Evaluating The Socioeconomic and Environmental Value of Noni Tree Farming in Lake Victoria Basin: Evidence from The Sesse Islands, Uganda

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Abstract—This study evaluates the socioeconomic and environmental value of noni farming and the sustainability strategies adopted by farmers in the Sesse Islands of the Lake Victoria Basin, Uganda. The study adopted a mixed-methods approach; data were collected through household surveys, key informant interviews, focus group discussions, and field observations. Quantitative and qualitative data were analyzed using descriptive statistics and thematic analysis, respectively. The findings indicate that noni farming contributes to household income diversification, employment creation, and livelihood resilience, while generating environmental benefits such as soil conservation, biodiversity enhancement, carbon sequestration, and landscape restoration. Despite these advantages, farmers face challenges including limited market access, inadequate processing facilities, and weak extension support. To address these constraints, farmers have adopted sustainability-oriented practices, including agroforestry integration, organic production methods, community-based seedling multiplication, and collective marketing arrangements. The study demonstrates that noni farming has considerable potential to promote sustainable rural development and environmental conservation in the Lake Victoria Basin. Strengthening market linkages, value addition, and extension services will be critical to enhancing the long-term viability and impact of the sector. The findings contribute to the growing body of evidence on the role of underutilized agroforestry species in supporting climate-resilient livelihoods and sustainable landscape management in tropical island ecosystems in Uganda

Index Terms—Morinda citrifolia; noni farming; sustainability; agroforestry; livelihoods; Sesse Islands; Lake Victoria Basin.

I. INTRODUCTION

Noni plants (*Morinda citrifolia* L.) is a tropical perennial plant in the Rubiaceae family widely recognized for its medicinal, nutritional, and agroforestry value. Originating from Southeast Asia and Oceania, it has spread across tropical and subtropical regions due to its remarkable ecological adaptability (Singh, 2024), (Amaresan & Kumar, 2025). The species thrives in diverse environments, including coastal zones, forests, degraded lands, and saline-prone areas, and tolerates drought, flooding, wind, and poor soils. This resilience makes noni a promising species for climate-sensitive landscapes such as island ecosystems in the Lake Victoria Basin (Bharati, 2026).
For centuries, noni has been used in traditional medicine across Polynesia, Southeast Asia, and other tropical regions. Different parts of the plant including fruits, leaves, roots, bark, and seeds are used to treat ailments such as hypertension, inflammation, respiratory disorders, diabetes, malaria, and skin infections (Heinrich et al., 2023a). Modern pharmacological studies attribute these effects to bioactive compounds such as flavonoids, iridoids, coumarins (notably scopoletin), anthraquinones, and polysaccharides, which exhibit antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory properties. In addition to its medicinal importance, noni has gained global commercial value in nutraceutical, pharmaceutical, and cosmetic industries, creating emerging income opportunities for rural producers (Fu et al., 2026a).

Beyond its health-related applications, noni contributes significantly to agroforestry and environmental sustainability. It supports income diversification, provides year-round fruit production, and integrates well with other crops in mixed farming systems (Heinrich et al., 2023b). Ecologically, it enhances soil conservation, improves biodiversity, contributes to carbon sequestration, and supports the rehabilitation of degraded landscapes. These attributes position noni as a multifunctional species capable of addressing both livelihood and environmental challenges.
In the Sesse Islands of the Lake Victoria Basin, communities face increasing pressures from declining fish stocks, land degradation, climate variability, and limited livelihood diversification options (Fu et al., 2026b). Although agroforestry has been promoted as a sustainable adaptation strategy in the region, little empirical evidence exists on the contribution of noni farming to household livelihoods and environmental sustainability. Understanding its role is therefore critical for informing rural development and climate adaptation strategies in island ecosystems (N, 2026).

This study evaluates the socioeconomic and environmental value of noni tree farming and examines the sustainability strategies adopted by farmers in the Sesse Islands. It further explores how noni-based farming systems contribute to livelihood diversification, ecosystem restoration, and resilience building in the Lake Victoria Basin (Bhatti et al., 2024). By providing empirical evidence from an under-researched context, the study contributes to the growing literature on underutilized agroforestry species as tools for sustainable rural development and climate adaptation in tropical island environments.

