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Dynamic System Modeling to Support Taro's Agribusiness Policy

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Abstract | In the development of agribusiness, the cultivation of taro (*Colocasia esculenta* (L.) Schott) in West Papua Province is of utmost importance in the development of food consumption and agro-industry raw materials, which powerfully highlights the necessity of research. Hence, the present study aims to construct a dynamic system model that supports sustainable policy formulation for the taro agribusiness. The methodology employed is dynamic system modeling, supported by both primary and secondary data. This research produced two main sub-models, namely the upstream agriculture sub-model and the downstream sub-model which shows important policy actions, namely the provision of capital assistance, agro-infrastructure development, control of land use change, empowerment of extension workers and farmers, provision of price subsidies, strengthening primary and secondary distribution, and regulatory modifications that are expected to increase taro production, distribution, and consumption. Upstream and downstream integration through a dynamic system model enables local authorities to formulate sustainable management strategies in line with the Sustainable Development Goals (SDGs), particularly those related to zero hunger (SDG 2), sustainable economic growth (SDG 8), and responsible consumption and production (SDG 12). Future research on taro should integrate food safety indicators, considering SDG 12 and especially SDG 3, as tuber crops face risks of contamination from microplastics and heavy metals.

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Introduction

The dependence on rice (*Oryza sativa* L.), wheat (*Triticum aestivum* L.), and corn (*Zea mays* L.) crops provides the bulk of the caloric and protein intake globally. This heavy reliance on cereal crops, the domination of which is caused by dependency on specific resources, continues to strengthen food vulnerability, predicts the decline of productivity, and codifies climate change (Farooq *et al*., 2023; Saxena *et al*., 2018), degradation of resources, and vulnerability of the geopolitics of the global supply change (Fathi *et al*., 2024; Ibba *et al*., 2025). Therefore, more alternative sources of food need to be sought and developed, such as the development of UMM - analog rice (Damat *et al*., 2021, 2022; Tain *et al*., 2023), or healty cookies/

bread – gluteen free (Damat *et al*., 2020, 2023). Another alternative is using waste for fungsional food/feed (Anam *et al*., 2023; Prihartini et al., 2009, 2021; Setyobudi *et al*., 2023, 2024a; Tonda *et al*., 2022).

Many alternative food sources are available, among others taro (*Colocasia esculenta* (L.) Schott) – common name: Yam, Cocoyam, Dasheen – is seen as a potential future alternative. Employment of taro flour and starch in the food industry has the potential to address and enhance food security in specific geographic ranges, especially local communities (Boahemaa *et al*., 2024; Mangallo *et al*., 2018; Shah *et al*., 2022). Taro has the potential to significantly enhance food diversification and sustain global food security in the future (Ndlovu, *et al*., 2025; Tan *et al*., 2025).

For a long time, Taro has been a vital component in the food systems of several people across the globe, including West Papua in Indonesia. Taro cultivation traces back to the 4th century BC, and though initially grown in places such as Micronesia and Cyprus, the agriculture of taro spread across Africa and into Europe (Fujimoto, 2009; Guzzon *et al*., 2025). As evidenced by the patterns of consumption, its importance spans across both Africa and Asia, and lately, portions of Brazil have engaged in growing commercial importance (Grimaldi *et al*., 2018; Nunes *et al*., 2012).

Taro serves as a substitute staple food and comes with important socio-cultural significance and economic benefits for community members. Taro is also used for ceremonial purposes, as medicine, in handicrafts, as livestock feed, and as a source of natural fertilizer, demonstrating the close relationship between traditional case uses of community wisdom (Shah *et al*., 2022; Sharma *et al*., 2025; Windarsih *et al*., 2023). Taro can support farmers' incomes, contribute to food security for poor households in rural areas, and a greater scope would exist through the breeding of upper-tuber varieties and sustainable intercropping systems (Gerrano *et al*., 2019; Maretta *et al*., 2022; Otekunrin *et al*., 2021). Farming with taro is an integral part of the culture and livelihoods of the local community.

Taro agribusiness faces several bottlenecks despite its potential in West Papua. Referring to the facts on the ground, there is no detail as to the strategic position that taro occupies in the regional food system, its availability and distribution status, as well as its relationships with production, consumption, and agro-industrial needs. Weakened marketing infrastructure, poor post-harvest handling, and limited access to requirements such as financial support have become significant constraints, and the same conditions easily apply to taro agribusiness development in West Papua (Chang, 2011; Giovannucci, 2015; Qange *et al*., 2024; Shiferaw *et al*., 2012). Few market access points may exacerbate the vulnerability of smallholder farmers, a situation that may also occur in Papua (Acquah *et al*., 2021; Bammite *et al*., 2018). Institutional weaknesses, such as limited technological and legal infrastructure, as well as governance challenges, have hampered agribusiness development (Borisova *et al*., 2024; Ikuemonisan, 2024; Bannor *et al*., 2024; Naz, 2015). This will also exacerbate the impact of slow adaptation to new technological innovations (especially post-harvest technology) on the generally low welfare and food security levels in West Papua (Iyai *et al*., 2023). Moreover, this gap may be exacerbated by the scarcity of comprehensive quantitative data and analytical approaches that can capture the dynamic interactions between social, economic, ecological, and institutional factors.

This research is important due to the various obstacles to taro agribusiness mentioned above and the applicability of dynamic system modelling. This modelling approach enables an in-depth analysis of the interrelations among the most complex interacting variables in taro agribusiness, including production, distribution, consumption, government policies, and local wisdom on taro management. Therefore, dynamic systems would not only explain the current occurrence in taro agribusiness but also build projections for its future state under any of the policies that may be adopted. Therefore, this research provides the rationale for developing a dynamic model to assess various taro agribusiness policies in West Papua Province.

This research is also relevant to tips for achieving the Sustainable Development Goals (SDGs). SDG 2, in particular, emphasizes SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production) (United Nations, 2025). The findings of this study not only support evidence-based decision-making at the local level (Government of West Papua Province, 2018) but also contribute directly to global efforts for sustainable development and circular economy improvement (Damat *et al*., 2024; Tonda *et al*., 2024).

Materials and Methods

Study area

The research was carried out in West Papua Province, one of the locations with the most significant potential for increasing taro production as a government target (BKP, 2020). The selection of research locations in three districts, namely Maybrat Regency (Coordinates: 1°17'33"S, 132°22'54"E), Sorong Regency (Coordinates: 0°52'46.42"S, 131°15'39.74"E), and South Sorong Regency (Coordinates: 1°30'17.6"S, 132°17'11.6"E), was deliberately determined because these areas are known for their taro production.

