Jurnal Pembelajaran Dan Biologi Nukleus p-ISSN: 2442-9481
Vol 11 (1): 259 - 267, March 2025 e-ISSN: 2685-7332

Circular Economy in Agriculture: *Examining Factors Affecting People's Intention to Use Organic Fertilizer*

Risna Maya Sari(*)[1], Karimi Karimi[2], Siti Yuli Meilanda Sormin[1]

[1]Agrotechnology Department, Institut Teknologi dan Sains Padang Lawas Utara, Padang Bolak Julu, Padang Lawas Utara Regency, Indonesia Postcode 22753
[2] Manajement Department, Muhammadiyah Mahakarya Aceh University, Jl. Gayo Simpang IV No.2, Bireun Meunasah Capa, Kec. Kota Juang, Kabupaten Bireuen, Aceh Province, Indonesia, Postcode 24252

***Corresponding Author:** risnamayasari94@gmail.com

Submitted November 05 Th 2024 and Accepted February 28 Th 2025

Abstract

Examining the variables that affect people's intentions to use organic fertilizer in agriculture is the aim of this study. By identifying these factors, it is expected to provide a better understanding of what encourages or hinders people in using organic fertilizers. The findings of this study will significantly aid in the formulation of plans and regulations that can promote the use of organic fertilizers and the adoption of a circular economy in the field of agriculture. Methods This research is designed as an explanatory research that can explain the method of testing a theory to strengthen or reject the research hypothesis. Therefore, the explanatory approach is very suitable to be used in this research in accordance with the research objectives. The data in this study consisted of primary data collected using a questionnaire. To examine the behavioral components of this study, researchers employed the Partial Least Square (PLS) method in conjunction with Structural Equation Modeling (SEM). The urgency of this study arises from the pressing need to address environmental degradation, resource scarcity, and unsustainable agricultural practices. Therefore, it is important to implement agricultural practices that prioritize sustainability aspects, one of the solutions is the widespread use of organic fertilizers in the community. The study's findings indicate that farmers' intentions to utilize organic fertilizer are influenced by social, institutional, and economic factors.

Keywords: *Circular Economy; Organic Fertilizer; Sustainable Development Goals; SDGs.*

https://doi.org/10.36987/jpbn.v11i1.6535

INTRODUCTION

Agriculture is a vital sector that plays a major role in meeting food needs (Ramamoorthy et al., 2024). However, rapid population growth, climate change and increased pressure on natural resources demand a sustainable approach to agricultural practices. According to Huang et al., (2024); Salam et al., (2021) research that organic fertilizers are crucial for preserving the health of soil since they supply vital nutrients like nitrogen and encourage the development of advantageous microbes. Zhang et al., (2024); Salam et al., (2021) By maintaining soil health and increasing nutrient availability, organic fertilizers contribute to maintaining agricultural productivity while minimizing environmental impacts. According to Zhang et al., (2024) The use of organic fertilizers is one of the applications of the circular economy.

The circular economy embraces the concepts of efficient use of resources, recycling, and waste reduction (Jiang et al., 2016; Yang & Zhang, 2022). In the context of agriculture, the implementation of circular economy is a must to achieve long-term sustainability (Abbasi et al., 2024). The circular economy is a topic that has received a lot of attention because it is an alternative solution to realize sustainability. However, despite the attention, there are still very few applications of the circular economy, especially in the field of agriculture (Abbasi et al., 2023; Mehmood et al., 2021).

In this study, research was conducted in Labuhanbatu Regency. Labuhanbatu Regency is an area that has a very large plantation land and usually within the plantation is always used for cattle and goat farming. With a large livestock population, there is potential for livestock waste management that can be used as organic fertilizer. Therefore, this research chose a case study on the use of organic fertilizer as an example of the application of circular economy.

