



Systematic Literature Review: Downstreaming of Sapindus rarak Processing to Achieve Green Economic Growth in Low-Compartment Communities

Prasetio Ariwibowo^{1*}, Deden Ibnu Aqil², Denny Heryadi³

¹⁻³Faculty of Education and Social Sciences, PGRI Indraprasta University, South Jakarta – Indonesia

*Corresponding Author: wibowoprasetio648@gmail.com

Abstract. This study aims to identify and synthesize previous research results on the processing and downstreaming of soapberry (*Sapindus rarak*), analyze its potential utilization in supporting an environmentally-based green economy, and formulate recommendations for inclusive downstream development strategies for low-income communities. The approach used is a Systematic Literature Review (SLR) with data sources in the form of journal articles, proceedings, and research reports obtained from the Scopus, Google Scholar, and Semantic Scholar databases for the period 2015–2025. The literature search and selection process follows the PRISMA stages, which include identification through the keyword “Soapberry (*Sapindus rarak*)”, followed by filtering based on relevance and inclusion criteria, article quality assessment, and thematic synthesis. The results of the study indicate that research on soapberry mostly focuses on its use as an environmentally friendly natural ingredient, such as organic soap, natural detergent, and botanical pesticide. However, studies that integrate downstreaming aspects with a green economy and community empowerment framework are still relatively limited. The literature synthesis resulted in a map of research developments related to soapberry processing, identification of opportunities for value-added downstream products, and a design of a conceptual model for green economy-based downstreaming that supports environmental sustainability and improving community welfare.

Keywords: Green Economy; Natural Surfactant; *Sapindus rarak*; Saponin; Systematic Literature Review.

1. BACKGROUND

Indonesia is known for its abundant natural resources, including medicinal and traditional plants with significant economic potential. One such plant is the soapberry (*Sapindus rarak* De Candolle), a plant traditionally used by local communities as a natural cleaning agent, dye, and traditional medicine. Its economic potential is significant due to its saponin content, which can be used as a base ingredient in soap, environmentally friendly detergents, and even herbal cosmetics. This aligns with the findings of research conducted by Ariwibowo, Ali, and Budiman (2023), which showed that MSMEs in the service and creative industry clusters in DKI Jakarta formulated business strategies to become Prospectors, Analysts, Low-Cost Defenders, and Different Defenders based on or having different external environmental backgrounds in terms of demographics, political/legal, economic conditions, and the technology used to run their respective businesses (Ariwibowo, Ali, and Budiman, 2023).

However, the use of soapberry leaves and fruit is currently limited to traditional household consumption and has not been widely developed into an integrated downstream industry. This situation results in relatively low added value from soapberry, thus not having a significant impact on increasing community income, especially among low-income groups.

However, with appropriate and innovative processing, soapberry has the potential to become a leading commodity that supports economic development based on local wisdom. Within the framework of sustainable development, the concept of downstreaming is not simply viewed as a conventional industrialization process, but rather as a strategic approach to integrating sustainable practices into the industrial value chain (Alkan & Kamasak, 2023). However, many industry players in developing countries remain trapped in the practice of "SDG-washing," which displays false support for the SDGs without concrete implementation on the ground (Mio et al., 2020).

This demonstrates a gap between policy intent and actual implementation, emphasizing the importance of transparent, measurable, and pro-local downstreaming governance. Low-income communities still need new economic opportunities to improve their well-being. Downstreaming of soapberry processing can be an alternative for economic empowerment while supporting sustainable development through environmentally friendly products.

2. THEORETICAL STUDY

Sapindus rarak is a plant belonging to the Sapindaceae family. This plant grows in tropical Asia, including Indonesia, at altitudes of around 450–1,500 meters above sea level. Soapberry fruit is widely known as a traditional washing agent due to its natural foaming properties, but the leaves also contain powerful bioactive compounds. Soapberry leaves and fruit are reported to contain various secondary metabolite compounds, including:

- a. Saponins (as natural surfactants, antimicrobials, and antifungals)
- b. Flavonoids (as antioxidants, anti-inflammatory, and antibacterials)
- c. Tannins (as astringents and antibacterials)
- d. Alkaloids (pharmacological potential, including analgesic and antimicrobials)

Sapindus Rarak has various benefits from various research results, including making Soapberry leaves a potential ingredient in the health, cosmetics, and environmental sectors. *Sapindus Rarak* fruit extract at concentrations of 25%, 50%, 75%, and 100% has inhibitory activity against *Staphylococcus epidermidis* with inhibition zones of 16 mm, 18.5 mm, 21.75 mm, and 20.5 mm, respectively. (Sukrama, Hendrayana, and Artha, 2022). The positive control used was vancomycin with an inhibition zone of 16 mm. 18.5 mm.

