International Journal of Social Science and Human Research

ISSN (print): 2644-0679, ISSN (online): 2644-0695

Volume 09 Issue 10 October 2026

DOI: 10.47191/ijsshr/v9-i10-29, Impact factor- 8.361

Page No: 8828-8834

Assessing the Sustainability Outcomes of Bamboo Shoot Value Addition and Packaging in Bugisu.

Shifa Wahab[1], Abubakar Yusuf Dutse[2], Muhammed Inuwa[3], Ibrahim Aliyu[4]

[1]Sa'adu Zungur University (Formerly Bauchi State University), Bauchi State, Nigeria

[2]Abubakar Tafawa Balewa University, Bauchi – Nigeria.

[3,4]Sa'adu Zungur University (Formerly Bauchi State University)

ABSTRACT: Bamboo shoots, locally known as *Malewa* or *Maleya*, represent a significant cultural and economic resource for the Bamasaba people in Eastern Uganda's Bugisu region. While previous research examined the processing and packaging practices for this organic food delicacy, the sustainability implications remain underexplored. This paper examines current bamboo shoot processing and packaging practices, identifies sustainability challenges affecting the bamboo shoot value chain, and proposes strategies for sustainable processing and packaging that improve economic, social, and environmental outcomes. The paper draws on qualitative data from processors and vendors to examine sustainability challenges and opportunities in bamboo shoot processing and packaging in the Bugisu region. Findings indicate that despite the nutritional and economic potential of bamboo shoots, current practices face sustainability constraints including limited awareness of processing benefits, inadequate packaging knowledge, and lack of formal value chain management. The theoretical contribution of this study lies in extending sustainability assessment frameworks to informal agri-food systems, applying stakeholder management theory to value chain formalization, and integrating packaging theory with food security and livelihood outcomes in a developing economy context. The study identifies key sustainability strategies including eco-friendly packaging adoption, stakeholder collaboration, capacity building, and policy support. Implications for sustainable agro-processing, food security, and rural livelihoods in Uganda are discussed.

KEYWORDS: Bamboo shoots, value addition, sustainability outcomes, stakeholder management, Bugisu.

1.0 INTRODUCTION

Bamboo shoot vegetable, known as *Malewa* or *Maleya* in the original dialect among the Bamasaba people, is an organic delicacy made from young bamboo shoots that grow naturally in the forests of Mount Elgon in Eastern Uganda (Shifa, 2025). The bamboo shoot value chain in Uganda centers traditionally on the slopes of Mount Elgon, where the Gisu (Bamasaaba) community harvests, processes, and trades tender edible shoots locally known as Malewa ("No Title," 2020). Common edible species include mountain bamboo (*Oldeania alpina*) and introduced varieties like *Bambusa vulgaris,* though primarily used for construction and biomass, its young shoots are edible when processed correctly to remove natural bitterness and cyanogenic glycosides (Nongdam & Tikendra, 2014).

For centuries, Malewa has been an integral part of Bagisu culture, traditionally served during *imbalu* (circumcision ceremonies), weddings, and important cultural gatherings ("No Title," 2020). The delicacy is believed to have originated when Bagisu ancestors, forced to take refuge in mountain caves during conflicts, discovered that young bamboo shoots could be boiled and consumed as food ("No Title," 2020).

Beyond its cultural significance, bamboo shoots possess considerable nutritional value, containing amino acids, proteins, carbohydrates, vitamins, and dietary fibers (Phuseerit, Seewaeng, Boonarsa, Seephua, & Siriamornpun, 2026; Shifa, 2025). The rich mineral content, including potassium, zinc, copper, manganese, and calcium, combined with vitamins A, B1, B3, B6, and E, positions bamboo shoots as a potential health food with medicinal properties, including promotion of digestive health and prevention of cardiovascular diseases and certain cancers (Long et al., 2026; Shifa, 2025). These nutritional attributes have contributed to bamboo shoots gaining popularity worldwide as a health food, particularly in countries like China and Northeast Asia (Kaur Bajwa, Santosh, & Nirmala, 2021; Shifa, 2025; Technology, 2025). In East Africa, Malewa styles tables in Nairobi, Mwanza, Kigali, Juba, and Dar es Salaam, not only as a nostalgic dish but also as a symbol of East African identity. Its migration tells a story of intra-African mobility, one in which indigenous food travels far ("No Title," 2021). Despite this potential, the methods used to process, package, and position Malewa as a high-value organic food in the market remain inadequate (Shifa, 2025).

