UMT PRESS

Journal of Sustainability Science and Management
Journal Homepage: https://jssm.umt.edu.my
eISSN: 2672-7226
DOI: http://doi.org/10.46754/jssm.2026.01.003

INCOME AND VALUE-ADDED ANALYSIS: A CASE STUDY OF GAMBIER (*Uncaria gambir* Roxb.) AGRIBUSINESS DEVELOPMENT IN TOMAN VILLAGE, INDONESIA

MERI ARIYANTINI[1,2]*, ELISA WILDAYANA[3], MIRZA ANTONI[3] AND DESSY ADRIANI[3]

[1]Doctoral Program in Agribusiness, Agriculture Faculty, Universitas Sriwijaya, 30862 Ogan Ilir, South Sumatra, Indonesia. [2]Regional Development Planning, Research and Development Agency of Palembang City, 30131 Palembang, South Sumatra, Indonesia. [3]Department of Agribusiness, Faculty of Agriculture, Universitas Sriwijaya, 30862 Ogan Ilir, South Sumatra, Indonesia.

**Corresponding author: meriariyantini876@gmail.com*

ARTICLE INFO

Article History:
Received: 10 February 2025
Revised: 13 June 2025
Accepted: 13 July 2025
Published: 15 January 2026

Keywords:
Farmers, South Sumatra, household industry, catechin, gambier tea.

ABSTRACT

This research study aims to assess the income and value-added potential of gambier agribusiness development in Toman Village, conducted between August and October 2023. The study employed a survey method, gathering data through questionnaires and in-depth discussions. The sampling was conducted using a census method, encompassing the entire population of 22 gambier farming households. The data was analysed using descriptive statistics, and the Hayami method was applied to assess the value added of catechin and gambier tea products. The findings indicate that annual income from gambier farming was IDR 34,119,017 ha/year, with an R/C ratio of 1.85, suggesting a profitable enterprise. The production of 1 kg of catechins requires approximately 3 kg of fresh gambier plant material, while 1 kg of gambier tea is obtained from 2 kg of dried gambier. These processes yield an added value of IDR 1,116,667 for catechins and IDR 100,000 for gambier tea, with corresponding profit margins of IDR 1,066,667 and IDR 87,500/kg of output.

Introduction

Gambier (*Uncaria gambir* Roxb.) is a product derived from the extraction of twigs and leaves of the gambier plant, which is widely cultivated in Indonesia, particularly on the island of Sumatra, the primary centre of its production and export (Widiyarti *et al*., 2020; Asmarhansyah & Hafif, 2021). West Sumatra Province is the largest gambier-producing region in Indonesia, with a production volume of 8,687 tonnes, followed by North Sumatra with 1,509 tonnes, Riau with 1,170 tonnes, the Riau Islands with 333 tonnes, and South Sumatra. Toman Village, located in South Sumatra Province, is recorded as the only centre of gambier production in the region, with a total output of 10 tonnes in 2020 (DJPKPRI, 2022; Ariyantini *et al*., 2025). Toman Village exhibits unique characteristics in gambier (*Uncaria gambir* Roxb.) cultivation, supported by favourable environmental conditions, including relatively fertile sandy loam soils and a tropical climate characterised by high rainfall and warm temperatures.

Additionally, the local community possesses hereditary knowledge of gambier cultivation and processing, which helps maintain both the quality and sustainability of production. In this village, gambier cultivation serves as the primary source of livelihood for the local community. The industry is predominantly managed at the household level using simple techniques (Santoso *et al*., 2021; Yulius & Andelia, 2023). Currently, the gambier produced in Toman Village is primarily sold as low-quality dried sap extract, providing limited economic benefits to farmers. Enhancing the price farmers receive could significantly improve the prospects for developing gambier farming. The utilisation and

processing of gambier plants have developed, including the production of gambier tea.