The Kruskal-Wallis analysis showed a result of 0.003, indicating a significant difference in the average inhibition zone area between concentrations of soapberry ethanol extract. Similarly, another study found that 2% Chlorhexidine Gluconate hand soap and

soapberry-based hand soap significantly reduced the number of microorganisms on hands (Firmansyah, 2025).

Downstreaming is the process of increasing the added value of a commodity through further processing of raw materials (upstream) into semi-finished or finished products (downstream). According to the Ministry of Industry (2021), downstreaming aims to strengthen the national industrial structure, reduce dependence on raw material exports, and increase the competitiveness of domestic products.

Despite its significant potential, the implementation of the downstreaming process faces several key challenges:

- a. Limited infrastructure and energy in rural areas.
- b. Uneven distribution of processing technology at the MSME level.
- c. Limited skilled human resources in the industry.
- d. Regulatory and bureaucratic barriers in product certification. herbal.
- e. Global price fluctuations and export market uncertainty

According to the United Nations Environment Programme (UNEP), a green economy is economic activity related to the production, distribution, and consumption of goods and services that leads to improved long-term societal well-being, while minimizing risks to future generations and mitigating environmental resource scarcity. A green economy is defined as one that is low-carbon, efficient in resource use, and socially inclusive (Pan et al., 2019).

The green economy approach positions soapberry processing as a strategic commodity that not only provides economic benefits to lower-income communities but also preserves the environment by substituting hazardous chemicals with natural organic surfactants.

3. RESEARCH METHODS

This study employed a Systematic Literature Review (SLR) method. The SLR method is used to identify other relevant studies, explore future research opportunities (Gough et al., 2017), and help explore different perspectives on a research topic to inform future research (Linnenluecke et al., 2020). In this study, the researchers sought to examine various possibilities and efforts for downstreaming opportunities for soapberry. Therefore, the documents reviewed were obtained through a search using the keyword "Soapberry (*Sapindus rarak*)" in the Scopus, Google Scholar, and Semantic Scholar databases for the period 2015-2025.

There are several stages in implementing the SLR method. Adapted from previous research, there are three main stages: planning the review, conducting the review, and reporting the review (Xiao & Watson, 2019). This Systematic Literature Review (SLR) study consists of five main structured stages:

- a. Stage 1: Formulating the Problem - Developing Research Questions (RQ1 to RQ4) to map trends in soapberry processing.
- b. Stage 2: Literature Search (Identification) - Using the Harzing's Publish or Perish database to search for relevant articles from Google Scholar, Semantic Scholar, and Scopus Elsevier for the period 2015–2025.
- c. Stage 3: Literature Selection (Screening & Feasibility) - Applying inclusion and exclusion criteria and stringent Quality Assessment (QA).
- d. Stage 4: Analysis of Literature Results (Analysis) - Classifying data using a bibliometric analysis approach and visualization using VOSviewer software.
- e. Stage 5: Drawing Conclusions - Synthesizing the facts on the logical relationship between soapberry processing and local economic well-being.

4. RESULTS AND DISCUSSION

Result

The results of this study were obtained from data processing conducted by the researchers. This study describes research trends on Downstream Soap Palm Processing to Achieve Economic Growth for the Lower Class from 2015 to 2025 in the Scopus database. The search was conducted using the following technique and yielded 462 document results. The number of Downstream Soap Palm Processing to Achieve Economic Growth for the Lower Class documents each year is shown in Table 1.

Table 1. Results of Scopus Indexed Article Mapping
(Keywords: Sapindu Rarak (Lerak), Lerak)

No.	Publication Year	Number of Documents
1	2015	1
2	2016	0
3	2017	0
4	2018	1
5	2019	2
6	2020	5

7	2021	1
8	2022	2
9	2023	1
10	2024	2
11	2025	1
Total		16

Source: Primary Data Processed by Researchers (2025)

Before using the Systematic Literature Review using the VosViewer analysis test tool, the researcher first used the Harzing's Publish or Perish analysis test tool which is open access first to capture the number of articles discussing soap nuts and soap nut processing with a limited number of 16 article titles indexed by Scopus Elsevier. Based on table 1., it can be seen that in 2015 there was 1 article, in 2016 there were 1 article, in 2017 there were 0 articles, in 2018 there were 1 article, in 2019 there were 2 articles that conducted research on the downstream processing of Soap Nuts. While in 2020 there were 5 articles, in 2021 there was 1 article, in 2022 there were 2 articles, in 2023 there was 1 article and articles found that discussed soap nut processing indexed by Scopus were in 2024 there were 2 articles and in 2025 there was 1 article.

