste management, or raw material use.		36
2.	Adopt more efficient technologies, such as automation of production processes or implementation of integrated supply chain management systems.		61
3.	Involve employees in planning and implementing operational efficiency initiatives, including rewards or incentives for successfully implemented ideas.		87

Source: Primary data (2023)

Collaboration with influencers or personalities interested in traditional herbal products is also supported (42%). This result can help create more incredible buzz and attention among the public. Furthermore, participating in health fairs or related events received approval (57%). This result allows organizations to introduce traditional herbal products to the right target audience. This strategy will help overcome negative performance issues and strengthen the brand image and visibility of traditional herbal products in the eyes of the public. This strategy can positively impact business growth and employee engagement in improvement efforts (Abdullahi et al., 2018).

The corrective actions to improve the competitiveness of traditional herbal products in the market have strong support from employees. These measures demonstrate the organization's commitment to achieving sustainability goals and improving product quality. Conducting market research to understand consumer trends and preferences is a crucial step, although it received lower support (38%). This strategy helps organizations understand changes in consumer tastes and adapt their products to market trends (Dzulfikar et al., 2022).

Undertaking product innovation received strong support (54%). With product innovation, organizations can create new variants, combine traditional ingredients with modern trends, or create more attractive product packages, increasing product appeal and improving market competitiveness. Ensuring product quality and safety in processing received the highest approval (78%). This strategy reflects the importance of meeting relevant standards and regulations in producing traditional herbal medicine. These actions will assist the organization in improving negative performance and achieving its goal of improving the competitiveness of traditional herbal products in the market. Employee support is valuable in this process and can motivate them to contribute to the company's long-term success (Daru, 2021).

Improving negative performance in terms of operational efficiency is an essential step for the traditional herbal medicine agroindustry. In this case, operational efficiency refers to improving the organization's production processes and resource management. Although the level of employee agreement varies, several actions can be taken to address this negative gap. First, conducting an operational audit is the first step to identify areas that require improvement (36% agree). This audit will help the organization identify issues that hinder efficiency, such as inefficient energy use, poor waste management, or suboptimal use of raw materials (Kasri et al., 2021).

Second, adopting more efficient technologies (61% agreed) can help improve operational efficiency. This result includes automating production processes and implementing integrated supply chain management systems. Technology can optimize operations and reduce waste. Finally, involving employees in planning and implementing operational efficiency initiatives and providing rewards or incentives for successfully implemented ideas are the actions that received the highest agreement (87% agree). Involving employees in efforts to improve efficiency can increase motivation and ownership, which may increase the effectiveness of these initiatives. With these actions, traditional herbal

agroindustry organizations can address negative operational efficiency gaps, supporting their business sustainability and growth (Permani et al., 2023).

4. CONCLUSIONS

The OGSM-Gaps analysis has yielded valuable insights into employee perceptions within a traditional herbal medicine agroindustry organization in Solo Raya. Notably, discrepancies surfaced between the organization's identified goals, objectives, strategies, and performance measures and employees' perceptions of their implementation. This study, employing OGSM-Gaps analysis, assessed the organizational performance of a traditional herbal medicine agroindustry, emphasizing eco-innovation and sustainability with local ethnobotanical raw materials. Employees strongly supported the organization's goals, objectives, and strategies for green products and quality improvement, signalling robust support for eco-innovation initiatives. However, negative gaps were identified in areas like enhancing product competitiveness and operational efficiency, underscoring the need for improvement. To address these gaps, involving employees in efficiency initiatives and enhancing education and training for sales or store staff is crucial. The focus on customer satisfaction as a key performance indicator and revenue growth underscores the critical parameters for organizational success. This research underscores the pivotal role of employee involvement in shaping strategic decisions, planning, and implementing green innovation initiatives. Positive employee perceptions of strategies supporting green innovation significantly impact the organization's ability to achieve sustainability goals. The study highlights that employee engagement and corrective actions such as training, competency development, and innovation are vital for overcoming negative gaps and fostering a sustainable and competitive traditional herbal agroindustry. Collaborative efforts between management and employees are pivotal for realizing sustainability and growth objectives, enabling these organizations to thrive in the market, positively influence the environment, and contribute to local communities.

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Study of Land Productivity in Composting Process of Tea Solid Waste at PT Gunung Slamat

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Abstract

PT. Gunung Slamat, as a company operating in the tea processing industry, was founded by the Sosrodjojo family. This scientific article aims to analyze land productivity in composting solid tea waste at PT. Gunung Slamat by considering land area, waste processing capacity, and providing recommendations for solutions that can significantly increase the productivity of solid tea waste processing land. The research adopts a phenomenological approach to obtain the required data. Phenomenology is defined as a type of research that seeks to analyze descriptively and introspectively various forms of human consciousness and experience. Data obtained from quantitative observations will cover various aspects such as the amount of compost produced, the time required to process waste into compost, which will then be collected and analyzed. The compost produced from waste processing at PT. Gunung Slamat is used as fertilizer within the company's environment and distributed to local farmers, benefiting both the environment and the local community. This compost product is not sold because PT. Gunung Slamat focuses more on selling tea products. In waste processing, several issues have been identified, including a lack of suitable technology for utilizing tea waste. The research findings indicate that land productivity in composting solid tea waste fluctuates during the study period, with changes associated with various factors such as waste quantity, weather, and management practices. Further evaluation of the factors influencing land productivity, along with the implementation of more advanced technology, can enhance efficiency and have a positive impact on the environment.