Gambier tea is a newly developed product derived from dried gambier leaves. As an innovative consumable product, gambier tea is believed to offer numerous health benefits. The high antioxidant content in gambier leaves makes it more beneficial for consumption than *Camellia sinensis* tea (Budaraga & Putra, 2023). Gambier leaves are rich in flavonoid antioxidant compounds, including catechins (7% to 33%), pyrocatechol (20% to 30%), and quercetin (2% to 4%) (Hernani *et al*., 2022). Catechins, in particular, serve as a critical indicator of gambier quality for applications in the pharmaceutical, cosmetic, and food industries (Rahman *et al*., 2018; Santoso *et al*., 2022; Mita *et al*., 2025). Due to their potent antioxidant properties, these compounds are extensively utilised in health supplements and herbal medicines (Rosaini *et al*., 2022).

Despite Toman Village being a significant centre of gambier production in Indonesia, gambier plants have not yet been utilised to produce gambier tea, and this product remains unfamiliar to the public. Developing this derivative product holds the potential to enhance the added value of gambier plants and create new employment opportunities (Hamira *et al*., 2021). Various gambier-derived products developed include herbal tea, toothpaste, talcum powder, and natural dyes. These products are primarily developed in West Sumatra Province (Sofyan *et al*., 2020; Zaadah *et al*., 2022; Budaraga & Putra, 2023).

Added value plays a critical role in agribusiness development by enhancing welfare through processing, diversification, and marketing (Asmah, 2011). It represents the difference in commodity value resulting from specific processing stages, minus the associated expenditures. Transforming gambier plants from their primary form into new products significantly increases their economic value (Whalen, 2019). To understand the profitability for farmers, an analysis of the income and added value generated from the gambier agribusiness development is essential. This study aims to evaluate the income and value-added generated by the development of the gambier agribusiness in Toman Village.

Materials and Methods

Location and Time of the Study

This research was conducted in Toman Village, located in Babat Toman Subdistrict, Musi Banyuasin District, South Sumatra Province. The village is bordered by the neighbouring villages of Bangun Sari and Lubuk Buah to the north, Karang Ringin to the south, Kasmaran to the west, and Babat to the east. Geographically, Toman Village is situated at an elevation of 15 to 96 m above sea level. The soil in the region is predominantly black, sandy, and has a gentle slope of approximately 6 degrees. The village experiences a tropical climate, with annual rainfall ranging from 2,618 to 3,400 mm distributed over 150 to 160 rainy days per year. The average temperature is 26°C. Toman Village spans approximately 12,300 hectares, of which 76.38% (7,982 hectares) is dedicated to agriculture. Within this agricultural area, 1,500 hectares (18.79%) are allocated explicitly to gambier cultivation. The study was conducted from August to October 2023. The research location is shown in Figure 1.

Data Collection Methods

This research utilised both primary and secondary data. Primary data were collected through direct observations using a survey method at the research site, supplemented by interviews (questionnaire) and in-depth discussions. The data gathered focused on information relevant to the research objectives, specifically regarding the income and value added to the gambier agribusiness development in Toman Village. In contrast, secondary data were obtained from reports published by the Directorate General of Plantations and previous studies in national and international journals. The sampling was conducted using a census method, encompassing the entire population of 22 gambier farming households. This