Table 2. Results of Mapping Articles Indexed by Google Scholar
(Keywords: Sapindus Rarak (Lerak), Lerak)

No.	Publication Year	Number of Documents
1	2015	11
2	2016	9
3	2017	12
4	2018	15
5	2019	9
6	2020	17
7	2021	15
8	2022	15
9	2023	33
10	2024	30
11	2025	18
Total		184

Source: Primary Data Processed by Researchers (2025)

The number of documents published between 2015 and 2025 indexed by Google Scholar using the keyword "Sapindus Rarak (Lerak)" can be seen in Table 2. The analysis shows that between 2015 and 2025, there were 184 documents discussing Sapindus Rarak (Lerak).

The number of documents published in the Google Scholar database using the keyword "Sapindus Rarak (Lerak)" increased in 2022 and 2023. In general, the number of open-access documents published on Lerak in the Google Scholar database experienced an increase and a decrease in the number of research articles on Sapindus Rarak (Lerak) between 2013 and 2022.

Table 3. Results of Mapping Articles Indexed by Semantic Scholar
(Keywords: Sapindu Rarak (Lerak), Lerak)

No.	Publication Year	Number of Documents
1	2015	12
2	2016	9
3	2017	16
4	2018	13
5	2019	13
6	2020	15
7	2021	17
8	2022	13
9	2023	11
10	2024	22
11	2025	10
Total		151

Source: Primary Data Processed by Researchers (2025)

Meanwhile, the analysis results using the Harzing's Publish or Perish analysis test tool which is open access first to capture the number of articles discussing soap nuts and soap nut processing with a limited number of 28 article titles indexed by Semantic Scholar. Based on table 6, it can be seen that in 2015 there were 12 articles, in 2016 there were 9 articles, in 2017 there were 16 articles, in 2018 there were 13 articles, in 2019 there were 13 articles that conducted research on the downstream processing of soap nuts. While in 2020 there were 15 articles, in 2021 there were 17 articles, in 2022 there were 13 articles, in 2023 there were 11 articles and articles found that discussed soap nut processing indexed by Semantic Scholar were in 2024 there were 22 articles while in 2025 there were 10 articles.

Table 4. Types of Documents Indexed by Scopus

(Keywords: Sapindus Rarak (Lerak), Lerak)

No.	Document Type	Document
1	Article	8
2	Chapter Book	0
3	Review	0
4	Book	0
5	Conference Paper (Proceeding)	8
6	Notes	0
7	Editorial	0
8	Conference Overview	0
9	Letter	0
10	Correction Paper	0
Total		16

Source: Primary Data Processed by Researchers (2026)

According to Table 5, the results of the analysis using the open access Harzing's Publish or Perish analysis test tool explain several types of documents published in journals in the Scopus database for 2015 - 2025, which were searched using the keyword "Sapindus Rarak (Lerak)" with 16 documents obtained consisting of 10 articles and 8 documents in the form of conference papers.

Table 5. Types of Documents Indexed by Google Scholar

(Keywords: Sapindus Rarak (Lerak), Lerak)

No.	Document Type	Document
1	Article	24
2	Chapter Book	0
3	Review	0
4	Book	0
5	Conference Paper (Proceeding)	8
6	Thesis/Dissertation	80
7	Editorial	0
8	Conference Overview	0
9	Citation	42

10	Correction Paper	0
	Total	184

Source: Primary Data Processed by Researchers (2026)

According to Table 7, the results of the analysis using the open access Harzing's Publish or Perish analysis test tool explain several types of documents published in journals in the Scopus database for 2015 - 2025, which were searched using the keyword "Sapindus Rarak (Lerak)" with 184 documents obtained consisting of 24 documents in the form of scientific articles, 80 documents in the form of theses/dissertations, 42 documents in the form of theses/dissertations, and Conference Papers totaling 8 documents.

