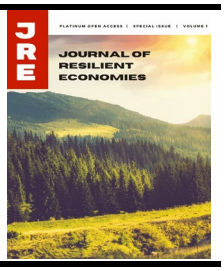
JRE OPEN ACCESS

JOURNAL OF RESILIENT ECONOMIES

PLATINUM OPEN ACCESS

Journal homepage: https://journals.jcu.edu.au/jre/index



Improving Women's Empowerment Through Management of Dairy Farms Based on Circular Economy: A Case Study of Tegalombo, Pacitan Regency, East Java

Anggraeni Ratnasari[1] and Catur Sugiyanto[2]

Abstract

This study examines the role of farmer wives in managing circular economy-based dairy farms and its impact on family income. The research focuses on the utilization of dairy waste through the production of organic fertilizer (manure) and biogas. The processed manure is used for fertilizing fodder crops and vegetables, both for personal consumption and sale. The study was conducted among farmers in the Tegalombo District of Pacitan, East Java. Regression analysis is employed to assess the factors influencing farmers' income and determine the potential of women's participation in farming to enhance household income. Based on a survey of 101 families, the findings reveal that households can save up to 145,949.35 rupiahs per month by reducing expenses on animal feed (grass). The regression results indicate that the adoption of circular economy practices positively impacts farmers' income, including income derived from dairy farming and overall farming activities. Moreover, by promoting the involvement of women in farm management, the study aligns with the second Sustainable Development Goal (SDG) to address hunger, achieve food security, and promote sustainable agriculture, as well as the fifth SDG to attain gender equality and empower women and girls.

Keywords: Circular Economy, Women Empowerment, Dairy Farming, Manure, Organic Farming, Households

[1] Graduate Student, Faculty of Economics and Business, Universitas Gadjah Mada, Indonesia, anggraeni.ratnasari@mail.ugm.ac.id,
ORCiD: https://orcid.org/0009-0008-2679-0836
[2] Corresponding author: Faculty of Economics and Business, Universitas Gadjah Mada, Indonesia, catur@ugm.ac.id,
ORCiD: https://orcid.org/0000-0001-6170-7569

Journal of Resilient Economies (JRE) publishes original research with a multidisciplinary focus to further advance the important concept of resilience. JRE is fully supported by James Cook University Open Journal Systems (OJS), driven by the belief that knowledge has the power to change lives, and that research outputs should be freely accessible online, without barriers. To cite, include Author(s), Title, Journal of Resilient Economies, volume, issue, year and DOI. DOI: https://doi.org/10.25120/jre.3.1.2023.4001

1. Introduction

Circular Economy (CE) is an emerging concept to combat the environmental degradation problem. It is not a single discipline, and its application opens up more opportunities to the business, both large and SMEs, and profit and non-profits entities, Sauvé et al. (2016). CE is attracting a considerable number of researchers, Suryantini et al. (2021) and has been widely practised by SMEs in the EU countries. Not only that, it is also widely applied in one emerging market cases, such as India, where Malik et al. (2022) underline five strategies to delineate problems faced by SMEs in applying the CE. Patricia and Wassenhove (2020) underline the new venture SMEs need to emphasize its change from LE to CE.

There are a variety of ways to apply CE among the five types of circular economy measures, Bassi and Dias (2019). In Hungary, with respect to shifting the business practice into the circular economy, SMEs tend to struggle the most with the initial phases of the shift; thus, it is crucial to assess the factors that prevent and support their transition, Bajnoczki et al. (2021). In Spain, SMEs focus on cost savings, Ormazabal et al. (2018), while in Italy reuse of products and their selling in second-hand shops or the recovery and redistribution of food surplus and the remanufacturing of personal computers are important, Ghisellini and Ulgiati (2020). With the heterogeneous types of CE applications across countries, Zamfir et al. (2017) underline the important role of the government in supporting the SME effort.