According to the literature, a number of obstacles, including economic ones like limited financial resources and the belief that utilizing organic fertilizers has no advantages, discourage farmers from using them, then social factors such as low knowledge and low awareness of sustainability, then the next factor is institutional factors which include policies, laws and standardization of organic products (Wang et al., 2020; Zhou et al., 2023).

The last few decades have seen an enormous transformation in modern agriculture, with a paradigm shift from conventional agriculture that relies on the use of synthetic chemical fertilizers and pesticides to sustainable agriculture that is more environmentally friendly (Gelaye, 2023; Rubagumya et al., 2023; Westerik et al., 2023). Livestock waste management based on circular economy will utilize livestock waste to be converted into products that have added value economically and also do not have an impact on the environment (Lehtokunnas, 2023). Unlike the traditional economic model, Since circular economic development is the most effective means of conserving resources and materials, economic expansion will continue (Nikolaienko, 2020).

Referring to the explanation above, it is necessary to conduct research on the factors that influence people's intention to use organic fertilizer, a case study in Labuhanbatu Regency. This research is in accordance with the 2017-2045 National Research Master Plan (RIRN), namely on the topic of poverty alleviation research and

food independence which has a target to produce innovations in managing economic potential through the strength of local food.

This research is very important to carry out because the use of organic fertilizers is a more natural and sustainable solution (Zhang et al., 2023). Organic fertilizer is a source of nutrients derived from natural materials such as compost, green manure, livestock waste, and other organic waste (Gupta et al., 2023; Xu et al., 2023). Through the widespread use of organic fertilizers in the community, it can help realize sustainable agriculture while improving the welfare of the community through reduced production costs, Researchers also have publications related to the management of agricultural waste into fertilizers and research related to compost (Sari, 2023).

Agriculture is a vital sector in a country's economy, but it often faces challenges in terms of sustainability and efficiency (Jiao et al., 2022). Organic fertilizers are one of the solutions that can be used to improve the resilience and sustainability of agriculture (Melo et al., 2022). However, the use of organic fertilizers is still not optimal among the community. Therefore, this study will look at the factors that influence people's intention to use organic fertilizer for agriculture. By understanding these factors, efforts can be identified to increase the adoption of organic fertilizers.

METHOD

Research Design

A quantitative approach is the method/design employed to accomplish the research goals that aims to test predetermined hypotheses, is deductive in nature, and is based on theory (Hair et al., 2010). The unit of analysis of this research is at the individual level, namely the people of Labuhanbatu who own oil palm plantations. The type of data is cross-sectional. Crossectional data is a type of data that captures a phenomenon at one point in time (Cooper & Schindler, 2014). The validity used in this study namely convergent validity and discriminant validity that shown in table 2 and table 3. The research begin in Mei 2024 until July 2024. The sample in this study was the people of Labuhanbatu Regency who had a garden. The number of samples is determined using the maximum likelihood estimation method with the recommended amount of data 100 to 200 samples. The Variables that used in this research to measure the analysis was Economic Factor, Institutional Factor and Social Factor refers to Zhang et al., (2024).

Data Analysis

This study's data analysis method tests the association between the independent and dependent variables using SMART PLS (Hair et al., 2024). This method was chosen because it can identify the relationship between mediating variables in a study. (Sarstedt et al., 2022). The SEM method is a type of multivariate analysis in social science that includes multiple regression that explains the relationship between latent and manifest constructs in a complex model, which can be estimated/tested simultaneously (Hair et al., 2014).

RESULT AND DISCUSSION

The data used in this research are primary data obtained through two methods, namely online surveys and direct surveys to respondents. According to Neuman (2014) surveys can observe field events by measuring using symbolic content to reflect, document, or represent abstract constructs.

Table 1. Questionnaire Return Rate

Description	Total	Percentage (%)
Questionnaire	103	100
Unsuitable questionnaires	9	8.8
Questionnaires that can be analyzed	94	91.2

Source: Primary data (2024).

