Exploring Guava (Psidium guajava) Germplasm Garden as a Living Laboratory in Sri Lanka: Educational, Conservation, and Socio-Cultural Insights

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ABSTRACT

The germplasm conservation gardens at university has a potentiality to facilitate experiential learning, environmental stewardship, and the conservation of biodiversity, and thus aid in the achievement of several United Nations Sustainable Development Goals, particularly in the areas of Quality Education (SDG 4), Climate Action (SDG 13), and Life on Land (SDG 15). This study utilized a qualitative method to value the educational, conservation, and sociocultural aspects of the Guava Germplasm Conservation Garden at the University of Sri Jayewardenepura in Sri Lanka. Stakeholders, who comprised 90 of the undergraduates and post-graduate students and academic and landscaping management staff, were interviewed through a variety of data collection techniques, which included semi-structured interviews, focus group discussions, and field observations. This data collection was carried out until thematic saturation was achieved, and thematic analyses were conducted and then coded through the NVivo software, which also facilitated the coding triangulation. Five primary themes emerged: (1) conservation of plant genetic diversity, (2) experiential and place-based learning, (3) guava's cultural and nutritional value, (4) stewardship and environmental responsibility, and (5) the garden's future challenges and opportunities. These findings point to the garden being a 'living laboratory' which augments learning, and promotes awareness of conservation and socio-cultural engagement. The study, however, also details the inadequate infrastructure and bureaucratic constraints that hinder the optimal use of the garden. Other suggestions are the incorporation of the garden into more curricula, enhancing interpretive infrastructure, and broadening community engagement for maximizing impacts related to the SDGs. This study illustrates the diverse possibilities of university germplasm gardens functioning as integrated sustainability hubs.

Keywords: Guava germplasm, conservation of biodiversity, university landscapes, experiential education, socio-cultural values, SDGs, guardianship of the environment, living laboratories

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INTRODUCTION

Plant genetic diversity, critical for achieving food security, ecological resilience, and sustainable development in agriculture, aligns with several United Nations Sustainable Development Goals (SDGs), including SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land). Germplasm conservation gardens work on multiple levels. They serve as living repositories of genetic resources. They also help preserve genetic resources and support education, research, and public awareness, as well as parameter SDG 4 (Quality Education) and SDG 13 (Climate Action) through various stewardship and awareness activities. In university settings, gardens promote conservation and become active educational resources that help students link theoretical knowledge with ecological practices on the ground, support interdisciplinary education, and enhance sustainability literacy.

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Guava (Psidium guajava) is an economically important, nutritionally, and medicinally valuable tropical fruit, as well as a mainstay of the Sri Lankan cultivation and value chain. To start conserving a broad range of guava varieties with a focus on plant genetic resources, the University of Sri Jayewardenepura set up a Guava Germplasm Conservation Garden on its Landscape. The establishment of the garden is an important initial step. Equally critical is the understanding of how users of the garden perceive, experience, and value this new space.

This study takes a qualitative approach, with the understanding, meaning, and value of the Guava Germplasm Conservation Garden as a focal point. Through the lens of stakeholders, the study attempts to understand the multilevel educational, conservation, and socio-cultural value of the garden in and beyond the university, particularly its relevance to the SDGs on biodiversity, education, and the promotion of sustainable agriculture and communities.

LITERATURE REVIEW

Germplasm Conservation & SDGs

Referring to the aforementioned SDG goals, germplasm conservation refers to the strategy of preserving genetic resources of plants to ensure their availability for future research, breeding, and restoration programs (Tian et al., 2021). Thus, it also aids in the achievement of SDG 2 (Zero Hunger) and SDG 15 (Life on Land) (O'Donnell & Sharrock, 2017). Botanical gardens, seed banks, and field gene banks, are examples of ex situ conservation methods that obtain living collections and that seed banks preserve species that cannot be stored as seeds in order to assist the observation, evaluation, and utilization of genetic traits. Germplasm gardens and botanical gardens are major biodiversity reserves. They help to protect and preserve the genetic diversity of plants. They do this along with the other major threats of climate change, habitat loss, and other human-induced factors (O'Donnell & Sharrock, 2017; Turner et al., 2023). Living collections and seed banks help to protect and preserve the world's plant diversity by safeguarding accessions of endangered species and crop wild relatives that are essential for adaptive breeding programs, food security, and climate change resilience (Tian et al., 2021; O'Donnell & Sharrock, 2017; Turner et al., 2023).