Research on bamboo in Uganda, relative to its probable contribution to sustainable development, remains limited (Shifa, 2025). There exists a general lack of awareness, combined with poor perception of bamboo products as having limited market opportunity and being associated with poverty (Shifa, 2025).

The global bamboo economy is valued at approximately USD 60 billion, presenting significant income generation potential for rural communities ("No Title," 2025). China and India lead global bamboo production, with national production values estimated at USD 19.5 billion and USD 13.5 billion, respectively (Kaur Bajwa et al., 2021; "No Title," 2025).

For Uganda, developing the bamboo sector presents an opportunity to contribute to poverty reduction, food security, and sustainable development. However, the sustainability of bamboo shoot processing and packaging in the Bugisu region faces multiple challenges that warrant investigation.

This paper builds on previous research on bamboo shoot processing and packaging in the Bugisu region to analyze the implications for sustainability. The study aims to: (i) examine the current processing and packaging practices for bamboo shoots in the Bugisu region; (ii) identify sustainability challenges affecting the bamboo shoot value chain; and (iii) propose strategies for sustainable bamboo shoot processing and packaging that enhance economic, social, and environmental outcomes.

2.0 LITERATURE REVIEW

2.1 Bamboo Shoot Processing

Bamboo shoots can be utilized fresh or processed and preserved in various forms, including dried, salted, fermented, marinated, and canned products (Shifa, 2025). The primary purposes of processing fresh bamboo shoots are to remove anti-nutrients that may be harmful for consumption and to extend shelf life, as bamboo shoots are highly perishable with a shelf life of about 2 days at ambient temperatures (20-25ºC), which leads to browning and renders them uneatable (Technology, 2025). However, certain processing methods such as marinating, boiling, and drying may affect nutritional value. Drying and dehydration remain the most widely used techniques due to their convenience for packaging, storage, and transportation (Shifa, 2025). However, washing and disinfection processes with the solution before filling them in the package might prevent color change and sweetness decrease, which are effective ways to reduce quality loss during transportation, and they can be stored at room temperature (Technology, 2025).

Processing transforms bamboo shoots into various value-added products. Examples of value-added products derived from bamboo shoots include biscuits, crackers, nuggets, candies, chips, chapattis, buns, chutney, pasta, and cookies (Hin et al., 2024; Midhun, K, S, & Rao, 2025). These products occupy a substantial position in the 21st-century market, particularly as consumers become increasingly health-conscious and demand foods with valuable minerals, vitamins, dietary fibers, micronutrients, and antioxidants (Shifa, 2025).

A study on harnessing the potential of bamboo for sustainable livelihoods in Sub-Saharan Africa by Wakweya (2026) noted that raw shoots contain natural toxins and require careful boiling, soaking, or sun drying before consumption. It is vital to process bamboo shoots before consumption to reduce the cyanide content in them, which ensures safety for consumption (Appl et al., 2025). Bamboo Uganda, the umbrella association for the bamboo value chain in Uganda, observed that most processing remains domestic and rural-based, which affects quality standards.

In the Bugisu region, processing practices remain relatively traditional. Fresh bamboo shoots are harvested from forests, with the outer sheath removed before smoking or drying (Shifa, 2025). The smoked bamboo shoots are then sold in local markets, often developing a whitish mold due to poor storage conditions (Shifa, 2025). The lack of appropriate processing technologies and knowledge limits the potential for value addition and market expansion.