Table 1 shows the number of respondents who filled out the questionnaire on the link distributed. The total number of respondents who filled out the questionnaire was 103 respondents, a relatively small number of respondents due to demographic factors such as the level of education of respondents which influenced respondents in filling out the questionnaire. Some respondents had difficulty understanding the meaning of the questions, so they did not complete the questionnaire.

Table 2. Convergent Validity Results

Construct	Economic Factor	Institutional Factor	Social Factor	Intention Using
FE1	**0.891**	0.485	0.536	0.522
FE2	**0.854**	0.382	0.415	0.496
FE3	**0.876**	0.48	0.471	0.557
FE4	**0.845**	0.359	0.37	0.487
FE5	**0.862**	0.373	0.435	0.541
FI1	0.307	**0.745**	0.528	0.336
FI2	0.441	**0.776**	0.576	0.471
FI3	0.377	**0.838**	0.549	0.433
FI4	0.399	**0.838**	0.557	0.512
FI5	0.405	**0.836**	0.586	0.496
FS1	0.444	0.444	**0.651**	0.421
FS2	0.452	0.549	**0.828**	0.606
FS3	0.275	0.574	**0.716**	0.41
FS4	0.447	0.524	**0.817**	0.476
FS5	0.352	0.58	**0.821**	0.48
NM1	0.433	0.533	0.48	**0.75**
NM2	0.568	0.366	0.445	**0.845**
NM3	0.504	0.396	0.589	**0.827**
NM4	0.528	0.475	0.493	**0.816**
NM5	0.415	0.52	0.547	**0.819**

Source: Primary data (2024).

Outer Model Testing

The analytical method used in this study to analyze data using the SEM PLS method through SMART PLS 3 software. In the outer model testing section, there are several things that need to be analyzed, namely the validity test which consists of convergent validity, discriminant validity and reliability. Based on Table 2, all the indicator meet the criteria of validity with loading value bigger than 0,6 (Hair et al., 2010). That means every indicator are availble to built each variable used in this study. As can be observed, every item satisfies the current requirements, indicating that they effectively explain the research variables. Since the correlated items are unable to adequately explain the research variables, they can be eliminated if the loading value exhibits a correlation with other constructs. Research items can be said to be valid if the loading value ranges from 0.6 (Hair et al., 2014).

Table 3. Results of Discriminant Validity with Fornell Larcker Criteria

Construct	Factor Economy	Factor Institutional	Factor Social	Intention Using
Economic Factors	**0.866**			
Institutional Factors	0.482	**0.807**		
Social Factors	0.516	0.692	**0.770**	
Intention to Use	0.603	0.566	0.631	**0.812**

Source: Primary data (2024).

The level to which a construct actually differs from other constructs in accordance with empirical norms is known as discriminant validity. The Fornell-Larcker Criteria is one method for figuring out if a concept is discriminantly valid. The Fornell-Larcker criterion is an approach method that contrasts the latent variable correlation with the square root of the AVE value (Hair, 2014). Acording to Fornell Larcker Criteria, the variabel caled valid when the loading value is highest among other variables. That means the variable is discriminant from others. Based on table 3 above, it can be seen that each variable can be declared discriminantly valid.

Table 4. Reliability and AVE Test Results

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Economic Factors	0.916	0.937	0.749
Institutional Factors	0.867	0.903	0.652
Social Factors	0.826	0.878	0.593
Intention to Use	0.87	0.906	0.659

Source: Primary data (2024).

Cronbach's Alpha and Composite Reliability values are displayed in Table 4. This table indicates that the Composite Reliability and Cronbach's Alpha values are higher than 0.70 (Hair et al., 2010). Therefore, when utilized as a measure throughout time, all of the constructs in this study are consistent and dependable.

Inner Model Testing

The purpose of inner model testing is to evaluate the study hypothesis and path relationship. The path coefficient value (β) and the significance p-value were examined in order to assess the three hypotheses in this investigation. Based on the research model showed on figure 2, All of the items utilized in this study are known to have attained the loading value's lower limit, therefore it can be concluded that they can be employed as measuring devices and undergo additional testing.