University Landscapes as Learning Spaces

University landscapes like arboreta, botanical gardens, and germplasm conservation gardens continue developing as active and responsive learning environments promoting experiential and place-based learning, thus contributing to the attainment of SDG 4 (Quality Education) and SDG 13 (Climate Action) (Lee, 2022, p. 5). Living collections promote direct engagement with a wide range of plant species, allowing students and researchers to observe different morphological traits and ecological interrelations, and conduct applied research beyond the traditional boundaries of a classroom (Chawla, 2020; Donaldson, 2009). The gardens also facilitate interdisciplinary learning by creating opportunities for field research, applied research, and quasi-formal education for students of different disciplines. The educational function of botanical gardens integrates knowledge of plant science with that of conservation and sustainability education, enhancing the environmental literacy and sustainability mindset of the campus community (Botanic Gardens Conservation International, 2025; Turner et al., 2023).

Socio-Cultural and Educational Value of Fruit Crops

In many parts of the world, fruit crops like guava (Psidium guajava) have important cultural, nutritional, and economic values. In Sri Lanka and other tropical countries, guava is important for vitamin rich foods in local diets (Ratnayake et al., 2020; FAO, 2019; Department of Agriculture Sri Lanka, 2020) and contributes to the achievement of SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being) to reduce malnutrition. The preservation of the genetic diversity of the fruit crops also contributes to the preservation of cultural heritage and local farming traditions and helps sustain biodiversity (Ratnayake et al., 2020; FAO, 2019; Department of

Agriculture Sri Lanka, 2020), thereby supporting SDGs 11 (Sustainable Cities and Communities) and 12 (Responsible Consumption and Production) by advocating for the sustainable use of the plant resources. These

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intangible values of the conservation of plants, which may be overlooked by the use of quantitative methods, can be explored through qualitative research more effectively. Although still in the developing stage, the bodies of literature dedicated to the perceived and lived experiences of university-based germplasm gardens have been largely qualitative. The ecological and educational roles of the plant collections and green spaces in higher education have been documented, but very little qualitative research has been dedicated to stakeholder perceptions of germplasm gardens within universities. This study fills this gap by examining the perceptions and experiences of stakeholders of the Guava Germplasm Conservation Garden at the University of Sri Jayewardenepura.

METHODOLOGY

Research Design

There is a need to understand the intertwining educational, conservation, and socio-cultural challenges of the Guava Germplasm Conservation Garden. Using Yin's (2018) case study analysis, these challenges can be explored through a reasonable depth framework by adopting a qualitative single-case study design for each stakeholder.

Participants and Sampling

One hundred (n = 100) stakeholders were purposively sampled for this study to capture diverse perspectives on the garden. Participants included undergraduates (n = 50), postgraduates (n = 10), academic staff (n = 5), nonacademic staff (n = 10), alumni (n = 10), visitors (n = 10), and landscape management staff (n = 5). A stratified purposive sampling approach ensured that all participants had meaningful engagement with the garden. Data collection continued until thematic saturation was achieved (Guest et al., 2020).

Data Collection

A triangulated qualitative method was adopted with the aim of improving the study's credibility and conformability. Staff and landscape personnel were interviewed to obtain their expert and operational perspectives.

Collective perceptions and experiences of students were captured through Focus Group Discussions (FGDs). Spatial arrangement, plant variety, maintenance, and user activities were systematically observed and documented. All activities were audio recorded with participant consent and detailed transcripts were created. In addition, separate field notes were maintained.