The study on CE and its application in Indonesian SMEs is limited. An overview of benefits derived from the implementation of the CE method is it alleviates the environmental problem caused by market failure, Yasa (2010). Aula et al. (2018) show the applicability of the circular economy with the optimal Circular Business Model Canvas (CBMC) for KPSP Setia Kawan using the expert opinion method. Others, such as Triasih et al. (2020), Dewi et al. (2021), and Luqman and Al-Ansari (2021) underline the practice of processing waste into biogas, which accords with the CE, practised in three regions in Java.

The purpose of this study is to shed some light on the profitability of practising CE, with special reference to the SME, i.e. livestock sector and the involvement of women. We survey farmers in Tegalombo subdistricts in Pacitan Regency, East Java province. East Java is the largest fresh milk-producing province in Indonesia, BPS (2021). The majority of the population in East Java works as dairy farmers. Tegalombo sub-District of Pacitan Regency in East Java population work as dairy farmers. Since the COVID-19 pandemic, demand for fresh milk has decreased. In this condition, dairy farmers are necessary to have alternative economic activities as a source of income. One alternative is implementing a circular economy by processing cow dung into manure, which is used to grow organic vegetables. These organic vegetables can be consumed by households or sold as additional income. Not only can it be an alternative to economic activities, organic farming will also increase the role of women or gender equality in the household.

We organized the paper as follows. In session 1, the background and purpose of this paper have been described. Section 2 discusses the relevant literature. Section 3 outlines the method of analysis. The research results are discussed in section 4, and section 5 concludes.

2. Literature Review

Circular Economy (CE) is an emerging concept to combat the environmental degradation problem. It is not a single discipline, and its application opens up more opportunities to the business, both large and SMEs, and profit and non-profits entities, Sauvé et al. (2016). The Circular Economy attracts many researchers, Suryantini et al. (2021). Shifting from a linear sales model to a circular service-based business model is far from straightforward. For most companies, the stretch is large. Companies will be forced to venture far out of their comfort zone. It should be clear that the combined uncertainties of changing consumer behaviours, financial support, and legal context make it hard for companies to engage, even if the odds look favourable and they essentially believe in sustainability, Patricia and Wassenhove (2020). For India, one of the emerging market cases, Malik et al. (2022) underlines five strategies to delineate problems faced by SMEs in applying CE. These include continually re-examined considering the risks involved, supporting SMEs by appropriate training and development and awareness-building communication programs, creating a culture that supports risk-taking and empowerment, encouraging large corporations working with SMEs, and discarding and disincentivize old routines by incentivizing new ones to embed CE principles.

SMEs in EU countries have widely practised the circular economy (CE). However, there is a variety among the five types of circular economy measures, namely Re-planning the way water is used to minimize usage and maximize re-usage, using renewable energy, Re-planning energy usage to minimize consumption, minimizing waste by recycling or reusing waste or selling it to another firm, and Redesigning products and services to minimize the use of materials or using recycled materials, Bassi and Dias (2019). In Hungary, with respect to shifting the business practice into the circular economy, SMEs tend to struggle the most with the initial phases of the shift; thus, it is crucial to assess the factors that prevent and support their transition. To better categorize obstructing and enabling factors and to ease navigating between them, they are to be broken up into three segments, macro-, meso, and micro-level factors, respectively. The role of government in providing a fertile ecosystem is crucial to SMEs. Both financial and nonfinancial are incentives for SMEs. Thus, when environmentally friendly goods have higher prices than traditional linear goods, people will not choose the more expensive ones. In other words, an effort to influence consumer preferences is needed. Overall, the initial change must come from the business itself, Bajnoczki et al. (2021).

In Spain, SMEs are focused on complying with the law and, in many cases, they are worried about their company's image. Moreover, they do not tend to be committed to environmental issues because they do not think it would increase their profits and competitiveness. They focus on cost savings (Ormazabal et al., 2018).