Data collection

The determination of research subjects or key informants is carried out by purposive sampling, namely through direct appointment based on the consideration that they have a role as influential actors in the decision-making process and master and understand information relevant to the focus of this research. The informants in the study included farmers, traders, collectors, and retailers, taro processing agroindustry players, and representatives of local governments and other relevant stakeholders. The determination of additional informants was carried out using the snowball sampling method, which is a sampling technique that starts with a small number of respondents, then develops gradually through the recommendations of previous informants, until reaching a wider number (Sugiyono, 2014). A total of 100 informants, comprising 54 taro farmers, 12 collectors and retailers, six units of taro processed agro-industry, and 28 government agencies in the agricultural sector.

Data collection uses primary data obtained through in-depth interviews with farmers, agribusiness actors, and local governments to obtain data on aspects of production, distribution, consumption, and socio-cultural factors. Next, secondary data were collected from official BPS publications, official reports, previous research results, and scientific literature related to taro commodities.

Model development

The design of this research was carried out using a system dynamics modelling approach, which aims to understand the relationships between variables in complex systems (Bozikov *et al*., 2018). The preparation of the system dynamics model is carried out with Studio 10 Academic Powersim software (Powersim Software AS, Norway), namely at the stage of making a causal diagram, making a flow diagram or sub-model diagram (level and rate) of the system being studied, the stage of developing the model of the system, the stage of testing model assumptions, and the simulation stage (Darly *et al*., 2024; Xu *et al*., 2021). For this study, the research results focus on the stages of creating causal loop diagrams and flow charts or sub-model diagrams (level and rate) of the general model structure for taro availability.

Validation in this modelling is carried out by comparing the behaviour of the model with the real system, namely, with the MAPE (Mean Absolute Percentage Error) test. MAPE was chosen because it can provide an error measure in the form of percentages, so that it is easier to understand and interpret the accuracy level of the model (de Myttenaere *et al*., 2016; Tofallis, 2015).

Results and Discussion

The research results focus on the stages of creating causal loop diagrams and flow diagrams or sub-model diagrams (level and rate) of the general model structure for taro availability. The relationship between factors is visualized through a causal loop diagram. The model of the causal loop diagram is shown in Figure 1.

The causal loop diagram above shows the interaction of sub-models between i) the sub-model of the upstream agribusiness system - farming business, and ii) the sub-model of the downstream agribusiness system. The explanation of the cause-and-effect relationship in the dynamic system model to support the taro agribusiness policy in West Papua is explained as follows.

Sub-model of upstream agribusiness – farming

The sub-model of upstream agribusiness–farming is used as the main model in the overall dynamic model structure. The purpose of the upstream agribusiness sub-model– farming is to examine taro production in relation to determining the surplus/deficit of taro supply in the research area. In the upstream agribusiness sub model, factors affecting taro production include the area of planting, changes in land function (conversion), harvest area, productivity, and local wisdom.

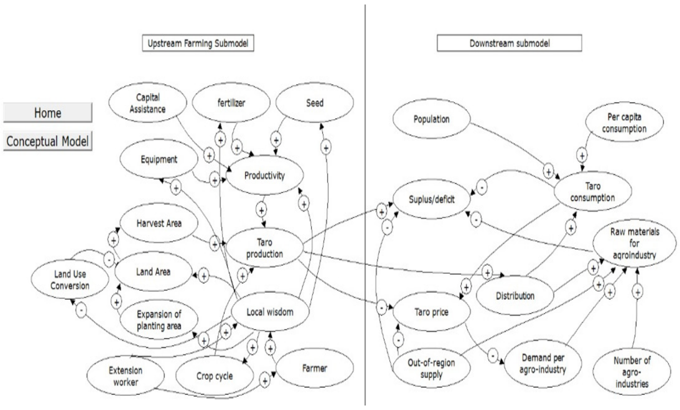

Figure 1: *Causal loop diagram of a dynamic system to support taro agribusiness policies in west papua*

Figure 1 outlines a sub-model of upstream farming for productive and responsive agriculture, based on the intersection of local wisdom and traditional productivity. It outlines the positive contributions of capital, whether in the form of productivity assistance, and productivity amplifying investments such as equipment, to local wisdom-based cycle patterns and boosted local taro culture. It amplifies the role of the civilization of agriculture in its local cycle of wisdom and adaptive culture variables.

Furthermore, taro production is influenced by the harvest area, which is determined by the land area and the expansion of the planting area. The land area itself is greatly influenced by land conversion, which has a negative relationship because it reduces the availability of land for agriculture. The expansion of the planting area plays a positive role in increasing the land area. It is also influenced by the planting cycle, which takes into account the rotation and intensity of planting based on the season or the local agricultural system. On the other hand, extension workers and farmers also play a positive role in encouraging the sustainability of the planting cycle through capacity building and knowledge.

Understanding the complex interactions in the sub-model of upstream agribusiness – farming and designing an effective development strategy - requires a model representation that describes the relationship between variables as a whole. Therefore, referring to the causal loop diagram (Figure 1) a dynamic model can be made of the upstream sub-model of farming as shown in the following image.

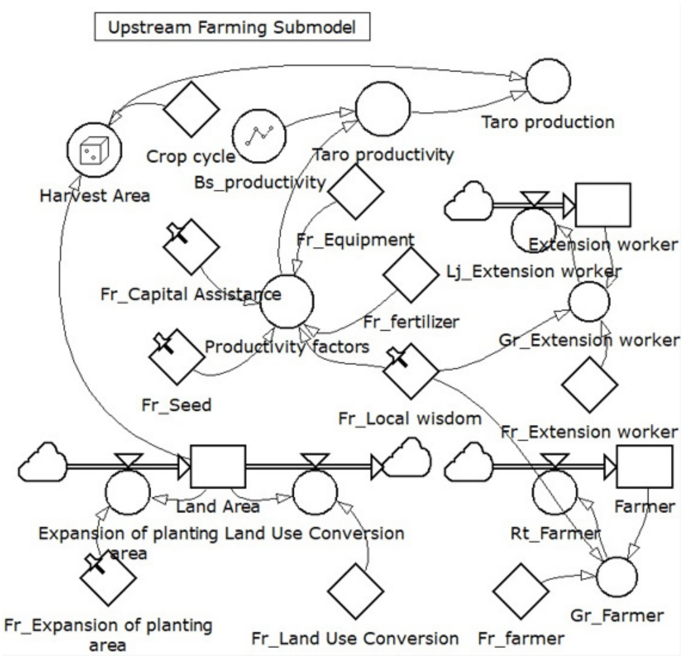

Figure 2: *Stock flow diagram sub-model of upstream agribusiness – farming*

The Figure 2 is a Stock and Flow Diagram of the upstream farming sub-model in the dynamic system of taro agribusiness. This model describes the interaction between various input factors, such as capital assistance, seeds, fertilizers, and equipment, that are brought together in the equipment variable (facilities and infrastructure). This equipment variable plays a key role in increasing taro productivity, which ultimately has an impact on taro production. In addition, productivity is also influenced by local wisdom fractions, which shows the importance of local practices and knowledge in the cultivation process.