Keywords: *Productivity*, *Tea Waste Compost, Waste.*

1. INTRODUCTION

Indonesia, with its favorable climate and soil conditions for tea plant growth, has gained a reputation as one of the world's largest tea producers (Zakariyah, Anindita and Baladina, 2014). Despite the significant economic benefits of this achievement, massive tea production also results in a considerable amount of solid waste. Tea solid waste consists of remnants of tea leaves and other parts of the tea plant that are not utilized in the production process.

PT. Gunung Slamat, a company in the tea processing industry, was founded by the Sosrodjojo family in 1953 after previously producing jasmine tea in 1940. In addition to jasmine tea, PT. Gunung Slamat produces black and green tea in various forms, both loose-leaf and packaged, under brands such as Teh Cap Botol, Teh Celup Sosro, Teh Cap Poci, and others (PT. Gunung Slamat, 2019). While the high productivity of tea can be observed through the production of products by PT. Gunung Slamat, it also leads to an increase in post-production waste. Based on field observations over approximately four months, it can be concluded that PT. Gunung Slamat in Slawi, Central Java, generates no less than 2.7 tons of tea waste every month.

Solid waste arising from the tea beverage industry, particularly at PT. Gunung Slamat, generally consists of unused tea leaves in the production process, leftover raw materials, and by-products of the production process. The solid tea waste in this company is derived from the oxidation/firing process, primarily related to the tea shoots changing color to red due to delayed leaf turning during shoot oxidation (Muningsih, 2019). From an economic value perspective, waste can be categorized as economically valuable or non-economic. Non-economic waste refers to material

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that does not provide added value even after undergoing processing, and processing is done solely for ease of disposal (Sulaeman, Arifin and Sadat, 2017). Unfortunately, most of the solid tea waste is currently considered economically valueless and is disposed of without further processing. Inefficient management of solid tea waste can have serious environmental impacts, including soil and water pollution, negatively affecting overall environmental quality.

1.1. Tea Waste

Solid waste is one of the types of waste generated from the tea processing industry. It consists of tea leaves that are not used in the tea production process. Solid tea waste has a composition rich in fibers, proteins, fats, and carbohydrates. If not properly processed, this waste can create environmental problems such as water and soil pollution and reduce land productivity. Accumulated tea waste not only poses a threat to the environment but also requires significant space and labor for disposal. Steps to address this issue need to be explored. Although some approaches, such as using it as livestock feedstock, converting it into fertilizer, and other methods, have been proposed, only a few are viable for meeting the needs of large-scale tea processing industries, and efficient methods have sparked great interest and hope among scientists (Yang, Liang, Wang, Sun, Tao, Xu, Zhang, Zhang, C. Ho, et al., 2016).

1.2. Compost

Indonesia faces recurring waste problems, including in remote villages, largely due to a lack of awareness about waste's environmental impact. Various methods are available to address this issue, but they are often not consistently applied in daily life and are neglected. As a result, waste accumulates, leading to environmental pollution. The waste generated is hazardous to health, and addressing this issue requires community empowerment and appropriate guidance. One effective method is converting waste into compost through an increasingly popular recycling process. Compost is made through the decomposition process of organic waste, such as leaves. Compost is known as a natural fertilizer that can nourish plants without the use of chemicals. By using compost, plants can grow well because it is a natural substance that does not harm the soil environment. Recycling waste into compost has a dual advantage: first, it efficiently processes waste, and second, it increases its commercial value by selling high-value compost (Sylvia, Anwar and Khairani, 2019).

Composting requires the assistance of microorganisms to break down materials and accelerate the process. One factor used in this process is Effective Microorganism 4 (EM4). EM4 functions to expedite the decomposition of organic material, reduce odors during the process, suppress the growth of harmful microorganisms, and enhance the activity of beneficial microorganisms (Anugrah Natalia, Anif Sholikhuddin and Muhammadi, 2021).

The aerobic composting process consists of three stages marked by changes in compost temperature: the mesophilic stage, the thermophilic stage, and the cooling stage. In the initial mesophilic stage, the temperature increases to around 40°C due to the activity of fungi and acid-forming bacteria. Subsequently, the temperature continues to rise into the thermophilic stage, ranging from 40 to 60°C, where the degradation and stabilization of materials occur maximally. In the cooling stage, microbial activity decreases and is replaced by mesophilic bacteria and fungi (Worotitjan, Pakasi and Kumolontang, 2022).