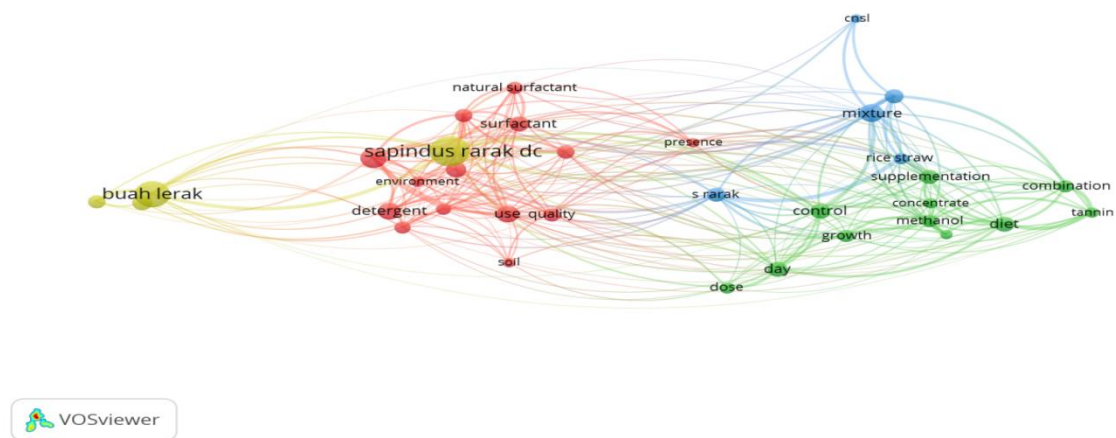
Table 6. Document Types Indexed by Semantic Scholar
(Keywords: *Sapindus Rarak* (Lerak), Lerak)

No.	Document Type	Document
1	Article	146
2	Chapter Book	0
3	Review	0
4	Book	0
5	Conference Paper (Proceeding)	5
6	Notes	0
7	Editorial	0
8	Conference Overview	0
9	Letter	0
10	Correction Paper	0
	Total	151

Source: Primary Data Processed by Researchers (2026)

According to Table 8, the results of the analysis using the open access Harzing's Publish or Perish analysis test tool explain several types of documents published in journals in the Scopus database for 2015 - 2025, which were searched using the keyword "Sapindus Rarak (Lerak)" with 151 documents obtained consisting of 146 articles and 5 documents in the form of conference papers.

Initially, researchers used the keywords "Lerak," "Green Economy," "Downstreaming," and "Lerak Processing." However, due to the scarcity of researchers from both Indonesia and abroad, they decided to use only "Sapindus Rarak," the scientific name for the Lerak plant.

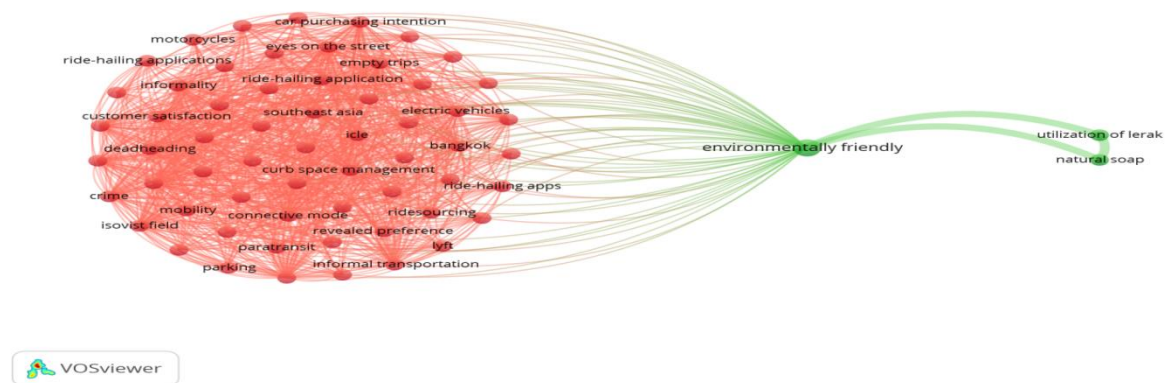


Source: Primary Data Processed by Researchers using VosViewer (2026)

Figure 1. Data Processing Results with Semantic Scholar Indexed VosViewer

Figure 1 shows the results of this study's analysis, illustrating that the keyword "Sapindus Rarak" is the largest cluster among all existing clusters and is the most frequently used by researchers. This is because data in the Semantic Scholar database used the keyword "Sapindus Rarak" from 2015 to 2025, resulting in analysis results related to environmentally friendly products such as detergents, bath soaps, pesticides, food supplements, health supplements, and medicines.