Furthermore, taro productivity and production are significantly influenced by the harvest area, which is the result of the delay and base productivity processes (taro productivity per hectare). The harvest area is determined by the planting area, which is formed from the balance between the expansion of the planting area and the conversion of land use. The land area variable acts as a stock, which is influenced by two flows: expansion of planting area (positive) and land Use Conversion (negative). Each of these flows is also influenced by the fractions (expansion of planting area fractions and land use conservation fractions), which reflect the intensity of land change.

In addition to physical and capital aspects, this model also includes human factors, namely extension workers and farmers. The number of extension workers and farmers is determined by the rate of recruitment (extension worker rate, farmer rate) and growth or training (extension worker growth, farmer growth), which is also influenced by the relevant factions (extension worker fractions, farmer fractions). The presence of extension workers and farmers is significant in strengthening the capacity of human resources to run the farming system.

Downstream agribusiness sub-model

The variables used in the downstream agribusiness sub-model are the need for taro for consumption and agro-industrial raw materials. The assumption used in this sub-model is the value of the per capita taro consumption rate in West Papua Province of 9.58 $kg^{-1}yr^{-1}$ $capita^{-1}$ (BPS, 2022).

Based on Figure 1, the causal loop diagram of the downstream sub-model of the taro agribusiness shows the relationships between the variables of consumption, distribution, price, agro-industrial raw materials, and surplus/deficit. Taro consumption is directly influenced by the population and per capita consumption. Increased consumption will reduce the surplus/deficit, which then has an impact on the availability of agro-industrial raw materials.

Agro-industrial raw materials themselves are formed from two primary sources: taro distribution and out-of-region supply. Distribution is affected by surplus/deficit as well as taro prices, where high prices tend to reduce distribution due to reduced purchasing power or market preferences. On the other hand, the increase in raw materials encourages the fulfillment of agro-industrial needs, which is calculated based on the number of agro-industries and their needs per unit.

When the need for agro-industry increases but raw materials decrease due to high consumption or limited supply, there will be an imbalance that pushes the price of taro up. The price increase can then encourage the entry of supply outside the region to balance needs, while affecting the redistribution of taro to the agro-industrial sector.

Referring to the causal loop image (Figure 1) a dynamic model can be created with a downstream sub-model as shown in Figure 3.

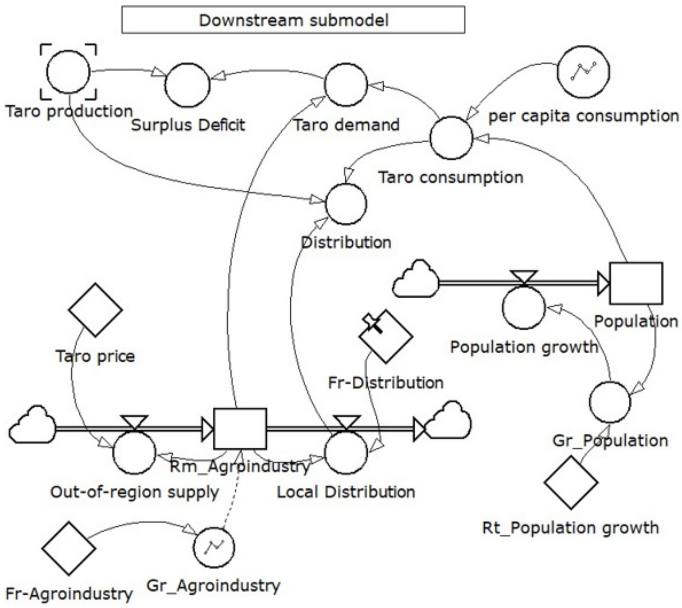

Figure 3: *Stock flow sub-model of downstream agribusiness*

The image is a Stock and Flow Diagram (SFD) of the Downstream Sub-model in the taro agribusiness system. This model depicts the dynamic flow between the supply, consumption, and utilization of taro for industry, as well as the relationship to population growth. On the right side of the diagram, the Population stock increases through the Population Growth Rate stream, which is influenced by the Population Growth and Population Growth Fractions. This variable then affects taro consumption by multiplying by per capita consumption, forming a Taro Consumption stream. On the left side, taro consumption will reduce the Surplus/Deficit stock, while Taro Production will increase it. In the event of a deficit, the system will respond by increasing External Supply and increasing Local Distribution that enters the agro-industry. This local distribution depends on the Taro Price, which is affected by the availability of surplus/deficit and is regulated by the Local Distribution Faction. The External Supply Faction also controls external supply. This model shows that the balance between production and consumption is essential in maintaining the stability of the taro supply for the agro-industry.

In the downstream sector, Agroindustry is a key component that is fulfilled by local distribution flows and external supply. The number of agro-industries is increasing through the Agroindustry Growth Rate, which the Agroindustry Faction determines. Thus, the growth of the agroindustry sector is highly dependent on the stability of taro raw materials, which is influenced by distribution, external supply, and consumption.

Testing using MAPE (Mean Absolute Percentage Error) was applied to taro production data, taro productivity data, and taro consumption data in 2020 to 2022, obtaining values of 7.2 % , 1.3 % and 0.1 %. Based on the accuracy criteria of the MAPE value model of the two variables that were tested, the calculation results showed that the MAPE value was below 10 %, so it can be concluded that the model is quite accurate and feasible to use.

This research accomplished the dynamic system modeling to assist the taro agribusiness within two sub models - the upstream sub model, farming business, and the downstream sub model. The upstream and downstream sub models are crucial to analyze the socio-economic and environmental interactions, assist integrated planning of agriculture and industry, and enhance the competitiveness of agribusiness value chains (Ferreira *et al*., 2016). Recent advances demonstrate the use of dynamic systems to drive sustainability in small-scale agribusiness through circular economy strategies, which provide valuable insights for policymakers and stakeholders (Wirjodirdjo *et al*., 2025).

The causal loop diagram of the upstream sub-model-farming is very complicated and interlinked, signifying the realities of strategic interventions within the upstream sector for the sustainable increase of taro production. Indeed, this kind of diagram helps to illustrate how the system dynamics are manifested as interconnected feedback from the interaction of agroecosystem structures, management practices, and climate factors (Manrique *et al*., 2020). Systems must integrate production inputs (seeds, fertilizers, and equipment), institutional support (capital assistance, extension workers), and local elements of local wisdom and farmers to be managed to optimize productivity while maintaining sustainability in the agricultural system. Traditional ecological knowledge gives a better-adaptive, resilient strategy to agro-ecosystem management (Sharma, 2017). Local factors also play a critical role by having a significant impact on linkages of energy, water, waste, and land concerning the sustainability of agricultural products (Pemi *et al*., 2024).