Table 5. Results of Path Relationship Analysis

Construct	Path Coefficient	P Values
Economic Factors -> Intention to Use	0.350	0.005
Institutional Factors -> Intention to Use	0.163	0.023
Social Factors -> Intention to Use	0.338	0.031

Source: Primary data (2024).

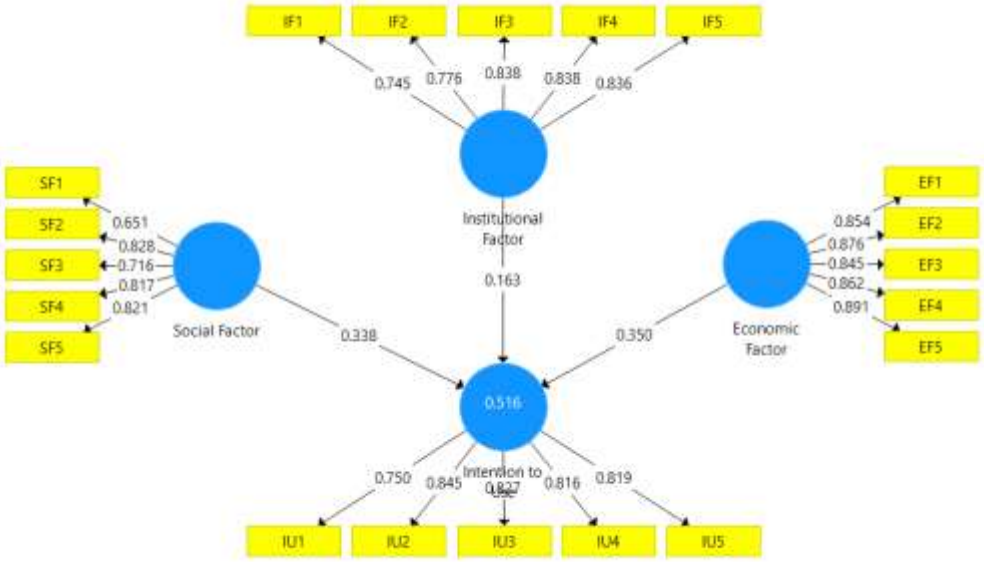

Figure 2. Research Model and Path Relationship
Description: SF: Social Factor, IF: Institutional Factor, EF: Economic Factor, IU: Intention to Use

CONCLUSION

Based on the test results and based on the results of the literature study that has been presented by the researcher, the conclusions obtained are: (1) Social factors have a positive and significant effect on farmers' intention to use organic fertilizer. (2) Economic factors have a positive and significant effect on farmers' intention to use organic fertilizer. And (3) Institutional factors have a positive and significant effect on farmers' intention to use organic fertilizer.

REFERENCES

Abbasi, I. A., Ashari, H., & Yusuf, I. (2023). System Dynamics Modelling : Integrating Empty Fruit Bunch Biomass Logistics to Reduce GHG Emissions. *Resources*, *12*(4), 53. https://doi.org/10.3390/resources12040053

Abbasi, I. A., Shamim, A., Shad, M. K., Ashari, H., & Yusuf, I. (2024). Circular economy-based integrated farming system for indigenous chicken: Fostering food security and sustainability. *Journal of Cleaner Production*, *436*(1), 140368. https://doi.org/10.1016/j.jclepro.2023.140368

Cooper, D. R., & Schindler, P. S. (2014). *Business Research Methods*. 12th Edition. US: Mcgraw-hill. 723 page.