We could also learn the stages followed by Italian SMEs. Not all the six circular economy measures are applied at once. Recycling resulted in being, among the so-called 6R practical framework, the preferred practice of most organizations involved over the whole supply chain, from the collection of post-consumption waste to the recovery, recycling, and producing secondary raw materials. The other "principles", such as repair, reuse, and remanufacturing, are progressing well, mainly within small companies, where several laboratories deal with the reuse of products and their selling in second-hand shops or in the recovery and redistribution of food surplus and the remanufacturing of personal computers, Ghisellini and Ulgiati (2020). Applying tree-based models to the population of European SMEs shows that the country in which they operate represents the most important factor influencing companies' decision to adopt circular economy practices. It means that economic development, national programs, funding mechanisms, the institutional framework, and incentives are still very heterogeneous across countries and this situation, Zamfir et al. (2017). In addition to government support, digital sharing platforms could also help realize a circular economy, Schwanholz and Leipold (2020).

The development strategy currently developing in Indonesia to achieve sustainable development is implementing a circular economy-based business model (Bappenas, 2021). This is also shown by the attention of the Government of Indonesia through the circular economy implementation master plan made until 2025. Although the master plan focuses on manufacturing companies, a business model based on a circular economy or zero waste can also be applied in agricultural management and farms.

The following researcher underlines the importance of CE applied on the dairy farm. Zhang et al. (2021) used Meta-Analysis to analyze potential pathways for managing cow dung and milk waste based on a circular economy. Ghisellini et al. (2014) analyzed integrated agricultural and dairy production in a circular economy framework by comparing Italian and Polish agricultural systems and use Material Flow Accounting, Cumulative Energy Demand, and Emergy Accounting and Life Cycle Assessment methods. Luqman and Al-Ansari (2021) mentioned that farm waste is not managed properly, so it needs to be replaced with solutions that are more efficient and more sustainable. Luqman and Al-Ansari (2021) suggest a polygeneration system that utilizes very low concentrations of methane in the barn and utilizes all dairy farm waste in an integrated manner. Aula et al. (2018) show the applicability of the circular economy with the optimal Circular Business Model Canvas (CBMC) for KPSP Setia Kawan using the expert opinion method. In addition to scenario testing, there is also a study that analyzes the role of farmers in biogas management toward zero waste in Glagahagung Village, Purwoharjo District, Banyuwangi Regency, East Java by Triasih et al. (2020). Dewi et al. (2021) conducted a study in Banyudono Hamlet, Semarang Regency, Central Java, to explain the management and feasibility study of dairy farming by comparing process and not process waste in biogas.

3. Methods of Analysis

Based on data from the Central Statistics Agency (BPS), 8.93 per cent of the total population in Pacitan Regency was in Tegalombo District in 2019 or as many as 53.25 thousand people. Tegalombo District is located at an altitude of 500 meters above sea level, which makes Tegalombo suitable as an area for raising dairy cows. The livestock business sector, especially dairy cows, is one of the sectors that the Government of Pacitan Regency is very concerned about. Through the Department of Agriculture, the government promoted a dairy farming empowerment program in 2014. In Tegalombo, 136 households have dairy farming businesses. This study uses primary data from interviews with all women (farmer wives or heads of households) in households that own dairy farming businesses in Tegalombo, namely Tahunan, Tahunan Baru, Gemaharjo, and Ploso villages. Primary data were obtained from surveys and in-depth interviews by the authors.[3] There are 136 households interviewed, but we only use 101 households with complete answers.

Figure 1- Map of Tegalombo, Pacitan Regency, East Java
Source: Pacitan Office of Agriculture

3.1 The Model

There are two objectives of this research; first, to analyze the financial benefit received by farmer households when managing dairy farms based on a circular economy; second, to analyze the effect of women's role in managing dairy farms based on a circular economy on household income. The analysis for answering the first question will be implemented by counting the expenditures and revenues of the farms and then estimating the net income of the farms.