The uncharged stock-and-flow diagram, representing the upstream farmer sub model, thus describes a dynamic flow that makes it possible to recognize the points in the intervention policies where capital assistance can be augmented, infrastructure provided, land-use transfer fully controlled, and the extension workers and farmers made even stronger for achieving sustainability within the taro agribusiness in West Papua. More recent studies also show that interventions in governance practices, such as agroforestry, reforestation, and farmer education, can also be recognized through an SFD-based analysis that would be capable of sustaining viable agribusiness practices (Alamsyah *et al*., 2025). In linking the SFD model to holistic indicators, especially considering short- and long-term benefits of natural environmental impacts on farmers' socio-economic sustainability, such an outcome allows tracing forward and backward linkages to choose proxy indicators for the variables that are complex or difficult to measure (Muthuprakash *et al*., 2017).

The downward Sub-model CLD presents the causal loop diagrams through which several variables affect one another in the downstream agriculture and also provides the policy-simulating opportunities like price subsidies, building up of distribution networks, or consumption control. CLD was used in the coffee agroindustry to amalgamate upstream and downstream lineages, notwithstanding the accentuation of the importance of production, quality, and institutional integration in shaping agribusiness sustainability (Santoso *et al*., 2021).

Furthermore, the Stock and Flow Diagram (SFD) model of the downstream sub-model reflects the complex relationships between variables and provides an overview of how policies on a single variable (*e.g*., distribution or consumption) can have a systemic impact on the overall downstream model of taro agribusiness. On the other hand, the integrated farming system model for agribusiness testifies the futuristic utilization of system dynamics in the smallholder approach of taro agribusiness, by highlighting the connection of production, agro-industrial activities, and cooperatives (Hakim *et al*., 2024).

The upstream and downstream integration of taro agribusiness in West Papua through a dynamic system model is certainly in line with the strategy to achieve the Sustainable Development Goals (SDGs).

SDG 2 emphasizes sustainable agriculture, reducing food waste, and promoting sustainable consumption and production patterns (Ardra *et al*., 2022; Donato *et al*., 2023; Gil *et al*., 2019; Kumar *et al*., 2022). SDG 8 focuses on decent work and economic growth (Babacan, 2025; Boudt *et al*., 2025; Fu *et al*., 2024). SDG 12 aims to ensure sustainable consumption and production patterns (Ardra *et al*., 2022; Guevara *et al*., 2019; Raman *et al*., 2024) Therefore, an integrative and collaborative approach that connects science, policy and community is essential to achieve that agenda.

The implementation of this research can be carried out through collaboration between taro farmers, local governments, and agribusiness institutions to evaluate its implementation in real life in West Papua. Further research can expand this model by including adaptive policy simulations to improve its accuracy and scalability in various regions in West Papua. This research not only contributes to the development of dynamic systems modeling theory, but also serves as a practical reference for future research and policy formulation in support of the sustainable development of taro agribusiness.

Conclusions and Recommendations

This research produced two sub-models, namely the upstream sub-model that focuses on agricultural activities and the downstream sub-model that focuses on consumption and agro-industrial raw materials. The model is designed to demonstrate the policy intervention points, namely increasing capital assistance, providing infrastructure, controlling land use diversion, and empowering extension workers and farmers. In addition, there are also intervention policies such as price subsidies, strengthening distribution, or controlling consumption to support taro agribusiness policies. Further analysis revealed that the integration of the two sub-models allows for a holistic evaluation of the relationship between local socio-economic, environmental, and cultural factors, thus facilitating integrated planning of agricultural production and agroindustry. This dynamic model is designed to support taro agribusiness policies and help local governments develop policies that benefit the sustainable consumption of food and agro-industrial raw materials, thereby increasing global food security, driving economic growth, and ensuring responsible consumption in line with the SDGs.

Future research

Future research on taro should include a food safety analysis, as this aspect is closely linked to the Sustainable Development Goals, particularly Goal 12 (responsible consumption and production) and Goal 3 (good health and well-being). Food crops grown in soil have been reported to be contaminated with microplastics and heavy metals. This includes vegetables or tubers such as carrots - *Daucus carota* subsp. Sativus (Hoffm.) Schübl. & G. Martens (Dong *et al*., 2021), radishes - *Raphanus sativus* L. (Shorobi and Park, 2025), onions - *Allium cepa* L. (Maity *et al*., 2023), garlic - *Allium sativum* L. (Song *et al*., 2024), sweet potatoes - *Ipomoea batatas* (L.) Lam. (Shi *et al*., 2023), potatoes - *Solanum tuberosum* L. (Chidewe, 2025; Qaiser *et al*., 2025; Setyobudi *et al*. 2024b, 2024c, 2025), and cassava - *Manihot esculenta* Crantz (Enyoh et al., 2023). Microplastics, often referred to as “emerging pollutants,” are suspected to be harmful to living organisms due to their potential to generate free radicals (Garfansa *et al*., 2024; Hermayanti *et al*. 2024, 2025).

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Novelty Statement

Research related to taro agribusiness in Indonesia, particularly in West Papua, remains limited to aspects of cultivation, nutritional value, and traditional utilization. Comprehensive studies with a systems approach to understanding the interactions between production, distribution, consumption, and policy have not been widely conducted. Additionally, there has been no research that explicitly builds dynamic system models based on the Powersim Studio software to evaluate policy strategies. The novelty of this research lies in its ability to formulate and develop alternative strategies for integrated and adaptive agribusiness policies that strengthen the role of taro as a staple food and economic commodity in

West Papua.

Author's Contribution

Anang Triyoso: Responsible for the formulation of research concepts, data collection and analysis, article preparation, editing, and response to reviewer comments.
Indah Prihartini: Contribute research ideas, provide direction and supervision, review draft manuscripts, and follow up on reviewer comments.
Anas Tain: Plays a role in the formulation of research concepts, provides guidance and supervision, reviews articles, and responds to reviewer input.
Endang Gunaisah and Maryam: Involved in the formulation of research concepts, providing guidance and supervision, reviewing manuscripts, and responding to reviewer comments.

Generative AI and AI-assisted technology statement
The authors state that they used generative AI and AI-assisted technology in preparing this manuscript, specifically utilizing ChatGPT and Grammarly to enhance English grammar and manuscript clarity. The Authors remain fully responsible for the content of this manuscript.

Conflict of interest
The author assures that this study is free from any conflicts of interest.

References

Acquah, I.N., J. Akyeh and E.K. Quansah. 2021. Minimizing post-harvest losses through digitally enabled supply chain visibility: A design science approach. 27th Annu. Am. Conf. Inf. Syst. AMCIS., 2021. 1786.