II. METHODOLOGY

The study adopted a mixed methodology for data collection of the required information. The study was conducted in the Ssese Islands of Kalangala District, located within the Lake Victoria Basin in Eastern Uganda. The district lies approximately between latitudes 00°06′N and 00°20′N and longitudes 32°30′E and 34°00′E, about 30 km from the source of the river Nile. Kalangala District covers an estimated area of 4,678.22 km², of which approximately 76.62% is water and 23.38% is land District Local Government, 2015). The islands are characterized by a humid tropical climate, fertile but fragile soils, and rich biodiversity, which support both natural ecosystems and human livelihoods. Furtado & Furtado, (2020) Socioeconomic activities in the district include agriculture, fishing, tourism, trade, and natural resource-based enterprises. However, the area has experienced significant environmental pressures over time, including deforestation, wetland degradation, shoreline encroachment, and declining fish stocks, largely driven by population growth and unsustainable resource use.

1) Research design

A case research design was used and it gave the in-depth and clear understanding of variables under investigation (Li, 2025). The combination of the design and mixed-methods research design was employed, integrating both quantitative and qualitative approaches. This design enabled a comprehensive assessment of the socioeconomic value of noni farming, while also capturing farmers' perceptions, experiences, and sustainability practices.

2) Population and Sampling Techniques

The study targeted approximately 360 farmers engaged in noni cultivation and related agroforestry activities in Kalangala District. It actually engaged 320 research participants who were scientifically selected using a combination of stratified and purposive sampling techniques to ensure representation across different islands and farming systems (Akotia et al., 2023). The primary respondents were household heads and active farmers, while key informants included extension workers, local government officials, and agroforestry stakeholders.

3) Data collection Methods

Data were collected using multiple complementary methods that proved suitable for this study and these were:

- Household surveys:

Structured questionnaires were administered to gather quantitative data on production levels, income generation, land use practices, and livelihood outcomes associated with noni farming.

- Key informant interviews:

Conducted with district agricultural officers, local leaders, and development practitioners to obtain expert insights on production systems, institutional support, and policy environments.

- Focus group discussions (FGDs):

Undertaken with farmer groups to explore shared experiences, challenges, and sustainability strategies in noni production.

- Field observations:

Used to document farm conditions, agroforestry integration practices, and environmental characteristics of selected sites.

4) Data analysis

The qualitative and Quantitative data were analyzed using descriptive statistical methods, including frequencies, percentages, and means, to summarize livelihood contributions and production characteristics (Badr & Lhoussaine, 2024). Qualitative data were analyzed thematically to identify key patterns related to sustainability strategies, benefits, and constraints in noni farming systems.

5) Contextual background and programmatic

The study is situated within broader environmental and livelihood transformation processes in the Lake Victoria Basin, where community-based natural resource management and agroforestry interventions have been promoted to address environmental degradation and livelihood vulnerability (Kumar, 2024). Previous initiatives in shoreline and island ecosystems have emphasized habitat restoration, biodiversity conservation, and livelihood diversification through participatory approaches involving local communities, government institutions, civil society organizations, and development partners.

These interventions have demonstrated the importance of community engagement, capacity building, and integrated resource management in enhancing ecosystem resilience (Research, 2023). The present study draws on these contextual experiences to better understand how noni farming functions as a complementary livelihood and environmental sustainability strategy in Kalangala District.

6) Ethical consideration

Ethical approval procedures were followed throughout the study. Participation was voluntary, and informed consent was obtained from all respondents (AlDhaen et al., 2025). Confidentiality and anonymity were ensured, and permission to conduct the study was secured from relevant district authorities and local leadership structures prior to data collection.