[3] The Questionnaire was approved by Ethical Review Board of the Universitas Gadjah Mada 2019

For the second question, this study uses dairy farming income and agriculture income in a month as yield variables. Further, the role of women i.e. their involvement in managing dairy farms based on a circular economy, is defined as a dummy variable as Women Responsibility (WR) in managing dairy farms, follows:

WR1 : dummy variable of women's involvement in managing cages and livestock
WR2 : dummy variable involvement in keeping and cleaning the cage and the cows
WR3 : dummy variable involvement in waste treatment planning
WR4 : dummy variable has attended training on cattle waste management and processing

While the variables of interest used to represent the circular economy are the dummy variables regarding manure and sewage management (MSM), which is as follows:

MSM1 : dummy variable managing livestock waste
MSM2 : dummy variable producing manure
MSM3 : dummy variable selling processed waste
MSM4 : dummy variable using waste to grow fodder crops
MSM5 : dummy variable growing organic vegetables and fruits

We also include control variables, namely individual characteristics, household characteristics, and livestock business characteristics (Diiro et al., 2018; and Fauzi and Sugiyanto, 2021). The specification models are as follows:

$$Y_{1i} = f(WR_i, MSM_i, I_i, H_i, L_i) \quad (1)$$

$$Y_{2i} = f(WR_i, MSM_i, I_i, H_i, L_i) \quad (2)$$

Where:

Y1i: i's household income from dairy farming (monthly)
Y2i: i's household income from dairy farming and agriculture (monthly)
WRi: Women's role in managing i's household dairy farm based on a circular economy
MSMi: Manure and sewage management in i's household dairy farm
Ii: Vector of individual characteristics in i's household
Hi: Vector of i's household characteristics
Li: Vector of i's household dairy farm characteristics

In previous studies, the role of women in the livestock business is represented by the Women Empowerment Agriculture Index (WEAI) or the Women Empowerment Livestock Index (WELI).

However, because this study focuses on the role of women in managing dairy farms based on a circular economy, this study uses variables taken from the questions in the questionnaire and the MSM variables.

4. Results and Discussions

The literature, including studies by Ghisellini et al. (2014), Luqman and Al-Ansari (2021), Aula et al. (2018), Triasih et al. (2020), and Dewi et al. (2021), highlights the applicability of the circular economy concept in dairy farming. This is due to the additional outputs of dairy cows, such as cow dung in the form of feces and urine, which can be effectively processed into valuable manure. Subsequently, this organic fertilizer is utilized to nourish and fertilize grass, which serves as essential feed for cattle.

In addition, manure can also be used to fertilize organic vegetables. Organic vegetables can be owned-consumed or sold for additional income. Through this scheme, the role of women in livestock management can be increased because women not only help as workers but also have a role in managing waste and obtaining additional benefits from organic farming.

The typical practice of circular farming applied in Tegalombo sub-districts is described in the following diagram. In the upper part, the dairy farm – producing fresh milk is the traditional way. Here, the waste is collected in a hole next to the cow cages. In the CE model, farmers process the waste into manure to grow organic vegetables, rice paddy, and grass for feeding the cows.

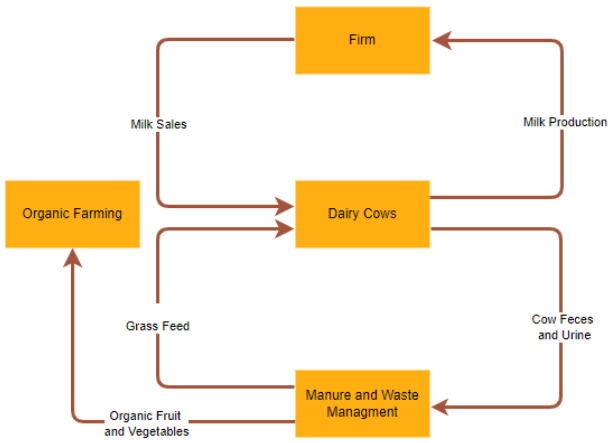


Figure 2- Typical Circular Economy Scheme in Tegalombo Dairy Farms (author's own survey)

From the sample information, we found almost all of the heads of the households are men (96 per cent), aged between 22 and 68. The highest percentage of education was junior high school or the equivalent, which reached 38.5 per cent, followed by the least educational background of elementary school or the equivalent, which reached 30.8 per cent, then the high school or equivalent 26 per cent, undergraduate 3.8 per cent, and the academy at 1 per cent. When we asked who they were (they can choose more than one profession), then they are housewives (50,96%), worked in livestock (30,77%) and farming (11,54%).