During the cooling stage, the process of water evaporation from the composted material continues, as well as the stabilization of pH and the refinement of humic acid formation. The final product is stable and serves as a source of organic fertilizer. However, the decomposition process of organic material in immature compost (C:N ratio > 25) still occurs, creating anaerobic conditions in the root zone due to oxygen consumption by microbes and immobilization of nutrients, especially nitrogen, leading to nutrient competition between microorganisms and plants (Saraswati and Pratapna, 2017).

Factors influencing compost production include the Carbon-to-Nitrogen (C:N) ratio, moisture content, oxygen content, temperature, pH, and other factors of the raw materials to be processed into compost. The ideal C:N ratio is between 20 to 40:1 or 30 to 1, considered the best ratio. Municipal waste has a relatively optimal C:N ratio of 30 to 40:1, supporting the composting process well (Sahwan, 2010).

1.3. Compost Processing

Based on the manufacturing process, there are two types of compost tea: aerated compost tea (ACT), which receives oxygen through stirring during its production process, and non-aerated compost tea (NCT), which has limited oxygen supply, resulting in restricted stirring (Berek, 2017). Composting can be done aerobically (with oxygen) or anaerobically (without oxygen). Aerobic composting produces CO_2, H_2O, nutrients, and some humus, while anaerobic composting produces CH_4, CO_2, and intermediate compounds that often produce a foul odor due to H_2S and sulfur organic compounds like mercaptan. Aerobic composting is more energy-efficient, producing more energy (484 - 674 kcal/mol glucose) compared to anaerobic composting (26 kcal/mol glucose), and it occurs more quickly (Saraswati and Pratapna, 2017). Composting technology has developed significantly, from open systems to closed systems with air injection. Various types of reactors are used in the composting process, such as vertical and horizontal tower reactors, but the basic process remains the same. According to a study by BPPT, an open system or variations of an open system are the most suitable options for Indonesia based on climate, economic, and socio-cultural conditions (Sahwan, 2010).

1.4. Ideal Composting Facilities

Composting facilities are used to transform organic waste into compost. The composting process takes place in well-managed composting facilities. Composting facilities can be used by individuals, families, or communities to manage the organic waste they generate. An ideal composting facility must meet several criteria to ensure an efficient and effective composting process. Some factors to consider when designing an ideal composting facility include:

1. Size: The composting facility should be large enough to accommodate the amount of organic waste generated by a family or community. An ideal composting facility should have a minimum volume of 10 m³.
2. Ventilation: The composting facility should have a good ventilation system to maintain air quality inside the facility and ensure the composting process runs smoothly. Ventilation can be achieved by creating holes in the walls or roof of the composting facility.
3. Drainage: The composting facility should have good drainage to dispose of water produced during the composting process. Drainage can be provided by installing drainage channels or placing the composting facility on sufficiently elevated ground.
4. Cover: The composting facility should be equipped with a cover to maintain moisture levels inside the facility, prevent rainwater and animals from entering. The cover can be made of waterproof or heat-resistant materials.
5. Accessibility: The composting facility should be easily accessible to facilitate management and maintenance.
6. Stability: The composting facility should be built on stable ground capable of bearing heavy loads.
7. Design: The composting facility should be well-designed and aesthetic, harmonizing with the surrounding environment

(Kementerian Lingkungan Hidup dan Kehutanan, 2021).

Research on land productivity through composting solid tea waste at PT. Gunung Slamat has some connections with previous research conducted in relevant fields. These connections include the nutrient content aspect of solid waste processed into compost(Muningsih, 2019) and (Mukarramah, Sari and Lusyiani, 2023) discussing leaf litter waste productivity. This research contributes positively to waste management efficiency by converting solid tea waste into compost. By reducing the volume of waste ending up in landfills, this research supports sustainable waste management practices. It also provides scientific evidence of increased land productivity in agriculture using compost from solid tea waste. This information can be beneficial for local farmers and the agricultural industry to improve crop yields and soil health. In this context, a critical assessment of the environmental impact generated by tea production, especially in terms of solid waste management, needs to be undertaken. Sustainable and innovative steps need to be taken to reduce its negative impact, considering the application of modern waste management technology and environmentally-based strategies. Awareness of these issues at the industry level can help achieve a balance between high productivity and environmental sustainability.

It is not yet known to what extent the amount of tea waste generated at PT. Gunung Slamat can be balanced with the products obtained through the composting process. Factors such as land limitations, possibly ineffective composting methods, and technological mismatch may contribute to this imbalance. Therefore, an analysis of land productivity in the composting process of solid tea waste at PT. Gunung Slamat is crucial to evaluate waste management land productivity in this company and provide appropriate solutions to significantly improve land productivity in solid tea waste processing. This research aims to analyze land productivity in the composting process of solid tea waste at PT. Gunung Slamat by considering land area, waste processing capacity, and providing recommendations for solutions that can significantly improve land productivity in solid tea waste processing.

2. METHODS

This study employs a phenomenological approach to explore the necessary data. Phenomenology is defined as a research type that seeks to analyze descriptively and introspectively various forms of human consciousness and experience, encompassing sensory, conceptual, moral, aesthetic, and religious aspects (Helaluddin, 2019).