III. RESULTS

Findings from the Ssese Islands of Kalangala District indicate that noni (*Morinda citrifolia*) is not indigenous to the Lake Victoria Basin but has been gradually introduced and adapted into island agroforestry systems. Its origin in Southeast Asia, Oceania, and tropical Australia aligns with its current distribution in tropical regions globally, including parts of East Africa (Fattah, 2024). In the Ssese Islands, farmers reported that noni was introduced through agroforestry initiatives, informal

plant exchanges, and small-scale experimental planting. The species has demonstrated strong adaptation to island conditions, particularly along lake shorelines and inland degraded lands (Bergstrom et al., 2023). Its successful establishment in Kalangala reflects its ecological flexibility and suitability for humid tropical island environments, where it is increasingly being integrated into mixed farming systems alongside bananas, cassava, and other perennial crops.

Soil and climate in Lake Victoria Basin

Field observations and farmer responses confirm that the Ssese Islands provide favorable climatic conditions for noni cultivation (Chate, 2026). The district experiences a warm humid tropical climate with temperatures generally ranging between 20°C and 32°C, conditions that fall within the optimal growth range of noni (20–38°C). Farmers reported that the species performs well under varying rainfall regimes and demonstrates tolerance to both wet and moderately dry conditions, consistent with rainfall patterns in the Lake Victoria Basin.

Noni Trees planted in good file Soils

(Source: Primary Data, 2026)

Soil assessments and farmer experiences indicate that noni grows successfully in a wide range of soil types in the islands, including sandy loam, red lateritic soils, and moderately acidic soils (Mishra, 2020). Its ability to tolerate a broad pH range (4.4–9.0) makes it particularly suitable for

the heterogeneous and often degraded soils found in Kalangala District. However, poorly drained and waterlogged areas, especially flood-prone shoreline zones, were reported to negatively affect seedling survival and early growth.

The picture of Noni plants of different spices.

Figure 1:

Figure 2:

(Source: Primary Data, 2026)

Propagation practices in Ssese Islands

The study found that propagation in the Ssese Islands is predominantly undertaken through seeds and stem cuttings. Seed propagation is the most common method due to ease of access and continuous fruit availability (Cohen, 2021). Farmers reported that a single mature fruit yields numerous seeds, supporting low-cost seedling production. However, germination is often slow and irregular unless pre-treatment such as seed scarification is applied.

Stem cutting propagation is practiced by a smaller proportion of farmers and is valued for faster establishment. Cuttings of approximately 20–40 cm from healthy mother plants are used, often planted in nursery beds or polybags filled with locally available growth media (Hasan et al., 2025). Despite its advantages in early growth, some farmers noted variability in plant vigor and disease tolerance compared to seed-propagated plants.

Germination and Nursery Beds

Findings indicate that noni seed germination in the Ssese Islands is highly variable, ranging from several weeks to several months depending on seed treatment and environmental conditions. Farmers who applied scarification techniques such as mechanical scratching or partial seed coat damage reported significantly improved germination rates and reduced dormancy periods (Ochora & U, 2026). Nursery practices are largely small-scale and community-based. Seeds and seedlings are commonly raised under partial shade conditions, with emphasis on maintaining moisture and warmth. Optimal germination was observed in warm microclimates such as simple greenhouse

structures or protected nursery beds, consistent with the species' requirement for temperatures around 30–38°C. in tropical climate (Mandal & Nicodemus, 2025).

Asexual propagation and establishment

Asexual propagation through stem cuttings and air layering is practiced on a limited scale but is gaining interest due to faster establishment rates. Farmers who adopted cutting-based propagation reported improved uniformity in growth, especially when rooting hormones or moist propagation media were used (Bergstrom et al., 2023). However, access to propagation materials and technical knowledge remains limited. Field transplantation typically occurs after 9–12 months of nursery growth. Farmers emphasized careful handling during transplanting to reduce seedling stress and improve survival rates. Planting is often done at the onset of rainy seasons to enhance establishment success (Bathla & Kannan, 2021).

Planting and field management practices.