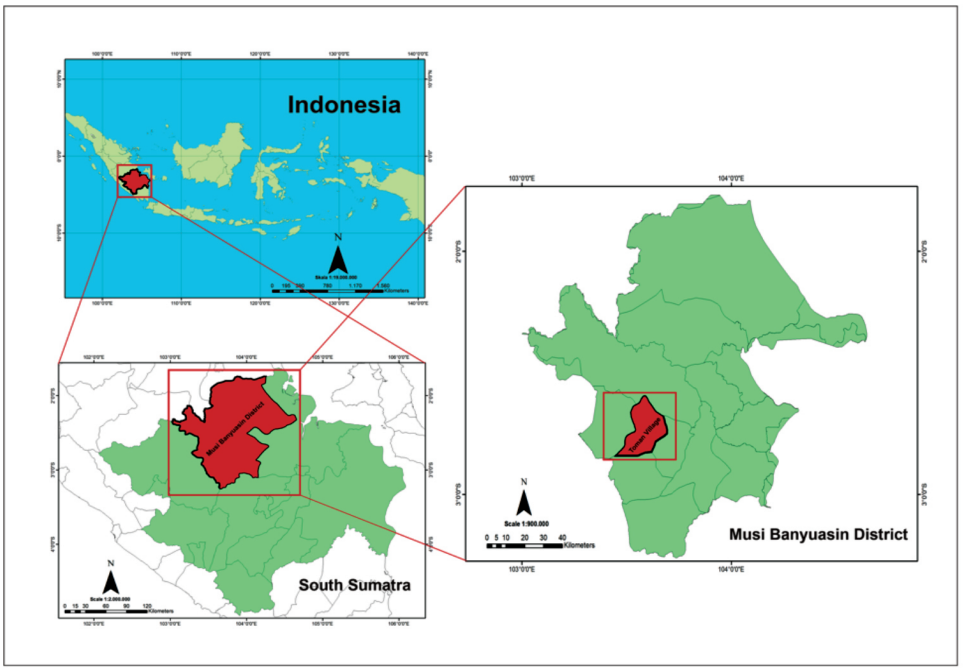

Figure 1: Research location map

approach was chosen due to the relatively small population, which enabled comprehensive data collection from all respondents (Ginting *et al*., 2025).

Data Analysis Methods

The data were analysed using descriptive methods to assess and illustrate income and value added from the gambier agribusiness development. The income and value added of gambier were calculated using the following formulas.

Gambier's Income

The income of gambier farmers and their derivative products can be systematically determined by analysing costs, revenues, and the revenue-to-cost (R/C) ratio. The total cost (TC) is calculated using the formula:

$$TC = FC + VC$$

where:

TC : Total coast
FC : Fixed cost
VC : Variable cost

Total revenue (TR) is calculated as:

$$TR = P \times R$$

where:

TR : Total revenue (IDR/cultivation area/year)
P : Price per unit of product (kg/cultivation area/year)
Q : Quantity of product sold (IDR/kg)

The income of gambier farmers can be calculated as:

$$I = TR - TC$$

where:

I : Income (IDR/cultivation area/year)
TR : Total revenue (IDR/cultivation area/year)
TC : Total cost (IDR)

The revenue-to-cost (R/C) ratio is a key metric used to assess the economic feasibility of farming activities. It is calculated as follows:

$$R/C\ Ratio = \frac{TC}{TR}$$

where:

TR : Revenue-to-cost
P : Total revenue (IDR/cultivation area/year)
Q : Total cost (IDR)

The decision criteria for the revenue-to-cost (R/C) ratio are as follows:

R/C > 1 : The farming activity is economically profitable, as revenue exceeds the total costs. Continuation or expansion of the business is recommended.

R/C = 1 : The farming activity breaks even, meaning revenue equals the total costs. The activity is neither profitable nor loss-making.

R/C < 1 : The farming activity is not economically viable, as costs exceed revenue. It may be necessary to reconsider or improve farming practices to increase profitability.

Value-added Analysis

The value-added analysis was conducted to quantify the profits generated by stakeholders in the gambier agribusiness supply chain (Sikone *et al*., 2022; Padapi *et al*., 2023). The calculation procedure for value-added analysis is shown in Table 1.

Table 1: Calculation of value-added analysis by the Hayami method

Variables		Value
Output, input, and price	1. Output (kg)	(1)
	2. Raw material input (kg)	(2)
	3. Labour input (DWH)	(3)
	4. Conversion factors	(4) = (1):(2)
	5. Field labour coefficient (DWH/kg)	(5) = (3):(2)
	6. Output price (IDR/kg)	(6)
	7. Labour wage (IDR/DWH)	(7)
Profit and revenue (IDR/kg raw material)	8. Input price (IDR/kg)	(8)
	9. Transaction fees (IDR/kg)	(9)
	10. Output value (IDR/kg)	(10) = (4) x (6)
	11. a. Added value (IDR/kg)	(11a) = (10) – (8) – (9)
	b. Value-added ratio (%)	(11b) = (11a)/(10) x 100
	12. a. Labour income (IDR/kg)	(12a) = (5) x (7)
	b. Labour incentives (%)	(12b) = (12a)/(11a) x 100
	13. a. Profit (IDR/kg)	(13a) = (11a) – (12a)
	b. Profit rate (%)	(13b) = (13a)/(10) x 100
Production factor services (IDR/kg of raw material)	14. a. Margin (IDR/kg)	(14a) = (10) – (8)
	b. Direct labour income (%)	(14b) = (12a)/(14a) x 100
	c. Other input donations (%)	(14c) = (9)/(14a) x 100
	d. Company profits (%)	(14d) = (13a)/(14a) x 100

Note: DWH = Daily human work; IDR: Indonesian rupiah.
Source: Sikone *et al*. (2022)

The criteria for evaluating the value-added ratio are as follows:

A low value-added ratio is defined as < 15%.