2.2 Packaging in the Food Industry

Packaging serves multiple essential functions in the food industry. It acts as a shield against external elements such as insects, light, heat, oxygen, bacteria, and odors, thereby preserving food products during their shelf life (Shifa, 2025). Packaging safeguards product quality and consumer safety, facilitates logistical efficiency, and serves as a marketing tool by conveying information through branding and labeling (Bhatlawande, Ghatge, Shinde, Anushree, & Patil, 2024). Effective packaging meets modern consumers' needs for convenience and time-saving (Bhatlawande et al., 2024). Presently, the packaging industry deeply relies on petroleum-based plastics due to their cost-effectiveness and good mechanical properties ("Food Chemistry -Konjac glucomannan-film with antibacterial, mechanical, and moisture-management properties for fresh bamboo shoots packaging 2026. Copyright © 2026 Elsevier Ltd. Guoqi Wu," 2026). Unfortunately, these materials are non-biodegradable, which contributes to severe environmental pollution and food safety concerns due to the potential migration of food additives.

Recent innovations in packaging technology emphasize active packaging systems, including antioxidant-releasing films that extend the shelf life of perishable food products, reduce food waste, and prevent the growth of bacteria, fungi, and other microorganisms (El jaouhari, Arif, Samadhiya, Naz, & Kumar, 2024). Packaging systems also help minimize food loss by preventing product damage during transportation activities (El jaouhari et al., 2024).

For bamboo shoots specifically, ideal packaging must possess multiple properties including antibacterial activity, moisture management, enzymatic browning mitigation, and good mechanical strength throughout transportation and storage ("Food

Chemistry -Konjac glucomannan-film with antibacterial, mechanical, and moisture-management properties for fresh bamboo shoots packaging 2026. Copyright © 2026 Elsevier Ltd. Guoqi Wu," 2026). Current packaging for fresh produce relies heavily on petroleum-based plastics, which contribute to environmental pollution and raise food safety concerns due to potential migration of additives ("Food Chemistry -Konjac glucomannan-film with antibacterial, mechanical, and moisture-management properties for fresh bamboo shoots packaging 2026. Copyright © 2026 Elsevier Ltd. Guoqi Wu," 2026). This has driven research into novel, eco-friendly packaging materials that can effectively and conveniently preserve fresh produce.

2.3 Sustainability in Agro-Processing

Sustainability in agro-processing requires balancing economic, social, and environmental considerations (Buranasiri, Lai, Woo, & Piboonrungroj, 2024). Sustainable agricultural system management can enable bamboo shoots to become a key economic activity that enhances people's standards of living (Shifa, 2025). Key elements of sustainability include: (a) economic viability, ensuring value addition and market access; (b) social equity that benefits local communities, particularly women and youth; and (c) environmental stewardship, conserving bamboo resources and ecosystems (Gelaw, Kassa, Abebaw, Kassa, & Abdelkadir, 2025).

Global experiences demonstrate that sustainable bamboo management can yield multiple benefits. In China, research on Lei bamboo shoot processing has examined greenhouse gas emissions, carbon footprints, and water footprints during processing, using life cycle assessment to evaluate environmental impacts across the product lifecycle ("Greenhouse gas emissions and carbon and water footprints during processing of Lei bamboo shoots Zixiang Weng," 2024). Such research provides scientific evidence to improve production processes and promote cleaner production.

In Uganda, partnerships between organizations like the Uganda Investment Authority and bamboo enterprises have demonstrated the potential of a circular economy model, where bamboo is transformed into diverse products including furniture, panels, and construction materials, with processing residues converted into biochar ("No Title," 2026). These models exemplify how bamboo value chains can be developed sustainably. The absence of processing and formal market structures (Wakweya, 2026) pose a sustainability problem.

3.0 METHODOLOGY

This study draws on data from the author's previous research on processing and packaging of bamboo shoots in the Bugisu region. The study employed a descriptive approach based on literature review and in-depth interviews with key informants. Interviews were conducted with 08 participants comprising 04 processors and 04 vendors operating in the Bugisu region (Shifa, 2025) . Participants were selected purposively based on their involvement in bamboo shoot processing and trade. Data collection focused on: (1) current processing methods and challenges; (2) packaging practices and awareness; (3) perceptions of sustainability; and (4) strategies for improving sustainability. Interview data were analyzed thematically to identify patterns and key themes relating to sustainability implications.