In the Ssese Islands, noni is mainly planted in mixed cropping systems rather than monoculture plantations. Recommended spacing of approximately 10–15 feet (3–4.5 meters) is generally observed, although some farmers practice closer spacing due to land scarcity. Overcrowding was identified as a challenge, leading to competition for nutrients and increased vulnerability to pests and diseases (Heinrich et al., 2023b). Farmers reported that full to partial sunlight exposure enhances growth performance, while shaded or heavily vegetated sites reduce productivity. The integration of noni into agroforestry systems has been observed to improve land utilization efficiency and contribute to diversified farm outputs.

Findings from the Ssese Islands indicate that wind exposure is a major constraint to the establishment and early growth of noni seedlings, particularly in open shoreline and exposed island landscapes (Montagnini, 2024). Farmers reported higher seedling mortality in windy sites due to desiccation and physical damage. To mitigate this challenge, some farmers have adopted the use of windbreaks, including tree species such as eucalyptus and ironwood, which are strategically planted around noni plots. These windbreaks are typically spaced at wider intervals to reduce wind speed while allowing sufficient sunlight penetration (Galliera & Brynjolson, 2025). However, adoption remains limited, and many farmers still cultivate noni in unprotected areas, increasing vulnerability during early growth stages.

Pruning and canopy management practices

Pruning practices in Kalangala District are still emerging but are increasingly recognized as important for productivity and plant health. Farmers observed that pruning young noni plants after initial fruiting encourages bushier growth and improves overall canopy structure. Mature noni trees, which can reach heights of approximately 6 meters or more under local conditions, are selectively pruned to remove excessive vertical branches, thereby facilitating easier harvesting and improving air circulation within the canopy. Farmers also reported that pruning reduces pest and disease incidence by improving sunlight penetration and reducing humidity within dense foliage (Nations,

2020). Despite these benefits, systematic pruning is not widely practiced due to limited technical knowledge and extension support.

Nutrients and irrigation practices

Nutrient management in the Ssese Islands is generally low-input and largely dependent on natural soil fertility. Most farmers do not apply synthetic fertilizers regularly, particularly in early establishment stages (Kitinoja, 2025). However, farmers who invest in nutrient management reported improved growth and earlier fruiting. Both organic and inorganic nutrient sources are used, with organic inputs such as composted manure, household waste compost, and plant residues being more common due to affordability.

Fertilizer application, where practiced, is typically done in small and infrequent doses and applied around the drip line rather than near the stem to avoid root damage. Farmers noted that noni responds positively to nutrient inputs, particularly during flowering and fruiting stages, but excessive application is avoided due to concerns about soil degradation and cost (Akram, 2026).

Regarding irrigation, findings show that young noni plants (below three years) require supplemental watering during dry periods, while mature plants demonstrate high drought tolerance once established. Over-irrigation is discouraged due to increased risks of root rot and pest infestation. Most farmers rely on rainfall-fed systems, with limited use of structured irrigation technologies (Bengtsson, 2024).

Weed management practices

Weed competition was identified as a significant challenge during the early stages of noni establishment. Common weed species in the Ssese Islands, including Guinea grass and other aggressive grasses, compete strongly for nutrients and moisture (Rubino et al., 2023). Farmers primarily rely on manual weeding, especially for young plants, to reduce competition and prevent mechanical damage. Mulching and weed mats are occasionally used; however, farmers noted that some weed suppression methods may reduce fertilizer infiltration and create favorable conditions for soil-borne pests such as nematodes (Galliera & Brynjolson, 2025). Established noni plants were observed to be more tolerant of weed pressure, reducing management intensity over time. Farmers also emphasized the importance of removing parasitic weeds such as dodder where they occur.

Organic farming practices.

Organic soil management practices are gradually gaining acceptance among noni farmers in the Ssese Islands. The use of farmyard manure, compost, and decomposed organic residues is common, reflecting both affordability and limited access to commercial fertilizers. Farmers reported improved soil moisture retention, plant vigor, and fruit quality under organic management systems (Nations, 2020). Evidence from agronomic trials in comparable tropical environments supports the effectiveness of integrated organic nutrient management combined with efficient irrigation practices in enhancing noni productivity. Farmers who adopted organic approaches also reported reduced production costs and improved long-term soil health, reinforcing the sustainability advantages of low-input cultivation systems in island agro-ecosystems (Kiiza, 2025).