Furthermore, Figure 1 also illustrates the results of the analysis of co-occurrences in Semantic Scholar-indexed journals using the keywords "environment," "concentrated methanol," "combination," "use quality," "detergent," "nice straw," "surfactant," and others within each article.



Source: Primary Data Processed by Researchers using VosViewer (2026)

Figure 2. Results of Data Processing with VosViewer Indexed by Google Scholar

In Figure 2, using the keyword "Sapindus Rarak" and the VosViewer analysis tool within the Google Scholar index, it can be seen that of the articles retrieved, the majority used the keyword "Sapindus Rarak" in combination with or closely related to detergent, soapberry, environment, surfactant, and natural surfactant.

This reflects the fact that research on soapberry from 2015-2025 was predominantly focused on biology and chemistry, with very little discussion of the economic value/benefits of soapberry for economic growth, particularly among lower-income communities. This is because soapberry research has identified three key areas: natural soap, utilization of soapberry, and environmental friendliness. Research on downstream soapberry processing reveals the complex relationship between *Sapindus Rarak* and the environment, specifically the various products produced by processing soapberry. Very few researchers have discussed the relationship between downstream soapberry processing and economic growth within the green economy.



Source: Primary Data Processed by Researchers using VosViewer (2026)

Figure 3. Data Processing Results Using Scopus Indexed VosViewer

Figure 3 shows the results of the analysis of this study using VosViewer. It illustrates that the keyword "Sapindus Rarak" is the largest cluster among all existing clusters and is the most frequently used by researchers. This is because data in the Scopus database using Scopus keywords from 2015-2025 contained a limited number of articles discussing the analysis results regarding the downstream processing of Sapindus Rarak related to/starting from the optimization of soapberry processing and "Rarak Saportin." Furthermore, the results of downstream soapberry processing influence or can provide solutions to problems related to ultrasonic waves, can help with environmental (pollution) problems, and can contribute to the community's economic well-being.

Grouped by proportion based on the number and percentage of selected articles, the three article sources are shown in Figures 1, 2, and 3. Furthermore, the year of publication of the articles is mapped. Therefore, it is sufficient to describe the year in which this research topic was most widely researched and published in the selected article sources. Table 2 and Figure 2 show that the most common source of articles is Google Scholar with 184 articles. The second most common is Semantic Scholar with 151 articles. Table 3 and Figure 3 show that Scopus is the smallest index discussing soapberry processing from 2015 to 2025 with 16 articles. In 2022, the majority of articles were dominated by articles on soapberry as a key variable in the development of a Green Economy in society. Meanwhile, in 2018, the majority of articles were dominated by variable articles such as downstream soapberry processing which is starting to emerge and become one of the dimensions that become various outputs or produce environmentally friendly products ranging from bath soap, laundry detergent, to batik washing

soap, cosmetic ingredients, and environmentally friendly motor vehicle oil mixtures (green economy) and the like.

Discussion

The results of the Systematic Literature Review indicate that trends in soapberry utilization are divided into five strategic sectors:

- a. Household & Cleaning Sector: The use of environmentally friendly liquid soap and detergent based on soapberry saponins has been proven effective in emulsifying fats without polluting water (Wulandari, 2016).
- b. Health & Cosmetics Sector: The formulation of an antimicrobial facial wash (Nyra Saponin Facial Wash) has demonstrated high business feasibility with a BCR of 1.77 (Ariawa et al., 2024).
- c. Agriculture Sector: The use of soapberry biochar for Andosol soil remediation has optimally increased soil pH and organic carbon content (Arum & Wikaningrum, 2022).
- d. Environment & Remediation Sector: The use of saponins as a substitute for synthetic surfactants in the ultrafiltration process of batik waste (Aryanti et al., 2019).

Based on the research results and various documents discussed individually in Tables 2 through 4, and their relationships illustrated in Figures 1 through 3, it is clear that saponin extraction technology is used in soapberry processing. These include:

Household and MSME Scale Processing

Soap nuts (*Sapindus rarak*) are a commodity that is becoming increasingly difficult to obtain in Indonesia and can be used as a natural soap substitute. Soap nuts contain several compounds, including 12% saponins, 1% alkaloids, 0.036% steroids, and 0.029% triterpenes. Reusing traditional materials like soap nuts to clean batik cloth is important because they are environmentally friendly and do not contain chemicals that cause environmental pollution (Anna, 2019).