4.0 RESULTS AND DISCUSSION

4.1 Current Processing Practices

The study found that bamboo shoot processing in the Bugisu region remains largely traditional. Processors harvest young bamboo shoots from forests, remove the outer sheaths, and either smoke or dry the shoots for preservation (Shifa, 2025). The smoked bamboo shoots are then sold in local markets, often with limited quality control.

Results indicated that most people in the Bugisu region are not aware that Malewa has benefits beyond being used as a food delicacy (Shifa, 2025). Appropriate processing could enhance nutritional value, improve quality, reduce wastage, and contribute to the nutritional security of consumers, thereby enhancing demand and market base (Shifa, 2025). The limited awareness of processing benefits represents a significant sustainability challenge. Without understanding the nutritional and economic potential of bamboo shoots, processors and vendors may not invest in improved processing methods that could enhance product quality, shelf life, and market value.

4.2 Packaging Practices and Challenges

The study revealed limited understanding of packaging importance among respondents. Only a few participants knew the significance of packaging bamboo shoots; others appeared not to have a proper understanding of packaging (Shifa, 2025). This knowledge gap has implications for product quality and market access.

Inadequate packaging contributes to several problems observed in the study. Smoked bamboo shoots for sale often develop a whitish mold due to poor storage conditions, indicating quality deterioration (Shifa, 2025). The lack of proper packaging limits shelf life, increases waste, and restricts market access beyond local areas.

However, innovation is emerging. Entrepreneurs like Wabule, through AW Bamboo Enterprises and Charene Enterprises, are packaging Malewa in various forms i.e., smoked dried, salted, canned, crisps, and fresh, for sale in supermarkets and for export *("Irene registered AW Bamboo Enterprises Limited in 2012 to enable local communities to grow bamboo on a large scale and to conserve , add value , and distribute bamboo products to low-income and environmentally vulnerable communities in the Mount*

Elgon region . Although her goals were clear , there was little or no dedicated land available for the enterprise to access for cultivation , so the bamboo had to be sourced from traders . Irene was highly resourceful in networking and raising funds and in-kind support from diverse sources for the venture . She joined the Uganda Small Scale Industries Association where she networked with other local businesses . At a 2018 trade show , she met with representatives of the Uganda Development Corporation . The corporation invited her to apply for funds , on condition that the business produces its own bamboo . Irene had the idea of applying to the UWA to use land within the Mount Elgon National Park for bamboo cultivation . By 2021 , Irene had signed a Memorandum of Understanding with the UWA and the Bududa District government , giving AW Bamboo Enterprises the right to use land within the national park for sustainable cultivation and livelihood activities . AW Bamboo Enterprises launched a pilot project to work with communities in the district . 5," 2018). These enterprises have sought technical assistance from institutions like the Uganda Industrial Research Institute to research best preservation methods. This demonstrates the potential for formalizing and upgrading the packaging value chain.

4.3 Sustainability Implications

4.3.1 Economic Sustainability

The economic sustainability of bamboo shoot processing faces several challenges. The bamboo resource is primarily sourced from forests rather than cultivated plantations. As one respondent noted, "since they did not own the land where the bamboo shoots were found, they didn't know what to do to sustain it" (Shifa, 2025). This reliance on wild bamboo creates uncertainty regarding long-term resource availability.

Access to bamboo sources is becoming more complicated as conservation authorities limit collection areas ("https://www.monitor.co.ug/uganda/magazines/farming/wabule-gives-malewa-fresh- touch-4136228 Wabule gives malewa fresh touch Saturday, February 25, 2023," 2023). Harvesting within Mount Elgon National Park is strictly regulated, requiring controlled harvesting to avoid poaching and habitat destruction ("No Title," 2025). While these regulations are necessary for conservation, they create challenges for processors and vendors who depend on bamboo shoots for their livelihoods.

The underutilization of bamboo presents both a challenge and an opportunity. The global market for bamboo production is growing in response to increasing demand for sustainable products (Shifa, 2025). However, development and management of trade in this industry in Uganda remain lacking (Shifa, 2025; Wakweya, 2026). Formalizing the bamboo value chain through policy support, investment, and capacity building could enhance economic sustainability.