A moderate value-added ratio falls between 15% and 40%.

A high value-added ratio is categorised as > 40%.

Results and Discussions

Respondent Profiles

The characteristics of the respondents are shown in Table 2, categorised by sociodemographic factors including age, education level, farming experience, number of family members, land ownership status, and land area. The majority of gambier farmers were aged 30 to 49 years old, placing them in the productive age group. Most respondents had completed only primary education. Additionally, 54.5% of gambier farmers had between 21 and 30 years of farming experience, indicating a high level of expertise in gambier cultivation. According to Kalimuthu and Applanaidu (2024), sociodemographic factors, such as age, education, land size, and farming experience, significantly influence agricultural productivity. In Toman Village, all respondents reported privately owned land. Most farmers owned more than 1 hectare of productive land, which contributes to the efficiency of gambier farming. Yan *et al*. (2019) emphasised that larger land areas positively impact both agricultural productivity and efficiency.

Table 2: Characteristics of respondents

Sociodemographic	Frequency	Percentage (%)
Age (years old)		
20–29	2	9.10
30–49	14	63.6
> 50	6	27.3
Education level		
Primary school	14	63.6
Secondary school	2	9.10
High school	4	18.2
Undergraduate	2	9.10
Farming experience (years)		
0–10	2	9.10
11–20	4	18.2
21–30	12	54.5
31–40	4	18.2
Family members (people)		
1–3	4	18.2
4–6	14	63.6
7–9	4	18.2
Land status		
Own land	22	100
Rent land	0	0
Land area (ha)		
< 1.5	2	9.10
1.5–3	16	72.7
> 3	4	18.2

Source: Primary data processed (2023)

Gambier Farmers' Income

The factors influencing the income of gambier farming in Toman Village include fixed costs, labour costs, and variable costs. These expenses play a crucial role in determining the overall income farmers generate. Tables 3 to 5 present the values of costs incurred by farmers, while Table 6 summarises the calculated income of gambier farmers in Toman Village.

Fixed costs are expenses incurred periodically and remain constant regardless of business volume (Li *et al*., 2019). Fixed costs in this study are shown in Table 3. In this study, fixed costs included land clearing, basket, small knife, machete, "irap", "kandul", slicing knife, cauldron, and tray. The fixed costs associated with gambier farming activities in Toman Village totalled IDR 3,104,618. Land clearing represented the highest fixed cost at 69.18% or IDR 2,147,727, while slicing knives accounted for the smallest fixed cost at 0.64% or IDR 20,000. The cost of land clearing is influenced by the size of the land owned by farmers, larger plots require higher expenses. The average cultivated land area per farmer in the study was approximately 2.7 hectares, which the farmer owned. These fixed costs are closely related to factors such as land condition, the need for heavy machinery, intensive labour, clearing and processing activities, and administrative costs, associated with permits or regulatory compliance.

Variable costs are expenses that fluctuate in proportion to changes in production activity, increasing with higher activity levels and decreasing with lower ones. In this study, variable costs included labour expenses, firewood, diesel, fertiliser, milling machine rental, and "pertalite", as shown in Tables 4 and 5. The total variable costs for gambier farming activities in Toman Village amounted to IDR 25,796,365, comprising both labour costs and variable costs (Khoirunnisa *et al*., 2023). Firewood represented the highest expense at IDR 9,545,455 (51.88%), while diesel accounted for the lowest at IDR 327,273 (1.78%). The traditional production of dried gambier extract relies heavily on firewood as a fuel during the boiling of gambier leaves, which is essential before the grinding and pressing stages of extraction.