Industrial-Scale Processing

In-depth laboratory testing conducted by Wiludjeng & Altway (2015) isolated saponins from the flesh of Soap nuts (*Sapindus rarak* DC) using the Winterstein & Meyer method. The isolation process can be divided into three interrelated stages: extraction, purification, and crystallization. Extraction was carried out by hot maceration in a water bath and stirring with 600 ml of 70% alcohol for every 250 grams of powder to be extracted for 3 hours (Wiludjeng and Altway, 2015). The moisture content of the powder used was 11%, while the ash content was 3.35%. The saponins obtained had a melting point of 150-210°C, averaging 2 grams for every 250 grams of soapberry pulp powder, or a 0.8% yield (Wiludjeng and Altway, 2015).

Innovation in Soapberry Derivative Product Processing

Soapberry processing innovations are not only focused on process technology but also on the development of value-added derivative products. Various product innovations have been developed, including environmentally friendly detergents, herbal liquid soaps, natural shampoos, botanical pesticides, and multipurpose cleaning agents. This product diversification increases the economic value of soapberry and expands the market. The research results showed that the three soapberry seed extract liquid detergent formulas met the physical quality requirements of SNI 06-4075-1996 (Nurrosyidah et al., 2023).

One of the main ecological benefits of soapberry utilization is its ability to replace synthetic chemicals, particularly fossil-based surfactants in detergents and cleaners. The saponin content in soapberry is biodegradable, meaning it easily decomposes in the environment and does not cause the accumulation of harmful residues in water or soil. This contributes to reducing water pollution and protecting aquatic ecosystems. This is evident in research conducted by Satria & Yanti (2025). To achieve a clean smear layer in the apical third, it is necessary to develop soapberry irrigation materials in nanoparticle form. Nanoparticle materials have the advantage of enhancing the antimicrobial and anti-inflammatory effects of *Sapindus rarak* DC and enabling effective delivery of active ingredients into the root canal (Satria & Yanti, 2025). Soapberry-based products are generally safer for health due to their minimal use of harmful chemicals. The use of this environmentally friendly product can reduce the risk of skin irritation and exposure to hazardous substances, thus positively impacting people's quality of life.

According to Hawa, Farhanrika, and Ahmad (2022), they stated that they had found the best treatment, balanced ratio of soapberry extract (2:1; 3:2; 1:1; 2:3), and dilution method for the soap base (heated and unheated) to produce liquid laundry soap with the best characteristics. Based on the results of community service-based research conducted by A'tourrohman, Ni'am, et al. (2021), two important points can be concluded. First, through a community service program in the form of generative soapberry conservation training, the community in East Java (Jatimas) can understand that the soapberry plant is a rare plant and needs to be preserved. Second, an ethnobotanical study showed that after the implementation of a community service program, the Jatimas community, members of the Padepokan mBuritan agricultural community, used soap nuts as a herbal soap, a detergent for batik cloth and jewelry, and a natural insecticide (A'tourrohman, Ni'am, et al., 2021).

In the soap nut processing process, the solid waste extracted can be used as compost or organic fertilizer. This approach aligns with the principles of a circular economy, which aims to minimize waste and maximize resource utilization. Thus, soap nut processing contributes to ecological efficiency and a reduced carbon footprint. Based on research conducted by Wardhani, Nisa, Aryanti, Nafiunisa, and Irmalasari (2019), saponin extract from the pericarp of *Sapindus rarak* DC was used to replace synthetic surfactants in a surfactant-enhanced ultrafiltration process. This process was used to treat batik wastewater. Extraction using the maceration method was carried out at various solute-to-solvent ratios. The precisely calculated extract was used in the wastewater treatment process at various CMC concentrations.

Soap nut processing encourages the utilization of natural resources sustainable local biodiversity. Soapberry plants can grow in various land conditions and do not require intensive chemical inputs. With proper management, harvesting soapberry fruit does not damage the ecosystem and can actually support local vegetation conservation. According to Mulana, Humaira, Fadhilah, & Faisal (2022), avocado oil and natural foaming agents are derived from soapberry fruit (*Sapindus rarak*). Saponification of avocado oil is carried out by mixing 100 g of avocado oil with various KOH concentrations (20; 25; 30; 35 and 40% w/w) at a temperature of 70-75°C for 2 hours. Then, coffee extract and soaked soapberry fruit are added, each as a fragrance and foaming agent. Parameters used to test the quality of liquid soap include density, viscosity, free alkali, pH, and organoleptic. The results showed that the concentration of KOH affects the viscosity of the resulting soap. Density, free alkali, and pH did not show significant differences with changes in KOH concentration. Organoleptic test results showed that the product had good quality and was very acceptable at a KOH concentration of 30%. The density, viscosity, free alkali, and pH values at this condition were 1.018 g/mL, 0.866 kg/m.s, 0.1041%, and 11, respectively (Mulana, Humaira, Fadhilah, & Faisal, 2022).