4.3.2 Social Sustainability

Bamboo shoot processing provides significant livelihood opportunities, particularly for women. Women are deeply involved in every stage of the value chain, that is, from harvesting bamboo shoots on steep mountain slopes to processing, smoking, drying, and selling final products ("No Title," 2025). In Mbale, Jinja, and Sironko, entire communities have organized informal women's collectives coordinating harvesting and drying schedules to meet growing demand ("No Title," 2025).

However, this work involves considerable risks. During rainy seasons, loose soils on the mountain can be deadly ("No Title," 2025). Despite these dangers, women continue harvesting and preparing Malewa because "it is how I feed my family". This highlights both the economic importance and the vulnerability of those engaged in the value chain.

Interventions to improve social sustainability could include: establishing safety protocols for harvesters; providing alternative livelihood options; strengthening women's cooperatives; and developing skills in food safety, quality assurance, and business management. Some women are already training others in food safety and quality assurance, building a new generation of agro-entrepreneurs rooted in indigenous knowledge ("No Title," 2025).

4.3.3 Environmental Sustainability

Environmental sustainability is a critical concern for bamboo shoot processing in the Bugisu region. Overuse by local people struggling to feed families and meet livelihood needs has depleted forest cover on Mount Elgon slopes (Allan, 2018). Deforestation has also caused tensions between the Uganda Wildlife Authority, which manages Mount Elgon National Park, and local communities who want continued access to timber and non-timber forest products (Allan, 2018). However, bamboo cultivation presents environmental opportunities. Highland bamboo (*Yushania alpina*) has the potential to provide multidimensional benefits to local people and the ecosystem, stabilizing mountain slopes to prevent landslides while contributing to local economic empowerment and disaster risk reduction (Irene, 2018).

Efforts to promote bamboo cultivation are underway. AW Bamboo Enterprises signed a Memorandum of Understanding with the Uganda Wildlife Authority and Bududa District government, giving the enterprise the right to use land within Mount Elgon National Park for sustainable cultivation and livelihood activities (Allan, 2018). More than 500 women and young people are now involved in growing bamboo and other tree species (Irene, 2018). The bamboo saplings planted in 2021 are bearing shoots that can now be harvested and packaged (Irene, 2018).

Climate change adaptation is also relevant to sustainability. Through partnerships with organizations like the International Network of Bamboo and Rattan (INBAR), training is provided to community members in bamboo value addition, post-harvest handling, financial skills, and climate change awareness (Irene, 2018; Bamboo Uganda).

4.4 Strategies for Sustainability

Based on the findings, the following strategies are proposed for enhancing sustainability of bamboo shoot processing and packaging in the Bugisu region:

4.4.1 Awareness and Capacity Building

There is a critical need to create awareness about the nutritional, economic, and environmental benefits of bamboo shoots. Communication and knowledge management systems should be developed to educate stakeholders (Shifa, 2025). Training and research in bamboo education and market development is needed (Wakweya, 2026).

Capacity building should target all stakeholders in the value chain, including harvesters, processors, vendors, and consumers. Training in appropriate processing technologies, packaging innovations, food safety standards, and sustainable harvesting practices would enhance product quality and market access.

4.4.2 Policy and Institutional Support

Government support is essential for sustainability. Sustainability requires various stakeholders to balance economic, social, and environmental issues (Shifa, 2025) . Recognition of Malewa as an export crop could help formalize its trade and attract investment (Irene, 2018). Programs like the Buy Uganda Build Uganda (BUBU) policy provide a framework for enhancing local production and value addition ("No Title," 2025).

Policy interventions should include: developing a national bamboo policy; including bamboo in national development plans; providing fiscal and non-fiscal incentives; strengthening producer cooperatives; and establishing a national bamboo multi-stakeholder platform (Hillary A et al., 2022).

4.4.3 Sustainable Packaging

The use of eco-friendly packaging materials should be encouraged to ensure sustainability (Shifa, 2025). Bamboo wood grown from cultivated sources could be used to make packaging for bamboo shoots, enhancing food quality and safety while minimizing food losses (Shifa, 2025) . Environmentally friendly packages can also facilitate distribution.