Alamsyah, A., I. Setiawan, H. Hapsari, T. Karyani, P.N. Kurnia and R.S. Sundari. 2025. Agribusiness governance model in the upper Citarik sub-watershed: Insights from the upper Citarum watershed, Bandung regency. J. Sustain. Sci. Manag., 20: 789–803. https://doi.org/10.46754/jssm.2025.04.007

Anam, C., N. Harini, D. Damat, R.H. Setyobudi, I. Ekawati, T. Liblik, E.D. Purbajanti, H. Bernedektus, L.M. Souripet, A. Fauzi, A.R. Farzana, R. Tonda, I. Iswahyudi, A. Amiroh, M. Qibtiyah, D.E. Kusumawati, I. Istiqomah and E. Hamidah. 2023. Functional characteristics of trash fish in Lamongan Regency, East Java, Indonesia. E3S Web Conf., 432(00007): 1–12. https://doi.org/10.1051/e3sconf/202343200007

Ardra, S. and M.K. Barua. 2022. Halving food waste generation by 2030: The challenges and strategies of monitoring UN sustainable development goal target 12.3. J. Clean. Prod., 380: 135042. https://doi.org/10.1016/j.jclepro.2022.135042

Babacan, H. 2025. From crisis to policy action: Tackling climate change through SDG 13. Int. J. Commun. Soc. Dev., 7(2): 205–221. https://doi.org/10.1177/25166026251351370

Bammite, D., P.J. Matthews, D.Y. Dagnon, A. Agbogan, K. Odah, A. Dansi and K. Tozo. 2018. Constraints to production and preferred traits for taro (*Colocasia esculenta*) and new cocoyam (*Xanthosoma mafaffa*) in Togo, West Africa. Afric. J. Food. Agric. Nutr. Dev., 18: 13388–13405. https://doi.org/10.18697/ajfand.82.17360

Bannor, R.K. and K.K. Arthur. 2024. A systematic review and bibliometric analysis on agribusiness gaps in emerging markets. Res. Glob., 8: 100214. https://doi.org/10.1016/j.resglo.2024.100214

BKP. 2020. Roadmap for local food diversification of non-rice carbohydrate sources (2020-2024). Jakarta, Indones., https://badanpangan.go.id/storage/app/uploads/public/ 5f6/18c/e7a/5f618ce7a70dc489660982.pdf

Boahemaa, L.V.B. Dzandu, J.G.N. Amissah, P.T. Akonor and F.K. Saalia. 2024. Physico-chemical and functional characterization of flour and starch of taro (*Colocasia esculenta*) for food applications. Food Humanit., 2: 100245. https://doi.org/10.1016/j.foohum.2024.100245

Borisova, L. and Y. Sorokina. 2024. Prospects for the development of agribusiness in conditions of economic instability. Bio. Web. Conf., 116(07039): 1–8. https://doi.org/10.1051/bioconf/202411607039

Boudt, K., Y. Inghels and A. Spithoven. 2025. Mapping economic growth and employment in EU-funded research projects: Trac(k)ing the SDG 8 trajectory. De Econ., 173(1): 245–275. https://doi.org/10.1007/s10645-024-09448-0

Bozikov, J., D. Relic and G. Dezelic. 2018. Use of system dynamics modeling in medical education and research projects. Stud. Health Technol. Inform., 247: 830–834. https://doi.

org/10.1051/bioconf/202411607039
BPS, P.P.B. 2022. Analysis of consumption expenditure patterns of the population of West Papua Province 2022. BPS Provinsi Papua Barat, Manokwari, Indonesia.
Chang, H.S. 2011. Quality management in the Papua New Guinea horticultural sector. Stewart Postharvest Rev., 7(3): 11. https://doi.org/10.2212/spr.2011.3.11
Chidewe, L. 2025. Emerging contaminants in potatoes: Occurrence of polycyclic aromatic hydrocarbons, microplastics and heavy metals. Potato Res. https://doi.org/10.1007/s11540-025-09925-2
Damat D., R.H. Setyobudi, P. Soni, A. Tain, H. Handjani and U. Chasanah. 2020. Modified arrowroot starch and glucomannan for preserving physicochemical properties of sweet bread. Ciênc. Agrotec., 44: 1–8. https://doi.org/10.1590/1413-7054202044014820
Damat, D., R.H. Setyobudi, J. Burlakovs, Z.V. Gaile, D.D. Siskawardani, R. Anggriani and A. Tain. 2021. Characterization properties of extruded analog rice developed from arrowroot starch with addition of seaweed and spices. Sar. J.Agric., 37(Sp.1): 159–170. https://dx.doi.org/10.17582/journal.sja/2021.37.s1.159.170
Damat D., R.H. Setyobudi, A.T. Salsabila, E. Andoko, D.N. Putri and R. Harini 2022. The characteristics of functional analog rice made from modified arrowroot starch and corn flour with seaweed. Jord. J. Biol. Sci., 15(4): 709–716. https://dx.doi.org/10.54319/jjbs/150420
Damat, D., R.H. Setyobudi, N. Harini, A. Asmawati, S. Anwar, C.Z. Mahesah, M. Wachid, E. Andoko and A.T. Salsabila. 2023. Characteristics of gluten free biscuit from purple sweet flour, rice brands and coffee cherry flour. E3S Web Conf., 432(00008):1–9. https://doi.org/10.1051/e3sconf/202343200008.
Damat, D., R.H. Setyobudi, S. Anwar, M.A. Wedyan, Z. Vincevica-Gaile, Y.A. Nugroho, T. Liwang, T.D.N. Subchi, A. Fauzi, H.A. Manshur, D.D. Siskawardani, V.A. Wahyudi, Y.M. Ananda and H.A. Rachmawati. 2024. Coffee pulp characterization and utilization in coffee cherry flour for circular economy improvement. Sar. J.Agric., 39(Sp.1): 71–83.| https://dx.doi.org/10.17582/journal.sja/2023/39/s1.71.83
Darly, S.S. and D. Kadhiravan. 2024. Simulation strategies for analyzing data. In Digital Twin Technology and Applications. New York: Auerbach/Taylor and Francis. 130–170. https://doi.org/10.1201/9781003469612-6
de Myttenaere, A., B. Golden, B. Le Grand and F. Rossi. 2016. Mean absolute percentage error for regression models. Neurocomput., 192: 38–48. https://doi.org/10.1016/j.neucom.2015.12.114
Donato, K., M.C. Medori, L. Stuppia, T. Beccari, M. Dundar, R.S. Marks, S. Michelini, E. Borghetti, C. Zuccato, L. Seppilli, H. Elsangak, G. Sozanski, D. Malacarne and M. Bertelli. 2023. Unleashing the potential of biotechnology for sustainable development. Eur. Rev. Med. Pharmacol. Sci., 27: 100–113. https://doi.org/10.26355/eurrev_202312_34694
Dong, Y., M. Gao, W. Qiu and Z. Song. 2021. Uptake of microplastics by carrots in presence of As (III): Combined toxic effects. J. Hazard. Mater., 411: 125055. https://doi.org/10.1016/j.jhazmat.2021.125055
Enyoh C.E., Q. Wang, M.H. Rabin, R.O. Bakare, J.L. Dadiel, W. Shangrong, S. Lu and I. Ilechukwu. 2023. Preliminary characterization and probabilistic risk assessment of microplastics and potentially toxic elements (PTEs) in garri (cassava flake), a common staple food consumed in West Africa. Environ. Anal. Health Toxicol., 38(1): e2023005. https://doi.org/10.5620/eaht.2023005
Farooq, A., N. Farooq, H. Akbar, Z.U. Hassan and S.H. Gheewala. 2023. A critical review of climate change impact at a global scale on cereal crop production. Agron., 13(1): 162. https://doi.org/10.3390/agronomy13010162
Fathi, A., S.R.G. Shiade, F. Kianersi, M.A. Altaf, E. Amiri and E. Nabati. 2024. Photosynthesis in cereals under drought stress. In: Pessarakli, M. (Eds.). Handbook photosynthes. fourth edition, 568–576. https://doi.org/10.1201/b22922-38
Ferreira, J.O., M.O. Batalha and J.C. Domingos. 2016. Integrated planning model for citrus agribusiness system using systems dynamics. Comput. Electron. Agric., 126: 1–11. https://doi.org/10.1016/j.compag.2016.04.029
Fu, B. and J. Zhang. 2024. Progress and challenges of Sustainable Development Goals (SDGs) in the world and in China. Bull. Chin. Acad. Sci., 39(4): 804–808. https://doi.org/10.16418/j.