In collecting existing data, there are three stages for obtaining understanding. 1) Epoche is the stage where the researcher suspends prejudices, assumptions, judgments, and interpretations to fully realize the reality faced. 2) Phenomenological reduction is the stage where the researcher looks at the phenomenon as a whole, including physical characteristics and experiences that emerge in the researcher's consciousness when observing the phenomenon. Through phenomenological reduction, the researcher identifies constituents of the experience related to the experienced phenomenon. 3) Imaginative variation is the stage where the researcher attempts to access structural components of the phenomenon with the goal of identifying related conditions. These conditions may involve factors such as time, space, or social relationships that influence the emergence of the phenomenon from Willing (In Yusuf, Nurwanah and Sari, 2022).

Data collection is conducted through observation and direct interviews with respondents who are employees responsible for compost production at PT. Gunung Slamat. Data obtained from quantitative observations will cover various aspects such as the amount of compost produced, the time required to process waste into compost, which will then be collected and analyzed to determine land productivity in waste processing into compost.

Figure 1. Composting Location

The research is conducted at PT. Gunung Slamat, a tea processing company located in Tegal Regency, Central Java. PT. Gunung Slamat was chosen as the research location because it is where solid tea waste is generated and can be used as raw material for compost production. The location of solid tea waste processing into compost, as depicted in Fig 1, is located at the back of the main production facility. The processing is carried out regularly during working hours, with solid tea waste entering every day. Daily data on incoming waste and compost results during the research period provide an overview that the average waste produced per day reaches 111 kg. Managing solid tea waste is the main focus at this location, and the process is designed to minimize environmental impact.

Productivity refers to the relationship between the outcomes produced and the resources utilized. Increasing productivity can have a positive impact on economic growth. It is important to emphasize that productivity is not identical to production. Instead, productivity encompasses a combination of effectiveness and efficiency in resource utilization. Productivity in agriculture is defined as the ability of an input (land area) to produce an output (production yield) per unit of land area (Reza and Effendi, 2022). To determine land productivity in composting, it is obtained by dividing the production yield (in tons) by the land area (in hectares) over a specific period. This can be systematically expressed as follows:

$$Land\ Productivity = \frac{Production\ Yield\ (tons)}{Land\ Area\ (ha)} \quad (1)$$

Source: Sudarmo (Reza and Efendi, 2022)

This research aims to analyze land productivity in the context of solid tea waste management into compost at PT. Gunung Slamat. The main focus of the research includes sustainability aspects, compost results, and environmental impact. This is a qualitative research with a phenomenological approach. Land productivity in composting is the phenomenon to be understood and analyzed.

3. RESULTS AND DISCUSSION

The investigation into land productivity through composting of solid tea waste at PT. Gunung Slamat is closely related to previous research conducted in the relevant field. This connection includes

the nutritional composition of solid waste transformed into compost, as explored by (Muningsih, 2019) and (Mukarramah, Sari and Lusyiani, 2023), focusing on the productivity of tea leaf waste. This research contributes positively to effective waste management by transforming solid tea waste into compost. By reducing the volume of waste reaching landfills, this study supports sustainable waste management practices. Additionally, it offers scientific evidence of increased land productivity in agriculture through the application of compost derived from solid tea waste. This provides valuable insights for local farmers and the agricultural industry to enhance crop yields and soil health.

The objective of this research is to analyze land productivity in the composting of solid tea waste at PT. Gunung Slamat by calculating the area and capacity for waste processing and providing solutions to improve land productivity in processing solid tea waste into compost. The collected data indicates that land productivity fluctuated during the research period. The data in Table 1 presents the results of observations conducted at PT. Gunung Slamat to determine the quantity of waste and compost produced. The tea leaves utilized by PT. Gunung Slamat are in a dried form imported from West Java (Nurbaity and Saring, 2017). Consequently, PT. Gunung Slamat does not engage in the harvesting of tea leaves used for production. The total land area of the composting site is 630 m^2, with 324 m^2, used for processing solid tea waste, while the remaining 306 m^2, is designated for rest areas and access roads. The amount of solid tea waste generated from the processing, conducted regularly during working hours, enters the system every day. Daily data on incoming waste and compost results during the research period provide an overview that the average waste produced per day in a month reaches 120 kg.

Table 1. Observation Data of Tea Waste at PT. Gunung Slamat

Month	Working Days	Compost Production Results	Averange Incoming Waste
September 2022	26 Days	2.885 Kg	110,9 Kg/ Day
October 2022	25 Days	2.781 Kg	111,2 Kg/ Day
November 2022	26 Days	2.418 Kg	93 Kg/ Day
December 2022	20 Days	3.314 Kg	165,7 Kg/ Day

The calculation using formula (1) yields data presented in Table 2. Based on the land productivity data obtained from September to December, it can be observed that land productivity varies over time. In September, land productivity reached 89,04 tons/ha, indicating good compost production. However, in October, land productivity significantly decreased to 85,83 tons/ha, marking the lowest compost production. This decline may be attributed to factors such as a decrease in the amount of waste processed during composting. In November, land productivity increased again to 74,62 tons/ha, indicating high efficiency in waste processing. In December, land productivity decreased once more to 102,28 tons/ha. Despite December producing a higher amount of waste than the previous month, land productivity remains relatively low, suggesting potential improvements in process efficiency. This aligns with the research conducted by (Siseraf Pamusu, Nur Alam and Sulaeman, 2013), which found that land area significantly influences the local red onion production in Olobuju Village.