Harvesting and post-Harvesting handling

Findings indicate that noni plants in the Ssese Islands typically begin flowering and fruiting within 9 to 12 months under favourable conditions. Fruiting is continuous once maturity is reached, allowing for multiple harvest cycles per year. Farmers harvest fruits at different maturity stages depending on intended use, particularly for juice production and medicinal processing(Mikulincer & Shaver, 2023). Harvesting is largely manual, with fruits collected at varying ripeness levels. Due to the fruit's durable skin, post-harvest losses are minimal, and the crop is well-suited for transport and short-term storage without immediate refrigeration. Farmers also noted that noni fruits continue to ripen after harvest, which supports flexible marketing and processing schedules.

IV. DISCUSSION

This study examined the value and sustainability of noni (*Morinda citrifolia*) farming in the Ssese Islands of Kalangala District within the Lake Victoria Basin. The findings demonstrate that noni is increasingly being adopted as a multifunctional agroforestry species contributing to livelihood diversification, environmental conservation, and climate resilience. This discussion interprets these findings in relation to existing knowledge, highlights comparative insights, and draws implications for policy and practice.

Socio-economic and livelihood resilience

The study established that noni farming contributes to household income diversification, employment opportunities, and improved livelihood resilience among smallholder farmers in the Ssese Islands. This finding is consistent with agroforestry literature which emphasizes that multipurpose tree crops enhance rural livelihoods by reducing dependence on single income sources and stabilizing household economies (*Climate Sensitivity & Economic Impacts of Agricultural Area in Haryana Region*, 2025). Compared to dominant livelihood systems in Kalangala District, particularly fishing and traditional crop farming, noni represents a relatively low-input but emerging alternative income source. However, unlike established cash crops, its commercialization remains limited due to weak market structures, low value addition, and limited supply chain integration (Bairwa et al., 2025). This indicates that while noni contributes to household-level resilience, its broader economic transformation potential is still underdeveloped.

Environmental sustainability and ecosystem

Findings further reveal that noni farming contributes positively to environmental sustainability through soil conservation, biodiversity enhancement, carbon sequestration, and land restoration. These outcomes align with broader studies on agroforestry systems that highlight the ecological benefits of perennial deep-rooted species in stabilizing fragile ecosystems (Williams, 2025). In comparison to mono-cropping systems prevalent in parts of Kalangala District, noni-based agroforestry systems exhibit greater ecological stability due to improved soil cover, reduced erosion, and enhanced microclimatic regulation. However, the ecological benefits remain partially

constrained by low planting density, limited spatial planning, and inadequate integration into large-scale landscape restoration programs.

Agronomic practices and production

The study revealed that noni cultivation is characterized by predominantly low-input management practices, with gradual adoption of pruning, organic fertilization, and informal wind protection measures. This reflects common patterns in smallholder farming systems in Sub-Saharan Africa, where limited access to extension services and production inputs shapes farming practices. Despite its adaptability, gaps exist between recommended agronomic practices and actual farmer implementation. Inconsistent nutrient management, limited pruning, suboptimal spacing, and reliance on rain-fed systems may reduce productivity and long-term sustainability (Fu et al., 2026b). These constraints highlight and suggest the need for improved technical guidance and stronger extension support systems.

Comparative analysis and Agroforestry system

When compared with other agroforestry systems in Uganda, such as banana and coffee-based systems, noni is less institutionalized but more resilient under marginal environmental conditions. Its tolerance to drought, poor soils, and salinity makes it particularly suitable for island ecosystems such as the Ssese Islands (Walsh et al., 2020). However, banana and coffee systems benefit from well-developed value chains, institutional support, and research investment, which noni currently lacks. This structural imbalance explains why noni, despite its ecological advantages, remains underutilized at commercial scale.