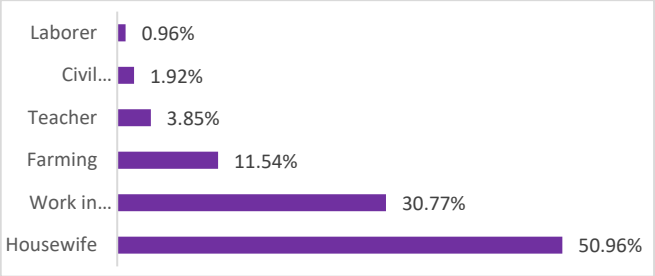


Figure 3- Typical Job, the housewife (%)

Those who own fields or rice fields (97.1 per cent) work 2 hours per day. For the men, although 63.4 per cent said their main job was as a cow grower, 87.4 per cent of these household heads also worked in the fields or rice fields. Thus, they are hard workers and diligent, not just doing one activity. Some households use their fields to grow grass for cattle feed, so there is potential to develop a circular economy by utilizing cattle farm waste to fertilize grass and organic farming. All farmers utilize livestock waste, namely cow dung, to be processed into manure, biogas, or just dried; specializes in processing manure (55 respondents), and biogas (30 respondents), while the rest is just dried or immediately disposed of.

So far, the amount of grass produced by farmers is not sufficient for livestock needs. Therefore, farmers are trying to increase grass production by fertilizing using livestock waste (95 per cent confirmed this). There are many factors that can be the cause of insufficient grass needs, such as due to limited grassland owned by livestock or the dry season. However, according to Hartatik and Widowati (2006), the use of cow dung without going through the composting process has a high carbon and water content, so it will suppress the growth of the grass. The purchase of the grass ranges from IDR 50,000 – 2,000,000 rupiahs per month.

In addition to being used to fertilize grass, manure that has gone through composting can be used to grow organic vegetables and fruits. By developing organic farming, farmers can reduce expenses for vegetable and fruits consumption or additional income. When farmer wives manage the farm, this additional income increase the role of women in livestock management. At the moment, there are 37 (out of 101) respondents who have used manure to cultivate organic vegetables and fruits. Farmers usually will follow their neighbours for new types of activities like producing manure.

The benefits of growing their own vegetables are already felt by households. From their own production, the average consumption of cabbage per person/month is 0.60 kg, eggplant is 0.54 kg, and chilli is 0.63 kg. If a household consists of 4 people, the monthly consumption of cabbage is 1 kg, eggplant is 0.84 kg, and chilli is 1.04 kg. With the price of cabbage at the time of the survey at 4,000 rupiah/kg, eggplant 5,000 rupiah/kg, and chilli price at 50,000 rupiah/kg, the household was able to save 145,949.35 rupiahs per month (about 10 per cent of the minimum wage). Although relatively small, since farmers do not need to buy manure and the availability of nutrients is more secure, the benefits will be higher than the costs.

4.1 Regression Results: Farmer's Income

Table 1 (as presented in Appendix 1) reports the estimated effect of women's role in managing dairy farms (WR), and manure and sewage management (MSM) on household income from selling milk (Model 1). Model 2 is a dairy farm and agriculture income. As we can show in Model 1, the involvement of women in managing the farms and livestock (WR1) did not significantly affect household income from dairy farming. However, by adding other variables, namely involvement in maintaining the cleanliness of cages and livestock (WR2), involvement in waste management planning (WR3), attend training on management and processing cattle waste (WR4), the WR1 could increase household income from dairy farming. The income of family whose wives is active has a higher income than those who are not involved in managing farm and livestock. Managing livestock waste (MSM1), in model 1, does not have a significant effect on household income from selling milk. Even when we add other variables, namely producing manure (MSM2), selling processed waste products (MSM3), using waste to grow animal feed crops (MSM4), and growing organic vegetables and fruits (MSM5), income from selling milk does not change. This is not surprising as farmers sell their milk to local collectors at the agreed price. As long as the milk meets the standard, it will be collected without considering the fam condition. However, there is a common understanding among farmers that keeping the farm clean will ease managing the milk quality.