Table 2. Land Productivity in Composting Solid Tea Waste at PT. Gunung Slamat

Month	Land Area (ha)	Compost Production Results (ton)	Land Productivity (ton/ha)
September 2022	324 m^2 = 0,0324 ha	2,885 tons	89,04 ton/ha
October 2022	324 m^2 = 0,0324 ha	2,781 tons	85,83 ton/ha
November 2022	324 m^2 = 0,0324 ha	2,418 tons	74,62 ton/ha
December 2022	324 m^2 = 0,0324 ha	3,314 tons	102.28 ton/ha

The research results in Table 2 show fluctuations in land productivity each month during the research period. The inconsistency in land productivity is attributed to various factors, including differences in the input of solid tea waste processed into compost, the number of effective working days, composting duration, and the final compost yield. In a previous study, the land productivity of tea compost production in the research conducted by Azurianti et al., (2022) ranged from 10.2 to 15.9 tons/ha. Meanwhile, in Bria (2016) research, the average land productivity of tea compost in Indonesia was 12.5 tons/ha.

In the waste processing at PT Gunung Slamat, a simple composting method is employed using EM4, which serves to expedite the decomposition of organic materials, eliminate odors during the decomposition process, and enhance the activity of beneficial microorganisms believed to increase productivity and process efficiency (Syafrudin and Zaman, 2007). Solid tea waste produced by PT Gunung Slamat is collected at the composting site and then shredded in the field to reduce its size for easier processing. EM4 is added in specific doses and mixed with water to achieve a moisture content of around 60-70%. After adding EM4, maintenance is performed to control moisture levels, and periodic mixing is done to optimize processing. Once the solid tea waste reaches a color similar to soil or dark brown, the compost is ready for harvesting or use. The time needed to harvest compost from solid tea waste is 1 to 2 weeks, indicating efficient waste processing in a relatively short period.

The costs incurred for processing solid tea waste at PT Gunung Slamat are quite low, especially by using water and EM4, and utilizing existing equipment at the facility. This indicates that the company can process waste effectively. The compost produced from waste processing at PT Gunung Slamat is used as fertilizer within the company's environment and distributed to local farmers, benefiting both the environment and the local community. This compost is not sold because PT Gunung Slamat focuses more on selling tea products than waste products. In waste processing at PT Gunung Slamat, some issues have been identified, including a lack of suitable technology for tea waste utilization, limited awareness of the importance of waste management, and land limitations. However, the company has taken steps to address these issues, such as developing appropriate technology and collaborating with external parties to expand land areas.

4. CONCLUSIONS

Based on the analysis of composting land productivity data, it can be concluded that the investigation into solid tea waste management into compost at PT. Gunung Slamat has yielded several significant findings. Productivity refers to the relationship between the outcomes produced and the resources utilized. Increasing productivity can have a positive impact on economic growth. It is important to emphasize that productivity is not identical to production. Instead, productivity encompasses a combination of effectiveness and efficiency in resource utilization. The research results indicate that land productivity in solid tea waste composting fluctuates during the research period, with changes that can be associated with various factors such as the quantity of waste, weather conditions, and management practices. Further evaluation of the factors influencing land productivity, along with the implementation of more advanced technology, can enhance efficiency

and have a positive impact on the environment. Therefore, this study contributes to the understanding of solid tea waste management in the tea industry, with a focus on land productivity, sustainability, and waste processing efficiency. Continuous evaluation is necessary to ensure the implementation of best practices in the management of the tea industry waste.

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Molecular Identification of Lactic Acid Bacteria from Broiler Chicken Meat

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Abstract

Lactic acid bacteria are bacteria used to ferment food. Molecular identification of isolates of lactic acid bacteria has a high degree of accuracy compared to morphological identification. This study aimed to molecularly identify isolates of lactic acid bacteria from broiler chickens. Molecular identification is carried out in 3 stages, namely: rRNA gene amplification stage, squencing and phylogeny tree. PCR electrophoresis results obtained amplicone results measuring about 1,500 bp. The results of BLAST analysis showed that the gen 16S rRNA sequence of BR 17 lactic acid bacteria isolate had a 97-98% similarity with the genome sequence of the Lactobacillus fermentum strain. Development of phylogenetic tree isolates of single clusters of lactic acid bacteria BR 17 with strains of Lactobacillus fermentum CAU2036, Lactobacillus fermentum JCM 7772, and Lactobacillus fermentum 10-18. The identification results of lactic acid bacteria isolate BR 17 showed Lactobacillus fermentum BR 17.