Table 3: Fixed cost in gambier farming

Description	Depreciation Costs	
	(IDR/ha/Year)	Percentage (%)
Land clearing	2,147,727	69.18
Basket	127,273	4.10
Small knife	190,909	6.15
Machete	120,000	3.87
"Irap"	183,109	5.90
"Kandul"	109,091	3.51
Slicing knife	20,000	0.64
Cauldron	75,000	2.42
Tray	131,509	4.24
Total	**3,104,618**	**100.00**

Note: ha (hectare): Cultivation area.
Source: Primary data processed (2023)

Table 4: Labour cost of gambier farming

Description	Labour Costs	
	(IDR/ha/Year)	Percentage (%)
Land clearance	1,636,364	22.12
Picker	1,390,909	18.81
Maintenance	1,200,000	16.22
Processor	1,581,818	21.39
Harvester	720,000	9.73
Packer	867,273	11.73
Total	**7,396,364**	**100.00**

Note: ha (hectare): Cultivation area.
Source: Primary data processed (2023)

Table 5: Variable cost of gambier farming

Description	Variable Costs	
	(IDR/ha/Year)	Percentage (%)
Firewood	9,545,455	51.88
Diesel	327,273	1.78
Fertiliser	1,000,000	5.43
Milling machine rental	2,727,273	14.82
"Pertalite"	4,800,000	26.09
Total	**18,400,001**	**100.00**

Note: ha (hectare): Cultivation area.
Source: Primary data processed (2023)

The results for revenue and income from gambier farming in Toman village are shown in Table 6. The average annual income generated by farmers from gambier farming activities was IDR 34,119,017 ha/year, with a revenue-to-cost (R/C) ratio of 1.85. Since the R/C ratio exceeds 1, it indicates that gambier farming is economically viable and profitable, with revenue exceeding production costs, demonstrating significant economic potential.

Table 6: Revenue and income of gambier farming

Description	(IDR/ha/Year)
Total revenue	63,100,000
a. Total production (kg/ha/year)	1,262
b. Gambier price (IDR/kg)	50,000
Total cost	28,900,983
a. Variable cost	25,796,365
b. Fixed cost	3,104,618
Income from gambier farming	34,119,017
Revenue-to-cost (R/C)	1.85

Note: ha (hectare): Cultivation area.
Source: Primary data processed (2023)

Value-added

Value-added refers to the increase in economic value resulting from transformations during the production process (Setiadi *et al*., 2018). Technical factors influencing value added included production capacity, the quantity of raw materials utilised, and labour requirements. Output-related factors encompass product pricing, labour wages, raw material costs, and other input expenses (Sikone *et al*., 2022). The added value generated by farmers in Toman Village is currently reflected in the processing of gambier into two products, namely catechins as the main product and gambier tea as an additional product. These two products are the mainstay commodities of the local community and have been produced consistently as part of the strategy to increase farmers' incomes through the diversification of gambier-processed products. The value-added analysis for catechin and gambier tea products was conducted for each production cycle. Table 7 presents the calculated average value added for farmers in Toman Village.

The conversion factor directly influences the output value (IDR/kg) of the produced product (Nasution *et al*., 2020). To produce 1 kg of catechin, approximately 3 kg of raw gambier material is required, without any other inputs. The output value of catechin was IDR 1,166,667/kg, yielding a value added of IDR 1,116,667, accounting for 95.71% of the total output value. Of this value added, labour income accounted for IDR 50,000/kg, or 4.48%. In comparison, producing 1 kg of gambier tea requires an average of 2 kg of dried gambier per production cycle, without supplementary materials. The output value of gambier tea was IDR 150,000/kg, resulting in a value added of IDR 100,000