In model 2, household income from dairy farming and agriculture is influenced by the high involvement of women in the management of cages and livestock (WR1). Likewise, waste management (MSM1) also has a significant effect on household income from dairy farming and agriculture.

The addition of other variables related to the role of women and MSM in model 2 shows that the involvement of women in managing the cowshed (WR1) has a significant effect on household income from dairy farming and agriculture.

The effect of training (WR4) did not appear to be as expected. Those who received training had lower incomes from milk and dairy farming and agriculture. It is necessary to examine whether the time spent on training makes them less productive (in the short term) or because of other factors. Mothers who use waste to grow animal feed crops (MSM4) have lower household income from cattle farming and agriculture than those who do not use waste to grow fodder crops. This relationship may be due to the fact that they always use fodder crops for themselves. But, farmers spend money on feed during the offseason.

Overall, other control variables that also significantly affect the income of farmers are age, education, age of the head of the household, the main occupation of the head of the household, gender of the head of the household, household expenses, and loans for cattle farming. The higher the age, the income of farmers decreases. Breeders whose household heads are a woman have lower incomes than men. The number of cows and the amount of loan received will increase the income of the family. This means that the size of the livestock business can still be increased to raise the farmer's income.

5. Conclusion

This paper analyzes what would happen if farmer wives managed their agricultural waste, practising green economy principles to increase income. The importance of sustainable agriculture and the need to increase the role of women in the management of dairy farms, especially in four dairy-producing villages in Tegalombo District, Pacitan Regency, was initiated by implementing Circular Economy-based dairy farming management. Farmers process livestock waste into manure and use it to fertilize fodder crops, vegetables and fruits. Farmers who process waste into manure have the opportunity to increase their income and are optimistic about achieving the SDGs (increasing income and increasing the role of women in the family economy).

The above conclusion is based on a survey of 101 dairy farmers in Tegalombo, Pacitan in 2021. Processing livestock waste into manure and utilizing it to fertilize fodder crops would save household expenses of 145,949.35 rupiah per month (about 10 percent of the minimum regional income). It means that practicing circular economy is beneficial to the dairy farmer, in line with the results of the circular economy in Europe and India as mentioned in the previous literatures reviewed.

The regression results confirm these calculations: that the income of the household from dairy cattle and agriculture is higher for women who are involved in managing cages and livestock than those who do not. Women in Tegalombo open up their potential to contribute the family income. As women also could be productive in the dairy farm, giving them opportunities to participate in the farm and other productive activities increase the family income. This activity will be one way to raise the women empowerment as in Ahmad and Catur, (2021).

References

Ahmad S, Catur S. (2021). The Effect of Women's Empowerment in Household Dairy Farming Business on Household Business Yields: Case Study Tegalombo, Pacitan Regency, East Java. The 16th IRSA International Conference, Indonesia

Aula M, Nasution AH, Ardiantono DS. (2018) Perancangan Model Bisnis Berbasis Circular Economy. Jurnal Sains dan Seni, ITS. 2018;7(2):2337-3520. https://doi.org/10.12962/j23373520.v7i2.34746

BPS. (2021), Kecamatan Pacitan Dalam Angka 2021. Badan Pusat Statistik Republik Indonesia, pp. 1-67

Bajnoczki C., Illes, Z., Szendro, P. (2021) The perspective of SMEs on the challenges of the circular economy in the 21st century Hungary, Progress in Agricultural Engineering Sciences 17, 1, 101-132, https://doi.org/10.1556/446.2021.00038