Keywords: *broiler chicken, identification, lactic acid bacteria, molecular*

1. INTRODUCTION

Lactic acid bacteria are a group of Gram positive bacteria, do not form spores, almost all strains are not able to produce the enzyme catalase, most are facultative anaerobic and able to ferment lactose with lactic acid end products (Krockel, 2013). Lactic acid bacteria are beneficial microorganisms used as starter cultures for functional food processing (Aritonang et al., 2017) These lactic acid bacteria are not toxic to the host and have the ability to kill pathogenic bacteria. Many studies have reported that lactic acid can have significant antimicrobial effects (Gao et al., 2019) Researchers have developed Lactic Acid Bacteria that can be used for food fermentation (Mathur et al., 2020) Most of the use of lactic acid bacteria for milk fermentation (Widyastuti, and Febrisiantosa, 2014)(Montet et al., 2014)(Soro-Yao et al., 2014)(Tsuda et al., 2012)and lactic acid bacteria as starter on the manufacture of fermented sausages (Franciosa et al., 2018)

Lactic acid bacteria are found naturally in foodstuffs including chicken meat (Sakaridis et al., 2014) (Arief et al., 2015) succeeded in isolating LAB from beef as a probiotic. Lactic acid bacteria BR 12, BR 17, BR 11, BR 10, and BR 7 obtained from broiler chicken meat resulted in the growth of lactic acid bacteria with continuous growth with the highest lactic acid levels and the lowest pH of all Lactobacillus genes (Mudawaroch et al., 2020). BR 17 isolate is more efficient in using sucrose when compared to BR 12. BR 17 isolate requires 0.246 g of sucrose in every 100 ml of medium to produce an optimal bacterial growth rate, while BR 12 is 0.34 g/100ml (Mudawaroch et al., 2019) *Lactobacillus fermentum* can be used as an starter in meat fermentation (Ruiz-Moyano et al., 2011)

Traditionally, bacteria were commonly identified through morphological characteristics, metabolites and other phenotypes, and this method was considered inefficient and no longer accurate because it relied on phenotypic expression. There are many differences in results between morphological identification and molecular identification (Ahmadi et al., 2015)**.** This study aims to molecularly identify BR 17 isolates from broiler chicken meat.

2. MATERIAL AND METHODS

BR 17 isolate was obtained from the isolation of lactic acid bacteria from broiler chicken meat (Mudawaroch et al., 2019) (Mudawaroch et al., 2020).

2.1 Research Method

Molecular identification consists of 3 stages, namely: rRNA gene amplification stage, squencing and phylogeny tree.

2.1.1 Amplifcation of 16S rRNA genes.

Lactic Acid Bacteria Isolate is harvested by fish method again in MRS Agar media until a pure isolate is obtained.

A. Isolation of DNA isolates.

Bacterial culture was grown into 5 ml of sterile MRS medium and incubated at 37ºC for 12 hours. Cells were harvested by centrifugation of bacterial culture as much as 2 ml at a speed of 13,000 rpm for 5 minutes. Cell deposits are taken and the supernatant is discarded. The bacterial culture precipitate was resuspended using a 750µL lysis buffer, then homogenized (vortex). Then 20µL (10mg/mL) of proteinase K was added and incubated at 55°C for 30 minutes. Stock lysozyme (100mg/mL) was added as much as 40µL, incubated at 55°C for 30 min and centrifuge at 13,000 rpm for 5 min. The supernatant is transferred into a new 2 ml microtube and 750µL of phenol is added. The sample was vigorously jogged, for 15 minutes, centrifuge returned to 13,000 rpm for 10 minutes. The formed top layer, carefully taken and transferred into a 2 ml microtube. Cold chloroform is added in a ratio of 1:1 (v / v) and gently cornered for 10 minutes, then centrifuge at a speed of 13,000 rpm for 10 minutes. Take the top layer carefully, transfer it into a new 1.5 ml microtube. 1:1 (v/v) cold absolute ethanol is added and stored at -80 C °for2 hours or -20°C overnight. Next, the sample was centrifuge at 13,000 rpm for 10 min. The supernatant was removed and the precipitate was washed using 0.5 ml of 70% ethanol and centrifuge again at 13,000 rpm for 10 minutes. The pellets are formed, dried and 50µL TE is added. The DNA extract is then stored at 4°C overnight, then transferred to -20ºC.

B. PCR

The PCR procedure follows the GoTaq Green mastermix PCR Kit procedure. The material mixture for uk PCR consists of 25 µl master mix 2xGoTaq Green readymix PCR, forward and reverse primers of 2 µl each, The primer used is forward 5'-AGAGTTTGA(C/T)(A/C)TGGCTCA-'3, Reverse 5'-CA(G/T)AAAGGAGGTGATCC-'3, DNA template 2 µl, and water free-DNase 19 µl. The PCR program in the thermal cycle used consists of an initial denaturation of 95 ºC for 3 minutes as much as 1 cycle; followed by 30 cycles which include denaturation temperature 94 ºC for 30 seconds; annealing temperature 55 ºC, elongation 72 ºC for 2 min; and 1 cycle covering final elongation of temperature 72 ºC for 5 min.