Gelaye, Y. (2023). Effect of combined application of organic manure and nitrogen fertilizer rates on yield and yield components of potato: A review. *Cogent Food & Agriculture*, *9*(1), 2217603. https://doi.org/10.1080/23311932.2023.2217603

Gupta, H., Mondal, S., Singh, S., & Kharub, M. (2023). *Industry 4.0 and Green Entrepreneurship for Environmental Sustainability: Exploring Barriers from an Indian SME Perspective.* In: Rezaei, J., Brunelli, M., Mohammadi, M. (eds) Advances in Best-Worst Method. BWM 2023. Lecture Notes in Operations Research. Springer, Cham. pp. 77–108. https://doi.org/10.1007/978-3-031-40328-6_6.

Hair, J F, Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis*. *Vol. 8 edition*. *New Jersey:* Prentice Hall. 758 page

Hair, Joe F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, *26*(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128

Hair, Joseph F, Sharma, P. N., Sarstedt, M., Ringle, C. M., & Liengaard, B. D. (2024). The shortcomings of equal weights estimation and the composite equivalence index in PLS-SEM. *European Journal of Marketing*, *58*(13), 30–55. https://doi.org/10.1108/EJM-04-2023-0307

Huang, B., Lv, X., Zheng, H., Yu, H., Zhang, Y., Zhang, C., & Wang, J. (2024). Microbial organic fertilizer prepared by co-composting of Trichoderma dregs mitigates dissemination of resistance, virulence genes, and bacterial pathogens in soil and rhizosphere. *Environmental Research*, *241*, 117718. https://doi.org/10.1016/j.envres.2023.117718

Jiang, C., Zhao, W., Sun, X., Zhang, K., Zheng, R., & Qu, W. (2016). The effects of the self and social identity on the intention to microblog: An extension of the theory of planned behavior. *Computers in Human Behavior*, *64*, 754–759. https://doi.org/10.1016/j.chb.2016.07.046

Jiao, M., Liu, T., Chen, X., Ren, X., & Zhang, Z. (2022). *Biochar for clean composting and organic fertilizer production, Chapter 9 - in* Biochar in Agriculture for Achieving Sustainable Development Goals (Tsang D. C. W., & Ok, Y. S.. Elsevier Inc: Academic Press. pp. 105–116. https://doi.org/10.1016/B978-0-323-85343-9.00012-4

Lehtokunnas, T. (2023). *Enacting a Circular Economy: A multi-sited ethnography on food waste practices in Finnish supermarkets, households and biogas plants.* Doctoral dissertation of Tampere University. https://researchportal.tuni.fi/en/publications/enacting-a-circular-economy-a-multi-sited-ethnography-on-food-was. Accessed on 22Th December 2024

Mehmood, A., Ahmed, S., Viza, E., Bogush, A., & Ayyub, R. M. (2021). Drivers and barriers towards circular economy in agri-food supply chain: A review. *Business Strategy and Development*, *4*(4), 465–481. https://doi.org/10.1002/bsd2.171

Melo, W. S., Pereira, N., Andrade, E. A. De, Santos, R. F., & Antônio, L. (2022). Organic fertilizer produced from chicken carcasses on soybean production. *International Journal of Recycling of Organic Waste in Agriculture, 11*(3), 355–362. https://doi.org/10.30486/IJROWA.2021.1918036.1172

Nikolaienko, A. (2020). Resource efficiency strategies based on the circular economy. *European Journal of Management Issues*, *27(3-4)*, 90–98. https://doi.org/10.15421/191910

Ramamoorthy, K., Dhanraj, R., Vijayakumar, N., Ma, Y., Al Obaid, S., & Narayanan, M. (2024). Vegetable and fruit wastes: Valuable source for organic fertilizer for effective growth of short-term crops: Solanum lycopersicum and Capsicum annum. *Environmental Research*, *251*(2), 118727. https://doi.org/https://doi.org/10.1016/j.envres.2024.118727

Rubagumya, I., Komakech, A. J., Kabenge, I., & Kiggundu, N. (2023). Potential of organic waste to energy and bio-fertilizer production in Sub-Saharan Africa: a review. *Waste Disposal & Sustainable Energy*, *5*(3), 259–267. https://doi.org/10.1007/s42768-022-00131-1