Innovations in biodegradable packaging materials are relevant for bamboo shoot packaging. Recent research has developed films with antibacterial properties, mechanical strength, and moisture management capabilities using konjac glucomannan and other natural polysaccharides ("Food Chemistry -Konjac glucomannan-film with antibacterial, mechanical, and moisture-management properties for fresh bamboo shoots packaging 2026. Copyright © 2026 Elsevier Ltd. Guoqi Wu," 2026). Such materials could provide sustainable alternatives to petroleum-based plastics.

4.4.4 Value Addition and Market Development

Increasing value addition through processing and packaging can enhance economic returns. Appropriate utilization of bamboo shoots as health food can help overcome malnutrition problems common in rural areas (Shifa, 2025). A study by (Wakweya, 2026) noted that the nutritional value of bamboo shoots gives the opportunity to boost the dietary range, enhance food security and contribute to income through fresh and processed markets. The potential for Bamboo to be developed into novel and health food items can add economic activities at industrial and community levels through cultivation, processing, packaging, and commercialization (Ma et al., 2024). Market development should target both domestic and regional markets. In the short term, government and institutional markets such as schools, housing, and fisheries should be targeted (Hillary A et al., 2022) . In the long term, export markets, including the growing European market for sustainable products, offer significant opportunities (Hillary A et al., 2022).

4.4.5 Cultivation and Resource Management

Cultivation provides the most sustainable path for resource security. Attempts to grow bamboo in lowland areas have proven difficult because "the unique mountain ecosystem cannot be easily replicated"(The Independent Uganda, 2023). However, land within Mount Elgon National Park can be used for sustainable cultivation through partnership arrangements (Global Center for Adaptation, The story of mt Elgon 2023). Community-based cultivation models, such as out-grower schemes, can expand bamboo production while providing alternative income streams in rural communities (Uganda Investment Authority, 2026). Investment in nursery operations and plantation establishment is essential for long-term sustainability.

Promoting Alternative Livelihoods & Planting: Conservation groups and local enterprises encourage cultivating bamboo on private land and buffer zones to lower the heavy reliance on the national park's natural stands (Global Center for Adaptation, The Story of mt Elgon 2023). In a training carried out on indigenous knowledge in Chepkitale, an adjacent community to mt Elgon, it was stated that *"There is enough traditional knowledge among this community for them to conserve their forest. We should look for ways of bridging indigenous knowledge and science so that both work in harmony"*. In this regard, communities working together with other stakeholders in conservation can help to reduce loss of biodiversity (Transformative Pathways, 2023).

5.0 CONTRIBUTION TO THEORY

The study contributes to stakeholder management theory by demonstrating how the formalization of an informal, culturally embedded value chain depends on the systematic engagement and alignment of diverse stakeholder interests, moving beyond a purely economic or technical analysis of value addition. The traditional Malewa chain is characterized by informal, trust-based

relationships among dispersed actors i.e. rural collectors, local vendors, and household consumers. The introduction of processing and packaging as exemplified by pioneers such as Irene Walimbwa and her enterprise, AW Bamboo Enterprises, fundamentally reconstitutes the stakeholder landscape. The intervention creates a new focal organization (the processor/packager) that must now manage relationships with a broader and more complex set of actors.

In Bugisu, the traditional handling of Malewa results in high spoilage and limited market access (low value, high waste). The study theoretically contributes by demonstrating that appropriate processing and packaging act as a "decoupling mechanism" that can reduce the environmental burden of wasted food (by extending shelf life and reducing spoilage) while simultaneously creating economic value through differentiation, i.e., positioning Malewa as a high-value organic health food. This extends the Eco-efficient Value Creation **(**EVR) framework from a design-centric optimization tool to a livelihood-oriented sustainability strategy in rural African contexts.

The study makes a theoretical contribution by explicitly linking packaging functionality to social sustainability outcomes; specifically, nutritional security and livelihood resilience in a developing country context. Packaging literature often treats social sustainability as secondary to environmental and economic dimensions. This study, however, positions packaging as a social determinant of health and income.