issn.1000-3045.20240221004

Fujimoto, T. 2009. Taro (*Colocasia esculenta* [L.] Schott) cultivation in vertical wet-dry environments: Farmers' techniques and cultivar diversity in South Western Ethiopia. Econ. Bot., 63: 152–166. https://doi.org/10.1007/s12231-009-9074-7

Garfansa, M.P., R.H. Setyobudi, I. Iswahyudi, S. Anwar, D. Damat, T. Liwang, M.S. Susanti, D. Hermayanti, M. Setiawani, T.D.N. Subchi, D. Mariyam, Y.M. Ananda, S.K. Wahono, A. Basir, M. Musrif, and A.S. Khan. 2024. Potential impact microplastic polyethylene terephthalate on mice. Sar. J. Agri., 39(1): 47–60. https://dx.doi.org/10.17582/journal.sja/2023/39/s1.47.60

Gerrano, A.S., W.S. Jansen Van Rensburg, P.O. Adebola, P. Manjeru, M.W. Bairu and S.L. Venter. 2019. Evaluation and selection of taro [*Colocasia esculentra* (L.) Schott] accessions under dryland conditions in South Africa. Acta Agric. Scand. Sect. B Soil Plant Sci., 69: 219–227. https://doi.org/10.1080/09064710.2018.1530296

Gil, J.D.B., P. Reidsma, K. Giller, L. Todman, A. Whitmore and M. van Ittersum. 2019. Sustainable development goal 2: Improved targets and indicators for agriculture and food security. Ambio., 48(7): 685–698. https://doi.org/10.1007/s13280-018-1101-4

Giovannucci, D. 2015. Fixing the leaky bucket: Why agribusiness matters. In: William A. Payne, W.A., D.R. Keeney, S.C. Rao (Eds). Chapter 17. Sustain. Agric. Sys. trans., 64: 185190. ASA Special Publication. https://doi.org/10.2134/asaspecpub64.ch17

Grimaldi, I.M. and T.R. van Andel. 2018. Food and medicine by what name? Ethnobotanical and linguistic diversity of taro in Africa. Econ. Bot., 72(2): 217–228. https://doi.org/10.1007/s12231-018-9413-7

Government of West Papua Province, 2018. Governor Regulation of West Papua Province number 19 of 2018 concerning duties and functions of the food security agency. Government of West Papua Province, Manokwari, Indonesia.

Guevara, S. and Julián, I.P. 2019. Sustainable consumption and production: A crucial goal for sustainable development—reflections on the Spanish SDG Implementation Report. J. Sustain. Res., 1: 2. https://doi.org/10.20900/jsr20190019

Guzzon, F., D. Iamonico, M.A.A. Pinheiro de Carvalho, C.S.S. Gouveia, H. Nóbrega, I.M. Grimaldi, P.J. Matthews, A.C. Kyratzis, D. Afonso-Morales, V. Pérez, M.E. Velázquez-Barrera, D. Ríos Mesa, A.C. Sukal, M. Canella and J.V. Müller. 2025. Taro (*Colocasia esculenta*) in Europe: A journey through fields, botanical gardens, ditches and city markets. Genet. Resour. Crop Evol., 72: 6253–6274. https://doi.org/10.1007/s10722-025-02354-7

Hakim, L., A. Arida and C. Faradilla. 2024. Technology innovation of integrated farming system model in cassava agribusiness development in Aceh Besar regency. IOP Conf. Ser. Earth Environ. Sci. 1290 (012042): 1–12. https://doi.org/10.1088/1755-1315/1290/1/012042

Hermayanti, D., R.H. Setyobudi, S. Anwar, M.P. Garfansa, I. Iswahyudi, M. Setiawan, T. Liwang, T.D.N. Subchi, L. Zalizar and P.G. Adinurani. 2024. The effect of polyethylene terephthalate microplastics on the growth of mice. Bio Web. Conf., 104(00005): 1–17. https://doi.org/10.1051/bioconf/202410400005

Hermayanti, D., R.H. Setyobudi, M. Setiawan, S. Suherman, M.A. Wedyan, M.I.S. Massadeh, N.I.D. Faradinah, R. Nisrina, R.P. Sanusi and H. Tsabita. 2025. Effectiveness of pineapple extract in improving microplastic hepatotoxicity in male white rats of Wistar strain. Sarhad. J. Agric., 39(Sp.1): 219–230. https://dx.doi.org/10.17582/journal.sja/2023/39/s1.219.230

Ibba, M.I., J. Timsina, S. Odjo, N. Palacios, P.K. Singh, X. He, A. Alakonya, T.J. Krupnik and K. Sonder. 2025. Challenges in the global cereal supply chain. Food safety: Grain based food., 245–270. https://doi.org/10.1016/B978-0-12-819340-2.00006-7

Ikuemonisan, E.S. 2024. Challenges and strategies in Nigerian agribusiness entrepreneurship for sustainable development. CABI Agric. Biosci., 5(115). https://doi.org/10.1186/s43170-024-00303-5

Iyai, D.A., L.Y. Sonbait, R. Siregar, S.N. Sirajuddin and Y.L.D. Wambrauw. 2023. Local resource-based livestock development policy in West Papua Province, Indonesia. AIP Conf. Proc., 2628(1): 130031. https://doi.org/10.1063/5.0143952

Kumar, D., S. Choudhuri, A. K. Shandilya, R. Singh, P. Tyagi, and A. K. Singh. 2022. Food waste & sustainability through a lens of bibliometric review: A step towards achieving SDG 2030. Proc. 3rd Int. Conf. Innov. Sci. Technol. Sustain. Dev., 185–192 https://doi.org/10.1109/ICISTSD55159.2022.10010596