Downstream soapberry processing offers a robust circular economic model for low-income communities. Solid waste from saponin extraction can be reprocessed into high-quality organic compost, minimizing the carbon footprint of the home industry.

Through a feasibility analysis of the traditional soapberry cleaning industry, the R/C ratio of 1.20 demonstrates that this business line is highly adaptable, low-cost in terms of initial capital requirements, and labor-intensive, enabling local employment in rural areas, aligning with the Sustainable Development Goals (SDGs).

5. CONCLUSION AND SUGGESTION

Based on the discussion of the utilization, technology, and ecological, social, and economic impacts of soapberry (*Sapindus rarak* DC.) processing, it can be concluded that soapberry is a local biological resource with significant potential for development as a value-added commodity within a green economy framework. The saponin content of soapberry makes it a multifunctional, environmentally friendly natural raw material, potentially replacing synthetic chemicals in various sectors.

Development of soapberry processing technology and methods, both at the household, MSME, and industrial levels, has been proven to improve product quality and diversification, thereby providing significant added economic value. Furthermore, soapberry utilization provides ecological benefits through reduced environmental pollution and sustainable use of natural resources. Socially, soapberry processing contributes to local community empowerment, the preservation of traditional knowledge, and an improved quality of life. Economically, soapberry has the potential to support inclusive and sustainable local economic growth in accordance with green economy principles.

Based on this matter, further in-depth research is needed regarding the optimization of extraction technology, product quality standardization, and economic and environmental feasibility analysis of soapberry processing, especially on an industrial scale. The government provides support through policies, training, and mentoring to the community and MSMEs in developing soapberry-based products, as well as encouraging the integration of soapberry as part of the green economy and sustainable development program. Business actors and local communities are advised to develop innovative soapberry processed products while still paying attention to aspects of sustainability, quality, and market needs so that soapberry-based products have high competitiveness. For subsequent researchers who will conduct similar research, they should be able to examine the potential for soapberry development in the context of a circular economy, integration with other local commodities, and its role in supporting the achievement of Sustainable Development Goals (SDGs).

ACKNOWLEDGEMENTS

The author expresses his deepest appreciation and gratitude to Indraprasta PGRI University for the financial support provided through the Unindra Research Grant program with Contract Number 2253/SP3M/KPM/LRPM/UNINDRA/XI/2025, November 5, 2025. His gratitude is also addressed to the Institute for Research and Community Service (LRPM) of

Indraprasta PGRI University for the support and facilities provided so that this research can be carried out until its completion.