Salam, A., Sarker, N. I., & Sharmin, S. (2021). Do Organic Fertilizer Impact on Yield and Efficiency of Rice Farms? Empirical Evidence From Bangladesh. *Heliyon*. *7*(8), e07731. https://doi.org/10.1016/j.heliyon.2021.e07731

Sari, R.M., Sormin, Yuli Meilanda Sormin; Siregar, Raja Aminuddin; Tanjung, A. A. (2023). Training On Making Livestock Manure Waste Into Compost/Organic Fertilizer In Farmer Groups-Aqiqah Village Livestock. *JES-TM Social and Community Service*, *2*(1), 6–9. https://jes-tm.org/index.php/jestmc/article/view/65 **[*In Indonesian language*]**

Sarstedt, M., Ringle, C. M., & Hair, J. F. (2022). *Partial Least Squares Structural Equation Modeling. In* Homburg, C., Klarmann, M., Vomberg, A. (eds) Handbook of Market Research. Springer, Cham. pp. 587–632. https://doi.org/10.1007/978-3-319-57413-4_15

Wang, Z., Huo, J., & Duan, Y. (2020). The impact of government incentives and penalties on willingness to recycle plastic waste : An evolutionary game theory perspective. *Front. Environ. Sci. Eng, 14*(29), 1208. https://doi.org/10.1007/s11783-019-1208-2

Westerik, D., Hoffland, E., & Hijbeek, R. (2023). Nitrogen fertilizer replacement values of organic amendments: determination and prediction. *Nutrient Cycling in Agroecosystems*. https://doi.org/10.1007/s10705-023-10316-7

Xu, W., Zhao, D., Ma, Y., Yang, G., Ambus, P. L., Liu, X., & Luo, J. (2023). Effects of long-term organic fertilizer substitutions on soil nitrous oxide emissions and nitrogen cycling gene abundance in a greenhouse vegetable field. *Applied Soil Ecology*, *188*, 104877. https://doi.org/https://doi.org/10.1016/j.apsoil.2023.104877

Yang, W., & Zhang, L. (2022). Biochar and cow manure organic fertilizer amendments improve the quality of composted green waste as a growth medium for the ornamental plant Centaurea Cyanus L. *Environmental Science and Pollution Research*, *29*(30), 45474–45486. https://doi.org/10.1007/s11356-022-19144-8

Zhang, B., Yan, S., Li, B., Wu, S., Feng, H., Gao, X., Song, X., & Siddique, K. H. M. (2023). Combining organic and chemical fertilizer plus water-saving system reduces environmental impacts and improves apple yield in rainfed apple orchards. *Agricultural Water Management*, *288*, 108482. https://doi.org/https://doi.org/10.1016/j.agwat.2023.108482

Zhang, S., Li, Y., Jiang, L., Chen, X., Zhao, Y., Shi, W., & Xing, Z. (2024). From organic fertilizer to the soils: What happens to the microplastics? A critical review. *Science of The Total Environment*, *919*, 170217. https://doi.org/https://doi.org/10.1016/j.scitotenv.2024.170217

Zhou, S., Jia, P., Xu, W., Shane Alam, S., & Zhang, Z. (2023). A novel composting system for mitigating ammonia emissions and producing nitrogen-rich organic fertilizer. *Bioresource Technology*, *386*, 129455. https://doi.org/https://doi.org/10.1016/j.biortech.2023.129455

How To Cite This Article, with *APA style* :

Sari, R.M., Karimi, K., & Sormin, S.Y.M. (2025). Circular Economy in Agriculture: Examining Factors Affecting People's Intention to Use Organic Fertilizer. *Jurnal Pembelajaran dan Biologi Nukleus*, *11*(1), 259-267. https://doi.org/10.36987/jpbn.v11i1.6535

Conflict of interest : The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions : All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was submited by [**Risna Maya Sari**]. All authors contributed on previous version and revisions process of the manuscript. All authors read and approved the final manuscript.