Maity, S., R. Guchhait, S. De and K. Pramanick. 2023. High doses of nano-polystyrene aggravate the oxidative stress, DNA damage, and the cell death in onions. Environ. Pollut., 316 (2): 120611. https://doi.org/10.1016/j.envpol.2022.120611

Mangallo, B., S. Taberima and I. Musaad. 2018. Utilization of extract tailings and cow manure for increasing of soil quality and uptake of micronutrients of *Xanthosoma sagittifolium* (L.) schott on sub optimal land of Wondama. Indian J. Public Heal. Res. Dev., 9: 1456–1460. https://doi.org/10.5958/0976-5506.2018.00937.3

Manrique, M.A.D. and C.A.C. Vargas. 2020. Study of the coffee agroecosystem structure through the casual loop diagram. Case study (Cundinamarca, Colombia). Ager., 2020: 135–160. https://doi.org/10.4422/ager.2019.08

Maretta, D., I. Helianti and E. Santosa. 2022. Sustainability cultivation and traditional conservation of taro diversity in Bogor Indonesia. IOP Conf. Ser. Earth Environ. Sci., 951(012063): 1–11. https://doi.org/10.1088/1755-1315/951/1/012063

Muthuprakash, K.M.S. and O.P. Damani. 2017. A stock and flow based framework to identify indicators for a holistic comparison of farming practices. Agric. Res., 6: 248–258. https://doi.org/10.1007/s40003-017-0266-6

Naz, R. 2015. Challenges en-route towards e-governance in small developing Island nations of the South Pacific: The case of Papua New Guinea. Trends, Prospects, and Challenges in Asian E-Governance. 1–34. https://doi.org/10.4018/978-1-4666-9536-8.ch001

Ndlovu, H.S., J. Odindi, M. Sibanda and O. Mutanga. 2025. Multi-temporal analysis of taro crop water stress using high-resolution thermal and multispectral proximal sensing for improved resilience of smallholder farming systems. Smart Agr. Tech., 12: 101337. https://doi.org/10.1016/j.atech.2025.101337.

Nunes, R.S.C., F.R. Pinhati, L.P. Golinelli, T.N.H. Rebouças, V.M.F. Paschoalin and J.T. da Silva. 2012. Polymorphic microsatellites of analysis in cultivars of taro. Hortic. Bras., 30(1): 106–111. https://doi.org/10.1590/S0102-05362012000100018

Otekunrin, O.A., B. Sawicka, A.G. Adeyonu, O.A. Otekunrin and L. Rachoń. 2021. Cocoyam [*Colocasia esculenta* (L.) schott]: exploring the production, health and trade potentials in sub-Saharan Africa. Sustain., 13: 8. https://doi.org/10.3390/su13084483

Pemi, B.A.P., D. Njomo, R. Tchinda, J.C. Seutche, A.Z. Kenfack, M.H. Babikir and V.S. Chara-Dackou. 2024. Sectoral assessment of the energy, water, waste and land nexus in the sustainability of agricultural products in Cameroon. Sustain., 16: 2. https://doi.org/10.3390/su16020565

Prihartini, I., Soebarinoto, S. Chuzaemi and M. Winugroho. 2009. Nutrient characteristics and fermented rice straw degradation by Lignolitic TLiD and BopR inoculums. Animal Produc., 11(1): 1–7.

Pihartini, I., M. Ari, M.F.M. Atoum, A.S. Ismail and L. Hendraningsih. 2021. The effect of supplementation lignolitic probiotic in rice straw for digestibility and efficiency of microbial protein synthesis using in-vitro residual gas production. Sar. J. Agric., 37(Special issue 1): 136–143. https://dx.doi.org/10.17582/journal.sja/2021.37.s1.136.143

Qaiser, Z., N. Khalid, A. Mahmood, S.Y. Lee, Z.F. Rizvi, M.K. Irshad, U. Ejaz and M. Aqeel. 2025. Tissue infiltration of polyethylene, polypropylene, and polystyrene microplastics in *Solanum tuberosum* L. influences plant growth and yield. Curr. Plant Biol., 43: 100496. https://doi.org/10.1016/j.cpb.2025.100496

Qange, S., L. Mdoda and A. Mditshwa. 2024. Exploring the relationship between agribusiness investments and postharvest losses among smallholder vegetable farmers in the eThekwini Municipality. Front. Sustain. Food Syst., 8: 1420460. https://doi.org/10.3389/fsufs.2024.1420460

Raman, R., H.H. Lathabai and P. Nedungadi. 2024. Sustainable development goal 12 and its synergies with other SDGs: Identification of key research contributions and policy insights. Discover Sustain., 5: 1. https://doi.org/10.1007/s43621-024-00289-0

Santoso, I., Y.N. Afifa, R. Astuti and P. Deoranto.

2021. Development model on upstream-downstream integration of coffee agroindustry using dynamics modelling approach. IOP Conf. Ser. Earth Environ. Sci., 733(012054): 1–7. https://doi.org/10.1088/1755-1315/733/1/012054

Saxena, R., S.K. Vanga, J. Wang, V. Orsat and V. Raghavan. 2018. Millets for food security in the context of climate change: A review. Sustain., 10(7): 2228. https://doi.org/10.3390/su10072228

Setyobudi, R.H., D. Damat, S. Anwar, A. Fauzi, T. Liwang, L. Zalizar, Y.A. Nugroho, M. Wedyan, M. Setiawan, S.Husen, D. Hermayanti, T.D.N. Subchi, P.G. Adinurani, E.D. Septia, D. Mariyam, I.R. Utarid, I. Ekawati, R. Tonda, E.D. Purbajanti, S. Suherman, M.S. Susanti, T.A. Pakarti, I. Iswahyudi, B.A. Prahardika and A.R. Farzana. 2023. Amino acid profiles of coffee cherry flour from different origins: A comparative approach. E3S Web Conf., 432(00032): 1–11. https://doi.org/10.1051/e3sconf/202343200032

Setyobudi, R.H., S. Anwar, M.A. Wedyan, D. Damat, Y.A. Nugroho, T. Liwang, P.G. Adinurani, S.K. Wahono, E.S. Savitri, B.A. Prahardika, I.R. Utarid, I. Iswahyudi and H. A. Rachmawati. 2024a. Characterization of amino acids in coffee cherry flour from different coffee cultivation areas: As potential functional food. Sar. J. Agric., 39(Sp.1): 36–46. https://dx.doi.org/10.17582/journal.sja/2023/39/s1.36.46

Setyobudi, R.H., S. Anwar, I. Iswahyudi, S. Husen, D. Damat, M.P. Garfansa, P.G. Adinurani, M. Mel, T. Liwang, R. Aprilianti, T.D.N. Subchi, M. Setiawan, D. Hermayanti, D. Mariyam, B.A. Prahardika, Z. Vincevica-Gaile, S.K. Wahono, T.N. Punjungsari, A. Fauzi, I. Andini, N.R. Malihah, I. Ekawati, D. D. Sulistyoningrum and Y.A.C. Ekalaturrahmah 2024b. Identification and quantification of microplastics contamination in potato from Malang Raya, Indones. Bio. Web Conf., 104(00036): 1–15. https://doi.org/10.1051/bioconf/202410400036