REFERENCE

- A'tourrohman, M., Niam, M. Y., Ulfah, M., Malianimah, S. F., Al Abda, A. N. M., Fatimah, S., Pertiwi, S., Sari, M., Afrizal, A., Wijayanti, E., & Rusmadi. (2021). Community training in Jatimas Semarang through ethnobotany-based conservation and utilization of lerak (*Sapindus rarak* DC.). *Engagement: Jurnal Pengabdian Kepada Masyarakat*, 5(2), 312–328. <https://doi.org/10.29062/engagement.v5i2.791>
- Alkan, D., & Kamaşak, R. (2023). The practice of “sustainable development goals washing” in developing countries. In *Proceedings of the 6th International Academic Conference on Management and Economics*. Diamond Scientific Publication.
- Ariawa, D., Wirdana, N. P. R. A. A., & Suena, N. M. D. S. (2024). Analisa peluang usaha kosmetika berbasis ekstrak lerak Nyra Saponin facial wash: Indonesia. *AJIE (Asian Journal of Innovation and Entrepreneurship)*, 8(1), 1–7. <https://doi.org/10.20885/ajie.vol8.iss1.art1>
- Artha, I. W. W., Hendrayana, M. A., Dewa, I., & Sukrama, I. D. M. (2022). Uji daya hambat ekstrak etanol buah lerak (*Sapindus rarak*) terhadap bakteri *Staphylococcus epidermidis*. *Jurnal Medika Udayana*, 11(5), 14–18. <https://doi.org/10.24843/MU.2022.V11.i5.P03>
- Arum, S., & Wikaningrum, T. (2022). Study of lerak (*Sapindus rarak*) biochar application for andosol agricultural soil remediation. *IOP Conference Series: Earth and Environmental Science*, 1065(1), 012020. <https://doi.org/10.1088/1755-1315/1065/1/012020>
- Aryanti, N., Nafiunisa, A., Irmalasari, L. N., Nisa, I. M. K., & Wardhani, D. H. (2019). Treatment of batik wastewater using plant derived surfactant-enhanced ultrafiltration membrane. *IOP Conference Series: Materials Science and Engineering*, 620(1), 012015. <https://doi.org/10.1088/1757-899X/620/1/012015>
- Firmansyah, H. P. (2025). *Perbedaan handwash berbahan dasar lerak dan chlorhexidine gluconate 2% terhadap persentase penurunan jumlah koloni mikroorganisme: Studi eksperimental dengan metode glove juice pada mahasiswa Fakultas Kedokteran UNISSULA angkatan 2021* [Doctoral dissertation, Universitas Islam Sultan Agung Semarang]. Repository Universitas Islam Sultan Agung.
- Gough, D., Thomas, J., & Oliver, S. (2017). Introducing systematic reviews. In *An introduction to systematic reviews* (pp. 1–16). SAGE Publications. https://doi.org/10.1007/978-3-030-12263-8_1
- Hawa, L. C., Farhanrika, N. L., & Ahmad, A. M. (2022). Utilization of lerak juice (*Sapindus rarak* DC) as natural surfactant in the liquid washing soap production. *Jurnal Teknik Pertanian Lampung*, 11(1), 24–34. <https://doi.org/10.23960/jtep-l.v11i1.24-34>
- Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, 45(2), 175–194. <https://doi.org/10.1177/0312896219877678>
- Mio, C., Panfilo, S., & Blundo, B. (2020). Sustainable development goals and the strategic role of business: A systematic literature review. *Business Strategy and the Environment*, 29(8), 3220–3245. <https://doi.org/10.1002/bse.2568>

- Mulana, F., Humaira, J. A., Fadhilah, T., & Faisal, M. (2022). Characteristic of avocado oil-based coffee-scented liquid facial soap with *Sapindus rarak* foaming agent. *Rasayan Journal of Chemistry*, 15(5), 65–71. <https://doi.org/10.31788/RJC.2022.1558065>
- Nurrosyidah, I. H., Putri, E. N., Klau, I. C. S., Wulandari, I., & Ramadhan, A. (2023). Formulasi deterjen eco-friendly ekstrak etanol biji buah lerak (*Sapindus rarak* DC) kombinasi surfaktan decyl glucoside dan lauryl glucoside. *Camellia: Clinical, Pharmaceutical, Analytical and Pharmacy Community Journal*, 2(1), 84–91. <https://doi.org/10.30651/cam.v2i1.17955>
- Pan, W., Pan, W., Hu, C., Tu, H., Zhao, C., Yu, D., Xiong, J., & Zheng, G. (2019). Assessing the green economy in China: An improved framework. *Journal of Cleaner Production*, 209, 680–691. <https://doi.org/10.1016/j.jclepro.2018.10.267>
- Satria, E., & Yanti, N. (2025). Pengembangan lerak (*Sapindus rarak* DC) sebagai bahan irigasi saluran akar berdasarkan teknologi nano. *INSOLOGI: Jurnal Sains dan Teknologi*, 4(2), 240–252. <https://doi.org/10.55123/insologi.v4i2.5083>
- Turofiq, I. (2019). *Studi variasi kadar air terhadap sifat fisik dan sifat mekanik lerak (Sapindus rarak)* [Sarjana thesis, Universitas Brawijaya]. Repository Universitas Brawijaya.
- Wibowo, P. A., Ali, J., & Budiman, J. (2023). Mediating factor of strategy business in the relationship between environmental and business performance. *Telaah Bisnis*, 24(2), 116–138. <https://doi.org/10.35917/tb.v24i2.423>
- Wulandari, M. A. (2016). *Lerak detergen: Pemanfaatan buah lerak (Sapindus rarak DC.) sebagai bahan alternatif sabun pencuci pakaian dengan aroma jeruk (Citrus sp.)* [Skripsi, Universitas Sebelas Maret Surakarta]. Digital Library Universitas Sebelas Maret.
- Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, 39(1), 93–112. <https://doi.org/10.1177/0739456X17723971>