Table 7: Value added of catechin and gambier tea in Toman Village

Variables			Value of Catechin	Value of Gambier Tea
Output, input, and price	1.	Output (kg)	1	1
	2.	Raw material input (kg)	3	2
	3.	Labour input (DWH)	3	1
	4.	Conversion factors	0.3	0.5
	5.	Field labour coefficient (DWH/kg)	1	0.5
			3,500,000	300,000
	6.	Output price (IDR/kg)	50,000	25,000
	7.	Labour wage (IDR/DWH)		
Profit and revenue (IDR/kg raw material)	8.	Input price (IDR/kg)	50,000	50,000
	9.	Transaction fees (IDR/kg)	-	-
	10.	Output value (IDR/kg)	1,166,667	150,000
	11.	a. Added value (IDR/kg)	1,116,667	100,000
		b. Value-added ratio (%)	95.71	66.67
	12.	a. Labour income (IDR/kg)	50,000	12,500
		b. Labour incentives (%)	4,48	12.50
	13.	a. Profit (IDR/kg)	1,066,667	87,500
		b. Profit rate (%)	91.43	58.33
Production factor services (IDR/kg of raw material)	14.	a. Margin (IDR/kg)	1,116,667	100,000
		b. Direct labour income (%)	4.48	12.50
		c. Other input donations (%)	-	-
		d. Company profits (%)	95.52	87.50
Revenue-to-cost (R/C)			2.4	2.4

Note: DWH= Daily human works; IDR: Indonesian rupiah.
Source: Primary data processed (2023)

or 66.67% of the total output value. Labour income from this process was IDR 12,500/kg, equivalent to 12.50% of the value added.

The profit from catechin production, calculated by subtracting direct labour costs from the value-added component, amounted to IDR 1,066,667/kg of output, representing 91.43% of the total output value. The margin, defined as the difference between the output value and the input cost, was IDR 1,116,667/kg, of which 95.52% constituted net profit, and 4.48% represented direct labour income (Cifra *et al*., 2022). In contrast, the value-added profit from gambier tea production was IDR 87,500/kg, equivalent to 58.33% of the total output value. The profit margin of IDR 100,000/kg for gambier tea was comprised of 87.50% net profit and 12.50% direct labour income. These findings indicate that higher production outputs lead to greater value added and profitability. Dobson and Chakraborty (2020) reported that innovation enhances efficiency, increases profitability, and generates broader social benefits. Efficient production processes further enhance competitiveness and economic sustainability for producers.

Conclusions

Gambier farming demonstrates economic viability and profitability, with revenue exceeding production costs, indicating significant economic potential. The average annual income of farmers is IDR 34,119,017 per ha. Furthermore, the processing of gambier into value-added products such as catechins and gambier tea has demonstrated substantial economic benefits. Specifically, the production of 1 kg of catechins requires approximately 3 kg of fresh gambier plant material, while 1 kg of gambier tea is obtained from 2 kg of dried gambier. These processes yield an added value of IDR 1,116,667 for catechins and IDR 100,000 for gambier tea, with corresponding profit margins of IDR 1,066,667 and IDR 87,500/kg of output.

The implications of these findings are important for the formulation of local and regional policies. Local governments are advised to support the development of the gambier processing industry by providing infrastructure, offering investment incentives, and facilitating partnerships between farmers and industry players. In addition, training and technical assistance programs need to be expanded to enhance farmers' capacity in post-harvest processing, agribusiness management, and adherence to product quality standards. This support is important to ensure the competitiveness of gambier products in both domestic and international markets. More broadly, the development of the gambier agribusiness can contribute to strategies to increase rural income, create local jobs, and strengthen the local resource-based economy. Through an integrated approach among the agricultural sector, industry, and public policy, gambier could be developed as a strategic commodity to drive inclusive and sustainable economic growth in producing regions.

Acknowledgements

The authors would like to thank the Doctoral Programme in Agricultural Sciences, Faculty of Agriculture, Universitas Sriwijaya, and the Regional Development Planning, Research and Development Agency (Bappeda Litbang) Palembang City for supporting the authors in completing this article.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

References

Ariyantini, M., Wildayana, E., Antoni, M., & Adriani, D. (2025). Alternatif strategi pengembangan agribisnis tanaman gambir di Desa Toman Kecamatan Babat Toman Kabupaten Musi Banyuasin. *JURNAL AGRICA*, *18*(1), 111-120.