6.0 CONCLUSION

This study examined the processing and packaging of bamboo shoots in the Bugisu region of Eastern Uganda, with a focus on implications for sustainability. The findings indicate that while bamboo shoots represent a valuable cultural, nutritional, and economic resource for the Bamasaba people, current practices face significant sustainability challenges. These include limited awareness of processing benefits, inadequate packaging knowledge, reliance on wild bamboo sources, and lack of formal value chain management. The sustainability of bamboo shoot processing and packaging requires a multi-stakeholder approach that balances economic, social, and environmental considerations. Key strategies include: awareness and capacity building to enhance knowledge of processing and packaging benefits; policy and institutional support to formalize the value chain; adoption of eco-friendly packaging materials; value addition and market development to enhance economic returns; and sustainable cultivation to ensure long-term resource availability. The potential for bamboo shoots to contribute to sustainable development in Uganda is significant. With appropriate agricultural system management, bamboo shoots in the Bugisu region can sustainably become a key economic activity that enhances people's standards of living. Despite this promise, the bamboo sector remains underdeveloped, and its contributions to sustainable livelihoods and the UN Sustainable Development Goals (SDGs) are not fully realised. The growing global market for bamboo products, combined with increasing consumer demand for sustainable and healthy foods, presents opportunities for Uganda to develop this sector.

Future research should focus on: cost-effective processing technologies suitable for small-scale producers; feasibility of eco-friendly packaging materials using local resources; models for sustainable bamboo cultivation in protected areas; and market development strategies for value-added bamboo shoot products. By addressing these areas, stakeholders can work toward a more sustainable bamboo shoot value chain that benefits communities, conserves ecosystems, and contributes to food security and economic development.

REFERENCES

1) Allan, M. (2018). Muwanga Allan, (June).
2) Appl, C., Technol, S., No, V., Techamahasaranont, J., Ponpang-nga, P., & Sirijariyawat, A. (2025). Physical and Antioxidant Properties of Bamboo Shoot : Impact of Boiling on Purine Content and Antioxidant Activity.
3) Bhatlawande, A. R., Ghatge, P. U., Shinde, G. U., Anushree, R. K., & Patil, S. D. (2024). Unlocking the future of smart food packaging: biosensors, IoT, and nano materials. *Food Science and Biotechnology*, *33*(5), 1075–1091. https://doi.org/10.1007/s10068-023-01486-9
4) Buranasiri, B., Lai, P. L., Woo, S., & Piboonrungroj, P. (2024). Impact of sustainable development goal orientation on supply chain collaboration and sustained competitive advantage: Evidence from the tea and coffee industry. *Asian Journal of Shipping and Logistics*, *40*(2), 83–88. https://doi.org/10.1016/j.ajsl.2024.01.004
5) El jaouhari, A., Arif, J., Samadhiya, A., Naz, F., & Kumar, A. (2024). Exploring the application of ICTs in decarbonizing the agriculture supply chain: A literature review and research agenda. *Heliyon*, *10*(8), e29564. https://doi.org/10.1016/j.heliyon.2024.e29564
6) Food Chemistry -Konjac glucomannan-film with antibacterial, mechanical, and moisture-management properties for fresh bamboo shoots packaging 2026. Copyright © 2026 Elsevier Ltd. Guoqi Wu. (2026).
7) Gelaw, Y., Kassa, G., Abebaw, D., Kassa, H., & Abdelkadir, A. (2025). Cleaner and Circular Bioeconomy Value chain analysis of smallholder highland bamboo products : The case of Hula and Gumer districts , Ethiopia. *Cleaner and Circular Bioeconomy*, *12*(July), 100177. https://doi.org/10.1016/j.clcb.2025.100177
8) Greenhouse gas emissions and carbon and water footprints during processing of Lei bamboo shoots Zixiang Weng. (2024).