The PCR product was then analyzed for the size of 16S DNA obtained with 1% agarose electrophoresis gel (Harisha, 2007). Agarose gel (Bioron) as much as 2% [1 g in 100 ml TAE stok 1x (20 ml TAE and 980 ml aquades)]. The stock composition of 1000 ml TAE electrophoresis buffer (Fermentation) consists of 40 mM Tris, 20 mM acetic acid and 1 mM EDTA. Agarose and TAE are dissolved until homogeneous by microwave and printed in trays and fitted with combs to form a spool. After cooling, the gel is placed in an electrophoresis device (BioCRAFT BE 520) and given TAE 1x until submerged. Samples and DNA ladders (1 kb DNA ladder Gene Rule-Fermentas) of 5 µl each were inserted in the well. Electrophoresis is performed at 100 volts for 40 minutes. Upon completion, the gel is taken and soaked in ethidium bromide (25 µl EtBr in 500 ml TAE 1x) for 20 minutes. The results of electrophoresis are observed with UV-transilluminators.

2.1.2 Sequencing.

Theg sequence was performed by 1stBASE Sequencing in Malaysia, using ABI PRISMTM 3730-XL 1406-022 instrument. A sample of 100 µl PCR product in a parafilm-coated PCR tube. The result of combining forward and reverse readings to obtain the DNA sequence sampel.

2.1.3 Tree phylogeny.

The amplified sequence data was then compared with the sequence data obtained from the Gene Bank (http://www.ncbi.nlm.nih.gov). The gene sequences obtained from the data base were aligned and gene phylogeny construction was carried out using the MEGA 6 program with the Maximum likehood (ML) algorithm.

3. RESULTS AND DISCUSSION

Molecularly identified is necessary to determine exactly the genus and species as well as proximity to other isolates. Molecular identification is used because of its high level of accuracy and can be used to identify isolates down to strain level (Taufiq et al., 2017). Characterization of lactic acid bacteria is based on 16S rRNA sequence analysis to determine genus and strain (Julendra et al., 2017).

Isolate lactic acid bacteria from broiler chicken meat broiler chickens obtained 21 isolates. From 21 isolates were selected by looking at the lowest pH value until 13 isolates were obtained. Of the 13 isolates selected growth acceleration, the highest lactic acid levels. Based on the use of the least energy source, namely isolate BR 17. BR 17 isolate Pure BR 17 isolate followed by DNA isolation of lactic acid bacteria isolate until DNA is obtained. Pure BR 17 isolates are followed by DNA solation of lactic acid bacterial isolates to obtain DNA. DNA isolation includes cell breakdown, protein and RNA removal and DNA purification (Agrawal & Prakash, 2013).

Amplification with *Polymerase Chain Reaction* (PCR) is carried out after DNA isolation of the genome*. Polymerase Chain Reaction* (PCR) is a system for DNA replication that allows DNA to selectively "target" DNA sequences several million times in just a few hours (Agrawal & Prakash, 2013). PCR consists of denaturation at 90 - 94ºC to open DNA strands, annealing at 50 - 65°C for primary hybridization of "anneal" (via hydrogen bonding) to its complement and elongation (elongation) at 72ºC is the appropriate temperature for polymerase against template. This cycle is repeated 30 – 40 times.

The results of DNA amplification by PCR, observation of the presence of DNA was carried out at the end of the reaction using agarose gel after an electrophoresis process (Pranawaty et al., 2012) PCR product detection is performed electrophoresis with 2% agarose gel and observed under UV lamp. The results of genomic DNA amplification are shown in Fig.1. The results of PCR electrophoresis obtained amplicom measuring about 1.500 bp of DNA. The PCR results are then sequenced to find out the nucleotide sequence.

DNA sequencing is the process of determining the sequence of nucleotide bases, namely adenine, thymine, guanosine, and cytosine in the DNA sequence, this DNA sequence is important for the gene information of a living thing. Sequencing was conducted by 1st BASE Sequencing in Malaysia, using ABI PRISMTM 3730-XL 1406-022 instrument. 16S rDNA sequencing is then followed by checking the similarity of nucleotides p a da GeneBank which is one of the molecular detection methods that is quite ideal to determine the kinship between bacteria because the 16S rDNA sequence is a gene found in all microbes and is indispensable in maintaining life.

The sequencing results were used for analysis of the Basic Local Alligment Search Tool (BLAST) program. BLAST is an algorithm for comparing primary biological sequence information, such as amino acid sequences or DNA sequences and RNA sequences. BLAST serves to compare the order of queries with libraries or databases, and identify database sequences that resemble the order of queries. The results of sequence homology analysis with the data base in NCBI are presented in Table 1.