Asmah, E. E. (2011). Rural livelihood diversification and agricultural household welfare in Ghana. *Journal of Development and Agricultural Economics*, *3*(7), 325-334. http://www.academicjournals.org/JDAE

Asmarhansyah & Hafif, B. (2021). Soil fertility evaluation and quality of gambier (Uncaria gambir Roxb) in Kundur, Kepulauan Riau. In *1st International Conference on Sustainable Tropical Land Management-IOP Conference Series: Earth and Environmental Science* (Vol. 648, pp. 1-8). https://doi.org/10.1088/1755-1315/648/1/012169

Budaraga, I. K., & Putra, D. P. (2023). Antioxidant study of the gambier leaves by-products into tea with red ginger powder addition (*Zingiber officinale* Var. *Rubrum*). In *The 5th International Conference on Agriculture and Life Science 2021 (ICALS 2021)- AIP Conference Proceedings* (Vol. 2583, pp. 1-8). https://doi.org/10.1063/5.0117233

Cifra, M. U. V., Lee, J. M. G., Vizcarra, C. M. Q., & Camaro, P. J. C. (2022). The influence of marketing margins, production cost, and labour productivity on farmers' welfare: A regression analysis. *UJoST-Universal Journal of Science Technology*, *1*(2), 145-187. http://ujost.org/index.php/journal/article/view/77%0Ahttp://ujost.org/index.php/journal/article/download/77/17

DJPKPRI. (2022). *Statistik Perkebunan Non Unggulan Nasional 2020-2022*. Jakarta: Sekretariat Direktorat Jenderal Perkebunan.

Dobson, P. W., & Chakraborty, R. (2020). Strategic incentives for complementary producers to innovate for efficiency and support sustainability. *International Journal of Production Economics*, *219*, 431-439. https://doi.org/10.1016/j.ijpe.2018.02.001

Ginting, A., Purba, E., Chalil, D., & Diana, N. (2025). Contribution of coffee farming and goat livestock based integration in Karo Regency, North Sumatra Province. *IOP Conference Series: Earth and Environmental Science*, *1441*, 1-5. https://doi.org/10.1088/1755-1315/1441/1/012011

Hamira, H., Robiani, B., & Mukhlis, M. (2021). Vertical integration in agro-industry: Eco-friendly gambier products. *Journal of Economic Development, Environment and People*, *10*(4), 9-17. https://doi.org/10.26458/jedep.v10i4.711

Hernani, Halimatussa'diyah & Supiati, S. (2022). The quality of cream formulated from gambier leaf extract. In *The 3rd International Conference on Agricultural Postharvest Handling and Processing - IOP Conference Series: Earth and Environmental Science* (Vol. 1024, pp. 1-7). https://doi.org/10.1088/1755-1315/1024/1/012010

Kalimuthu, K., & Applanaidu, S. D. (2024). Factors effecting paddy productivity in the MADA regions, Malaysia. *Malaysian Management Journal*, *28*, 145-172.

Khoirunnisa, K., Riswani, R., & Lifianthi, L. (2023). Expenditure on oil palm farmers' households in Bayung Lencir Subdistrict. *Biovalentia: Biological Research Journal*, *9*(1), 41-47.

Li, Y., Li, F., Emrouznejad, A., Liang, L., & Xie, Q. (2019). Allocating the fixed cost: An approach based on data envelopment analysis and cooperative game. *Annals of Operations Research*, *274*(1-2), 373-394. https://doi.org/10.1007/s10479-018-2860-9

Mita, S. R., Muhtar, N. I., Kusuma, S. A. F., Sriwidodo, S., & Hendrawan, R. P. (2025). Catechins as antimicrobial agents and their contribution to cosmetics. *Cosmetics*, *12*(11), 1-12.

Nasution, W. I., Hasyim, H., & Lubis, S. N. (2020). Analysis of value added of Arabica coffee in Central Aceh Regency (Case of Indi Gayo Coffee business unit). In *IOP Conference Series: Earth and Environmental Science* (Vol. 454, pp. 1-4). https://doi.org/10.1088/1755-1315/454/1/012006

Padapi, A., R., F., Wulandary, A., & Haryono, I. (2023). Modification of Hayami value-added analysis calculations in the processing of cayenne pepper. *Anjoro: International Journal of Agriculture and Business*, *4*(2), 82-91. https://doi.org/10.31605/anjoro.v4i2.2399