9) Hillary A, Fred K, Isaac K, Christine M, Michael M, Theodros G, … Durai J. (2022). INBAR Working Paper Technical Paper Bamboo Site-Species Matching Study in Uganda. Retrieved from https://www.inbar.int/project/sino-east-africa-bamboo-development-
10) Hin, M., Shaeera, N., Mohd, H., Chai, A., Mantihal, S., & Pindi, W. (2024). Advances in Bamboo Science Impact of bamboo shoot powders on the quality attributes of cassava-based crackers. *Advances in Bamboo Science*, *9*(July), 100114. https://doi.org/10.1016/j.bamboo.2024.100114
11) https://www.monitor.co.ug/uganda/magazines/farming/wabule-gives-malewa-fresh- touch-4136228 Wabule gives malewa fresh touch Saturday, February 25, 2023. (2023), 4136228.
12) Irene registered AW Bamboo Enterprises Limited in 2012 to enable local communities to grow bamboo on a large scale and to conserve , add value , and distribute bamboo products to low-income and environmentally vulnerable communities in the Mount Elgon region . Although her goals were clear , there was little or no dedicated land available for the enterprise to access for cultivation , so the bamboo had to be sourced from traders . Irene was highly resourceful in networking and raising funds and in-kind support from diverse sources for the venture . She joined the Uganda Small Scale Industries Association where she networked with other local businesses . At a 2018 trade show , she met with representatives of the Uganda Development Corporation . The corporation invited her to apply for funds , on condition that the business produces its own bamboo . Irene had the idea of applying to the UWA to use land within the Mount Elgon National Park for bamboo cultivation . By 2021 , Irene had signed a Memorandum of Understanding with the UWA and the Bududa District government , giving AW Bamboo Enterprises the right to use land within the national park for sustainable cultivation and livelihood activities . AW Bamboo Enterprises launched a pilot project to work with communities in the district . 5. (2018).
13) Kaur Bajwa, H., Santosh, O., & Nirmala, C. (2021). Bamboo shoot for food and nutritional security. *~ 24 ~ Journal of Pharmacognosy and Phytochemistry*, *10*(4), 24–30. Retrieved from www.phytojournal.com
14) Long, F., Hu, Z., Luo, H., Chu, Z., Li, S., Zhou, Y., & Li, A. (2026). Remodeling of Bamboo (Phyllostachys edulis) Shoot Polysaccharides by Monascus purpureus Fermentation Enhances Antioxidant Protection in Caco-2 Cells, 1–22.
15) Ma, T., Mo, W., Lv, B., Wang, W., He, H., Jian, C., … Guo, Y. (2024). A Review of the Nutritional Composition , Storage Challenges , Processing Technology and Widespread Use of Bamboo Shoots, 1–26.
16) Midhun, J., K, M. S., S, N. S., & Rao, J. (2025). Sustainable Food Technology Sustainable functional foods derived from indigenous resources : the utilization of tamarind seed , bael , and bamboo shoot powders as. *Sustainable Food Technology*, *3*(September), 2270–2281. https://doi.org/10.1039/D5FB00285K
17) No Title. (2020).
18) No Title. (2021).
19) No Title. (2025).
20) No Title. (2026).
21) Nongdam, P., & Tikendra, L. (2014). The Nutritional Facts of Bamboo Shoots and Their Usage as Important Traditional Foods of Northeast India, *2014*. https://doi.org/10.1155/2014/679073
22) Phuseerit, O., Seewaeng, P., Boonarsa, P., Seephua, N., & Siriamornpun, S. (2026). Effects of Processing on Antinutrients , Bioactives and Functional Properties of Bamboo Shoots (Bambusa beecheyana), 1–20.
23) Shifa, W. (2025). International Journal of Social Science and Human Research Processing and Packaging of Bamboo Shoots (Malewa) in Bugisu Region , Eastern Uganda ., *08*(07), 4990–4997. https://doi.org/10.47191/ijsshr/v8-i7-07
24) Technology, A. (2025). Effect of soaking solution and various packaging conditions on shelf life of fresh Bambusa sp. shoot, *9*(October), 51–57.
25) Wakweya, R. B. (2026). Advances in Bamboo Science Harnessing the potential of bamboo for sustainable livelihoods in Sub-Saharan Africa : A meta-synthesis, *16*(January).

There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non-Commercial 4.0 Intenational (CC BY-NC 4.0)

(https://creativecommons.org/licenses/by-nc/4.0/), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.