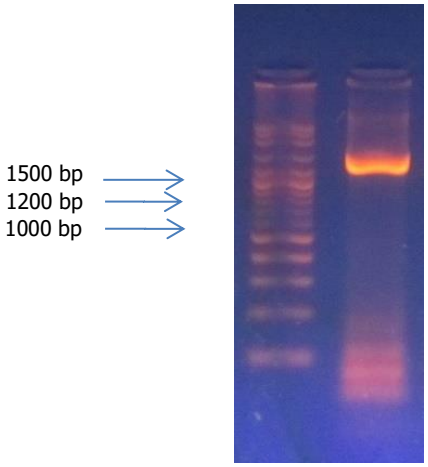

Figure 1. DNA electrophoresis

Table 1. Results of sequence homology analysis with data base in NCBI

No	Description	IDENT	Accession
1	*Lactobacillus fermentum* strain CAU2036 16S ribosomal RNA gene, partial sequence	9.8%	MF42-4967.1
2	*Lactobacillus fermentum* strain 10-18 16S ribosomal RNA gene, partial sequence	98%	KY458550.1
3	*Lactobacillus fermentum* strain FTDC 8312, complete genome	97%	MF992210.1
4	*Lactobacillus fermentum* strain SNUV175, complete genome	97%	LC311073.1
5	*Lactobacillus fermentum* strain BCS9 16S ribosomal RNA gene, partial sequence	97%	KM257692.1

The results of BLAST analysis showed that the 16S rRNA gene sequence of the BR 17 lactic acid bacteria isolate had 97 to 98% similarity to the genome sequence of the Lactobacillus fermentum strain. Within one species there is only a difference of around 3% in the 16S rDNA sequence or it can be said to have a sequence homology of ≥97%. Sequence homology with a value of ≥97% is equivalent to a hybridization similarity of 70%, the minimum value used to state that two bacteria belong to one species (Madigan & Martinko., 2012)

To better see the proximity of BR 17 isolates to several partial sequences and genomes of *Lactobacillus fermentum*, phylogenetic analysis is necessary (Fig.2). Phylogenetic analysis can provide a further picture of the closeness between bacteria. The phylogeny tree is described according to a scale with the length of the branches in the same unit as kinship (Taufiq et al., 2017). The scale length of the tree is 0.0 2, with the branch length in units equal to the evolutionary distance used to infer the phylogenetic tree. Trees are drawn with scales, with branch length measured in the number of substitutions per location (Tilahun et al., 2018) Based on the phylogeny tree, the isolates of lactic acid bacteria BR 17 are clustered with Lactobacillus fermentum strain CAU2036, Lactobacillus fermentum *strain* JCM 7772 and *Lactobacillus fermentum* strain 10-18.

The results of molecular identification of lactic acid bacteria isolate BR 7 from broiler chicken meat are *Lactobacillus fermentum* species. These results are the same as those reported(Lengkey et al., 2009) who get *Lactobacillus fermentum* bacteria from broiler chicken meat (Han et al., 2017). identified isolates of lactic acid bacteria from fermented sausages, as well as *Lactobacillus fermentum* bacteria. Lactobacillus fermentum bacteria as a starter in the manufacture of fermented sauceis (Chen et al., 2016(Chen et al., 2016)(Domínguez et al., 2016).

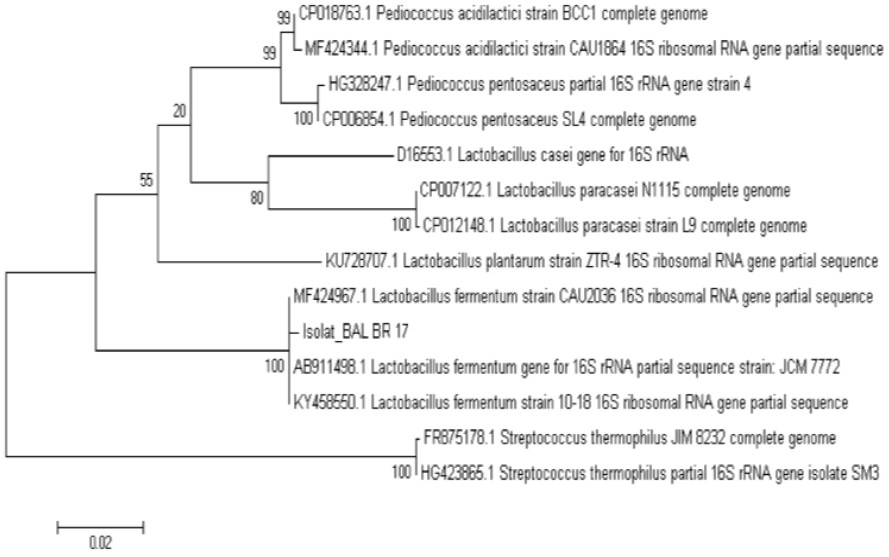

Figure 2. Phylogenetic tree of lactic acid bacteria isolate BR 17

4. CONCLUSIONS

The results of electrophoresis PCR isolate of lactic acid bacteria BR 17 obtained an amplicom measuring about 1.500 bp. sequence homology with data base in NCBI isolate of lactic acid bacteria BR 17 amounting to 97-98% is a strain of *Lactobacillus fermentum*. The phylogeny *tree Lactobacillus fermentum* BR 17 has a close relationship with the sequence in the NCBI database.

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