Rahman, E. D., Sari, E., Burmawi, Frizka & Endah. (2018). Determination of extraction process conditions of Gambier Catechin (*Uncaria Gambier* Roxb) from Solok Bio Bio Lima Puluh Kota District - West Sumatera. *IOP Conference Series: Materials Science and Engineering*, *316*(1). https://doi.org/10.1088/1757-899X/316/1/012022

Rosaini, H., Elfadri, Y., Makmur, I., Margi Sidoretno, W., Halim, A., & Yetti, R. D. (2022). Formulation and evaluation of Granul Effervescent of Catechin from Gambier (*Uncaria gambier* (Hunter) Roxb). *Ecology, Environment and Conservation*, *28*(01s), 83-83. https://doi.org/10.53550/eec.2022.v28i01s.083

Santoso, B., Aulia, M. R. W., Jannah, S. R., Priyanto, G., Wijaya, A., & Hermanto, H. (2022). Incorporation of catechin extracts from gambier products and pasak bumi in the production of functional instant green robusta coffee. *Potravinarstvo Slovak Journal of Food Sciences*, *16*, 367-374. https://doi.org/10.5219/1735

Santoso, B., Dwiyanti, R., Wijaya, A., Priyanto, G., Hermanto, & Syaiful, F. (2021). Functional characteristics improvement of edible film through addition of gambier and bay leaf extract. *Current Nutrition & Food Science*, *17*(8), 876-882. https://doi.org/10.2174/1573401317666210618143215

Setiadi, S., Nurmalina, R., & Suharno, S. (2018). Analisis Kinerja Rantai Pasok Ikan Nila pada Bandar Sriandoyo di Kecamatan Tugumulyo Kabupaten Musi Rawas. *Mix: Jurnal Ilmiah Manajemen*, *8*(1), 166-185. https://doi.org/10.22441/mix.2018.v8i1.010

Sikone, H. Y., Hartono, B., Suyadi, Utami, H. D., & Nugroho, B. A. (2022). Value-added analysis of the meat agroindustry in Indonesia. *Online Journal of Animal and Feed Research*, *12*(5), 266-271. https://doi.org/10.51227/ojafr.2022.36

Sofyan, S., Failisnur, F., Silfia, S., Salmariza, S., & Ardinal, A. (2020). Natural liquid dyestuff from wastewater of gambier processing (*Uncaria gambir* Roxb) as textile Dye. *International Journal on Advanced Science, Engineering and Information Technology*, *10*(6), 2512-2517. https://doi.org/10.18517/ijaseit.10.6.12891

Whalen, K. A. (2019). Three circular business models that extend product value and their contribution to resource efficiency. *Journal of Cleaner Production*, *226*, 1128-1137. https://doi.org/10.1016/j.jclepro.2019.03.128

Widiyarti, G., Sundowo, A., Filailla, E., & Arya Laksmono, J. (2020). The mechanically extraction process of gambier (*Uncaria gambier* Roxb.) from Limapuluh Kota, West Sumatera and its antioxidant activity. *The Journal of Pure and Applied Chemistry Research*, *9*(1), 8-15. https://doi.org/10.21776/ub.jpacr.2020.009.01.509

Yan, J., Chen, C., & Hu, B. (2019). Farm size and production efficiency in Chinese agriculture: Output and profit. *China Agricultural Economic Review*, *11*(1), 20-38. https://doi.org/10.1108/CAER-05-2018-0082

Yulius, Y., & Andelia, S. R. (2023). The utilisation of a Briquette making machine to process gambier leaf and twig waste as fuel for gambier sap processing to reduce gambier sap production costs in Toman Village, Babat Toman Sub District, Musi Banyuasin District, South Sumatera Province. In *Proceedings of the Tegal International Conference on Applied Social Science & Humanities (TICASSH 2022)* (pp. 86-94). Atlantis Press SARL. https://doi.org/10.2991/978-2-494069-09-1

Zaadah, Z., Nazir, N., & Novelina, N. (2022). Study of herbal toothpaste made from virgin coconut oil and gambier (*Uncaria gambir* Roxb). *AJARCDE | Asian Journal of Applied Research for Community Development and Empowerment*, *4(*3), 20-25. https://doi.org/10.29165/ajarcde.v4i3.89