Bassi, F., and Dias, J. (2019). The use of circular economy practices in SMEs across the EU, Resources, Conservation & Recycling 146, 523–533, 2019 https://doi.org/10.1016/j.resconrec.2019.03.019

Dewi, K.R. et al. (2021). Waste management of traditional dairy farming for alternative energy: A feasibility study on biogas processing in Dusun Banyudono, Semarang. Journal of Environment and Sustainability. Volume 5 Number 1 (2021) 9-24. https://doi.org/10.22515/sustinere.jes.v5i1.117

Diiro, G. M., Seymour, G., Kassie, M., Muricho, G., & Muriithi, B. W. (2018). Women's Empowerment in Agriculture and Agricultural Productivity: Evidence from Rural Maize Farmer Households in Western Kenya. PLoS ONE, 13(5), 1–27. https://doi.org/10.1371/journal.pone.019799

Ghisellini P, Protano G, Viglia S et al. (2014) Integrated Agricultural and Dairy Production within a Circular Economy Framework. A Comparison of Italian and Polish Farming Systems. Journal of Environmental Accounting and Management. 2(4): 372-391. https://doi.org/10.5890/JEAM.2014.12.007

Ghisellini, P., and Ulgiati, S. (2020). Circular economy transition in Italy. Achievements, perspectives and Constraints, Journal of Cleaner Production, 243, 118360, 2020 https://doi.org/10.1016/j.jclepro.2019.118360

Hartatik W and LR Widowati. Pupuk Kandang (2006) . balittanah.litbang.pertanian.go.id

Luqman M, Al-ansari T. (2021). A novel solution towards zero waste in dairy farms: A thermodynamic study of an integrated polygeneration approach. Energy Conversion and Management. 230. https://doi.org/10.1016/j.enconman.2020.113753

Malik, A., Sharma, P., Vinu, A., Karakoti, B. (2022) Circular economy adoption by SMEs in the emerging markets: Towards a multilevel conceptual framework, Journal of Business Research, 142(March):605-619, https://doi.org/10.1016/j.jbusres.2021.12.076

Ormazabal, M., Prieto-Sandoval V., Puga-Leal, R., and Jaca, C., (2018). Circular Economy in Spanish SMEs: Challenges and Opportunities, Journal of Cleaner Production 185, 157-167, 2018 https://doi.org/10.1016/j.jclepro.2018.03.031

Sauvé, S., Bernard, S., and Sloan, P. (2016). Environmental sciences, sustainable development and circular economy: Alternative concepts for trans-disciplinary research, Environmental Development, 17, 48–56, https://doi.org/10.1016/j.envdev.2015.09.002

Schwanholz, J., Leipold, S. (2020) Sharing for a circular economy? an analysis of digital sharing platforms' principles and business models, Journal of Cleaner Production 269, 122327 https://doi.org/10.1016/j.jclepro.2020.122327

Suryantini, NPS., Arsawan, IWE., Moskalenko, S., Gorokhova, T., and Darmayanti, NPA. (2021) Circular economy: barrier and opportunities for SMEs, E3 E3S Web of Conferences 255, 01017, ISCMEE https://doi.org/10.1051/e3sconf/202125501017

Triasih et al. (2022). Peran Serta Peternak Sapi Perah Dalam Pengelolahan Biogas Menuju Daerah Zero Waste. E-Prosiding Seminar Nasional Ilmu Peternakan Terapan Jurusan Peternakan Politeknik Negeri Jember.