Policy and development implications

The findings underscore the need for targeted policy and institutional interventions to enhance the contribution of noni farming in the Lake Victoria Basin. Strengthening agricultural extension services is critical for improving farmer knowledge on propagation, nutrient management, pruning, and post-harvest handling (Nations, 2020). In addition, investment in value addition, processing infrastructure, and market development is necessary to transition noni from subsistence-level production to a viable commercial agroforestry enterprise. Integrating noni into national agroforestry, climate adaptation, and ecosystem restoration frameworks would further enhance its visibility and adoption.

V. CONCLUSION

This study assessed the value and sustainability of noni (*Morinda citrifolia*) farming in the Ssese Islands of Kalangala District within the Lake Victoria Basin. The findings demonstrate that noni has emerged as a promising multifunctional agroforestry species with notable socioeconomic and environmental benefits. It contributes to household income diversification, employment creation, and livelihood resilience, while simultaneously supporting soil conservation, biodiversity enhancement, carbon sequestration, and landscape restoration.

Despite these positive contributions, noni farming in the study area remains at a relatively early stage of commercialization and adoption. Farmers largely rely on low-input management systems and informal knowledge, with limited access to structured extension services, improved planting materials, and organized markets. These constraints reduce productivity and limit the full realization of the crop's economic and ecological potential.

The study further concludes that noni has strong comparative advantages in fragile island ecosystems due to its tolerance to variable climatic and soil conditions, making it particularly suitable for climate change adaptation and sustainable land use in the Lake Victoria Basin. However, its benefits can only be fully realized if supported by appropriate institutional, technical, and market interventions.

Overall, noni farming represents a viable but underexploited pathway for promoting sustainable rural development in the Ssese Islands. Strengthening value chains, improving agronomic practices, expanding extension services, and integrating noni into national agroforestry and climate resilience programs are essential for scaling its impact. With targeted support, noni has the potential to evolve from an emerging crop into a strategic livelihood and environmental resource for island communities in Uganda.

VI. RECOMMENDATION

Based on the findings of this study on noni (*Morinda citrifolia*) farming in the Ssese Islands of Kalangala District, the following recommendations are proposed to enhance its sustainability, productivity, and contribution to livelihoods and environmental conservation in the Lake Victoria Basin.

The study recommends that Government agencies responsible for agriculture and environment should formally integrate noni into national agroforestry, climate change adaptation, and ecosystem restoration programmes. At district level, Kalangala District Local Government should develop supportive policies that promote noni production, processing, and marketing as part of diversified rural development strategies.

It further recommends that, there is a need to strengthen extension services with specific focus on noni agronomy. Farmers should be trained in improved propagation techniques, field establishment, spacing, pruning, nutrient management, pest and disease control, and post-harvest handling. Establishing demonstration plots and farmer field schools would enhance practical learning and improve adoption of recommended practices.

Nevertheless, it also recommends to have community-based nurseries should be established and supported to ensure reliable access to quality, disease-free planting materials. Collaboration between research institutions, NGOs, and farmer groups is essential to improve seed systems, enhance seedling quality, and ensure uniformity in field establishment.

The study more still recommends farmers to Invest in value addition are critical to unlocking the economic potential of noni. Processing facilities for products such as juice, powder, and herbal formulations should be promoted. In addition, farmer cooperatives should be strengthened to improve collective marketing, bargaining power, and access to regional and international markets.

The study recommended that participating Farmers should be encouraged to integrate noni into diversified agroforestry systems to maximize land productivity and ecosystem benefits. Its use in soil conservation, shoreline stabilization, and landscape restoration should be actively promoted within Lake Victoria Basin

Further research is needed on yield performance, optimal agronomic practices, pest and disease management, and value-added product development. Long-term studies should also be conducted to assess economic viability and environmental impacts. Stronger collaboration between universities, research institutions, and local communities is recommended to support innovation and knowledge transfer.

Lastly study recommended for Strengthening Noni trees farmers groups and cooperatives is essential for improving knowledge sharing, coordinated production, and market access. Participatory approaches should be prioritized to ensure that farmers are actively involved in planning and decision-making processes related to noni development initiatives.

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