Setyobudi, R.H., I. Iswahyudi, D. Damat, M.P. Garfansa, D. Hermayanti, S.D. Ramadani, Z. Vincevica-Gaile, L.R. Nurfadilah, E.S. Savitri and Z. Meylanzharie. 2024c. Presence of microplastics in water, soil, organic fertilizer, and potato plants on potato plantations. Environ. Qual. Manage., 34(2): e70001. https://doi.org/10.1002/tqem.70001

Setyobudi, R.H., D. Hermayanti, S. Husen, M.P. Garfansa, T.D.N. Subchi, S. Suherman, S. Anwar, I. Iswahyudi, Y. Sincihu, A. Anekawati, M.S. Susanti, M. Anwar, T.A. Pakarti and S.A.A. Putra. 2025. Bioremediation using microorganisms and earthworms in reducing the impact of microplastics in potato cultivation. Sar. J. Agric., 39(Sp.1): 171–184. https://dx.doi.org/10.17582/journal.sja/2023/39/s1.171.184

Shah, Y.A., F. Saeed, M. Afzaal, N. Waris, S. Ahmad, N. Shoukat and H. Ateeq. 2022. Industrial applications of taro (*Colocasia esculenta*) as a novel food ingredient: A review. J. Food Process. Preserv., 46: 11. https://doi.org/10.1111/jfpp.16951

Sharma, R., N. Cheikhyoussef, A. Cheikhyoussef, M. Makhaba and A.A. Hussein. 2025. Bioactive phytochemicals in taro (*Colocasia esculenta*) by-products. Chapter. In: Ramadan, M.F. (Ed.). Bioact. Phytochem. by-produc. leaf, stem, root tuber vegetab., p. 265–279. https://doi.org/10.1007/978-3-031-80700-8_14

Sharma, S.B. 2017. The relevance of traditional ecological knowledge (TEK) in agricultural sustainability of the semi-arid tropics. Adaptive soil management: From theory to practices. Singapore: Spring., 453–463. https://doi.org/10.1007/978-3-031-80700-8_14

Shiferaw, B., G. Muricho, M. Kassie and G. Obare. 2012. Rural institutions and imperfect agricultural markets in Africa: Experiences from producer marketing groups in Kenya. Collective action and property rights for poverty reduction: Insights from Africa and Asia. Philadelphia: University of Pennsylvania Press. 110–147.

Shi, L., Z. Chen, Y. Hou, J. Li, Z. Shen and Y. Chen. 2023. The original polyethylene microplastics inhibit the growth of sweet potatoes and increase the safety risk of cadmium. Front. Plant Sci. Sec. Plant Abiotic. Stress., 14. https://doi.org/10.3389/fpls.2023.1138281

Shorobi, F.M. and J.H. Park. 2025. Effect of polyethylene terephthalate (PET) microplastics on radish and carrot growth, nutrient uptake, and physiological stress responses. Appl Biol. Chem. 68: 66. https://doi.org/10.1186/s13765-025-01039-0

Song, Z., Z. Chen, Y. Dong, H. Deng and M. Gao.

2024. Response of garlic (*Allium sativum* L.) to the combined toxicity of microplastics and arsenic Sci. Tot. Environ., 923: 171432. https://doi.org/10.1016/j.scitotenv.2024.171432.

Sugiyono. 2014. Quantitative, qualitative and R&D Research Methods. CV. Alfabeta, Bandung, Indonesia.

Tain, A., L. Windiana, I. Baroh, D. Damat, M. Rahmah and E. Andoko. 2023. Consumen preference analysis of UMM analog rice in Malang - Indonesia. E3S Web Conf., 432(0005): 1–11. https://doi.org/10.1051/e3sconf/202343200005

Tan, Y., Z. Feng-Jin, B. Lin, J. Chen, K.K. Verma, C. Gan-Lin. 2025. From starch to bioactives: Emerging trends in taro (*Colocasia esculenta* L.) research on composition, functionality, health benefits, and sustainable food potential. In: Ahmad, M.I. (Eds.). Harnessing the potential of functional foods containing bioactive compounds: implications for health and sustainability. Front. Nutr., 12. https://doi.org/10.3389/fnut.2025.1640156

Tofallis, C. 2015. A better measure of relative prediction accuracy for model selection and model estimation. J. Oper. Res. Soc., 66: 1352–1362. https://doi.org/10.1057/jors.2014.103

Tonda, R., L. Zalizar, W. Widodo, R.H. Setyobudi, D. Hermawan, D. Damat, E.D. Purbajanti, H. Prasetyo, I. Ekawati, Y. Jani, J. Burlakovs, S. K. Wahono, C. Anam, T.A. Pakarti, M.S. Susanti, R. Mahnunin, A. Sutanto, D.K. Sari, H. Hilda, A. Fauzi, W. Wirawan, N.S. Sebayang, H. Hadinoto, E.Suhesti, U.Amri, and Y. Busa. 2022. Potential utilization of dried rice leftover of household organic waste for poultry functional feed. Jordan. J. Biol. Sci., 15(5): 879–886. https://doi.org/10.54319/jjbs/150517.

Tonda, R., R.H. Setyobudi, Z. Vincevica-Gaile, L. Zalizar, D. Roeswitawati, I. Ekawati, I. Zekker, J. Burlakovs, I. Iswahyudi, and V. Rudovica. 2024. Dried rice for alternative feed as a waste management product for sustainable bioeconomy in rice-producing countries. Sustain., 16(13): 5372. https://doi.org/10.3390/su16135372

United Nations. 2025. The 17th goal. UN - Department of Economic and Social Affairs, Sustainable Development. https://sdgs.un.org/goals

Windarsih, G., A.F. Rahma, D. Mulyana, M.R. Hariri, I. Erlinawati, I. Riastiwi and M. Efendi. 2023. Pragmatical utilization of beneng taro (*Xanthosoma undipes*) based on local knowledge of the community of Mount Karang, Pandeglang, Indonesia. Biodivers., 24: 6415–6424. https://doi.org/10.13057/biodiv/d241202

Wirjodirdjo, B., A.F. Fudhla, M.L. Singgih and H. Ridho. 2025. Driving forces for sustainable development of smallholder sugarcane agribusiness: A system dynamics approach to circular economy strategies. Agric. Resour. Econ., 11: 32–64. https://doi.org/10.51599/are.2025.11.02.02

Xu, X. and P.X.W. Zou. 2021. System dynamics analytical modeling approach for construction project management research: A critical review and future directions. Front. Eng. Manag., 8: 17–31. https://doi.org/10.1007/s42524-019-0091-7