Yasa, IGW M. (2010), Ekonomi Hijau, Produksi Bersih, dan Ekonomi Kreatif: Pendekatan Mencegah Resiko Lingkungan Menuju Pertumbuhan Ekonomi Berkualitas di Provinsi Bali, Jurnal Bumi Lestari, volume 10 No 2, Agustus, hal. 285-294, Ahmad S, Catur S. (in Indonesian language)

Zamfir, AM., Mocanu, C., and Grigorescu, A. (2017) Circular Economy and Decision Models among European SMEs, Sustainability, 9, 1507 https://doi.org/10.3390/su9091507

Zhang J, Wang M, Yin C et al. (2021). The potential of dairy manure and sewage management pathways towards a circular economy: A meta-analysis from the life cycle perspective. Science of the Total Environment. 2021;779. https://doi.org/10.1016/j.scitotenv.2021.146396

Appendix 1

VARIABLES	Model 1	Model 1 with multi-interest var	Model 2	Model 2 with multi-interest var
WR1	1.683	2.333**	2.136**	2.609***
	(1.026)	(1.007)	(0.960)	(0.902)
WR2		-0.957		-0.535
		(0.663)		(0.592)
WR3		-0.158		-0.172
		(0.490)		(0.489)
WR4		-1.128**		-0.941*
		(0.454)		(0.505)
MSM1	0.455	0.610	1.040**	0.923*
	(0.465)	(0.455)	(0.474)	(0.494)
MSM2		-0.409		0.00551
		(0.470)		(0.512)
MSM3		0.423		0.103
		(0.566)		(0.654)
MSM4		-6.432*		-5.768*
		(3.612)		(3.126)
MSM5		0.215		0.232
		(0.380)		(0.401)
age	-0.0776	-0.0604	-0.110**	-0.0919**
	(0.0517)	(0.0445)	(0.0523)	(0.0426)
educ	0.259**	0.251**	0.208*	0.209*
	(0.116)	(0.102)	(0.113)	(0.107)
job	2.093	0.853	2.075	0.819
	(1.940)	(1.158)	(1.894)	(1.278)
workhours	0.142	0.0634	0.132	0.0511
	(0.130)	(0.0890)	(0.128)	(0.0975)
agehh	0.0852*	0.0714*	0.124***	0.106***
	(0.0451)	(0.0390)	(0.0456)	(0.0398)
hheduc	-0.164	-0.100	-0.0682	-0.00750
	(0.118)	(0.101)	(0.116)	(0.106)
hhjob	1.726*	1.677**	0.881	0.852
	(0.865)	(0.672)	(0.986)	(0.899)
numfamem	0.400	0.166	0.181	-0.0546
	(0.266)	(0.176)	(0.251)	(0.197)
hhgender	-1.920**	-1.770*	-2.325**	-2.065**
	(0.937)	(0.904)	(0.992)	(0.968)
hhworkhours	-0.0170	0.0742	-0.0280	0.0437
	(0.0833)	(0.0602)	(0.0821)	(0.0688)
hhexpense	1.300*	0.938**	1.651**	1.344***
	(0.713)	(0.419)	(0.630)	(0.385)
numcows	0.388***	0.445***	0.294**	0.314**
	(0.144)	(0.135)	(0.147)	(0.150)
durbusiness	-0.143	-0.0883	-0.133	-0.0901
	(0.115)	(0.0991)	(0.119)	(0.112)
workers	-0.315	-0.114	-0.116	0.00621
	(0.291)	(0.240)	(0.282)	(0.267)
owncow	-0.104	-0.657	-1.383	-1.816**
	(0.952)	(0.718)	(0.904)	(0.862)
selldistnc	-0.0477	-0.0253	-0.162*	-0.147
	(0.0942)	(0.0939)	(0.0948)	(0.0957)
distncfeed	-0.0474	-0.111	0.0748	0.0295
	(0.103)	(0.103)	(0.105)	(0.106)
loan	0.280	0.707*	0.451	0.816**
	(0.390)	(0.402)	(0.377)	(0.388)
productncost	-0.181	-0.125	-0.213	-0.148
	(0.290)	(0.230)	(0.284)	(0.255)
hhworkinagr			-0.150	0.0637
			(0.887)	(0.978)
Constant	-3.526	3.226	-2.413	3.678
	(2.326)	(4.376)	(2.194)	(3.977)
Observations	85	84	85	84
R-squared	0.623	0.766	0.671	0.775