Researcher Reflexivity

The research team involved adopted a reflexive approach for this study. K.M.S. Weerasinghe, the university landscape curator and a sustainability researcher and K.I. Malalgoda, senior assistant registrar and a sustainability researcher, recognized their respective positions in the processes of data collection and analysis. To foster some level of self-awareness, the team employed reflective journaling, peer debriefing, and crosscoding of transcripts to minimize bias and increase the reliability of their results.

Data analysis

The data was analyzed through the lens of inductive thematic analysis, and the software used for this purpose was NVivo 13. Each phase of the analysis was dependent on the previous one, and the phases of coding were open, axial, and selective to arrive at both manifest and latent themes, respectively (Braun & Clarke, 2006). The cross-sectional design, embracing interviews, FGDs, and field observations, fortified the credibility, and the comprehensive audit trails provided the necessary confirmability. Within the research team, themes were established and agreed upon to foster consensus and reliability. The findings were framed within existing literature, and the SDG frameworks were used for positioning the educational, conservation, and socio-cultural value of the garden.

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Trustworthiness

The study applied Lincoln and Guba's (1985) criteria to ensure rigor:

Credibility: triangulation of methods and peer debriefing

Transferability: thick descriptions of participants, context, and processes

Dependability: transparent documentation of methods and iterative coding

Confirmability: audit trail and reflexive documentation of researcher influence

RESULTS AND DISCUSSION

Overview of Data Analysis

The qualitative analysis of the 100 stakeholder responses using NVivo 13 identified five key themes. These were: (1) Conserving the genetic diversity of plants; (2) Learning by experience and being in a particular place; (3) The culture and nutrition of the Guava tree; (4) Stewartship, Sense of Responsibility, and the environment; and (5) the garden's muted use because of operational and infrastructural barriers. Using semi-structured interviews, focus group discussions, and field observations, these themes were inductively derived and crossvalidated, confirming the methodological rigor through triangulation (Braun & Clarke, 2006). The results showcase the multi-faceted significance of the garden while outlining its shortcomings in fulfilling its potential for education and conservation.

Theme 1: Encapsulation of Plant Genetic Diversity

All the respondents pointed out the garden's dual role in conservation and research as a living collection of guava genetic resources. One of the lecturers mentioned,

"This garden preserves guava traits that future researchers and farmers, breeders, Colombo city dwellers will depend on; it is a genetic library for the university and the country."

This description fits the conservation biology perspective that, for example, O'Donnell and Sharrock (2017) describe, whereby the garden's collection would be considered a conservation collection aimed at safeguarding adaptive genetic diversity and contributing to food security. By preserving varieties of crops, the garden aids in achieving SDG 2 (Zero Hunger) and by conserving diversity in the varieties of plants it also helps achieve SDG 15 (Life on Land). Although the garden does preserve a number of guava cultivars, the respondents pointed out the lack of a documented systematic particularization of the garden's genetic traits. This would perhaps signal shortfalls in the research-oriented protocols of conservation that perhaps would constrain its future usefulness for breeding or restoration programmes. Were the institution to dedicate some resources to digital systems for monitoring germplasm and setting a schedule for the periodic assessment of the collection, the garden would achieve more of its intended strategic role in conservation (Tian et al., 2021; O'Donnell & Sharrock, 2017; Turner et al., 2023).

Theme 2: Experiential and Place-Based Learning

The university garden area with many divisrese landscape features and designs served as a 'living laboratory' for students and educators for observation and active learning. A third year student remembered:

"Seeing different guava varieties, with various tastes, colours, size and shapes in one location made germplasm conservation tangible; defnitely a case of theory fully understood by me, because I was able to see the theory." This connects with Kolb's (1984) Experiential Learning theory, which emphasizes learning from 'active' and reflective experiences. It also connects with place-based education; which appreciates the use of the surrounding community and environment as a learning resource (Sobel, 2004).

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SDG Linkages : SDG 4 (Quality Education): Learning by doing improves student engagement and fosters sustainability literacy and SDG 13 (Climate Action): Encounters with diverse live plants increase awareness of ecosystem resilience and climate conservation.

Students noted the positive aspects of the garden but also expressed disappointment that in formal curricula, the garden and similar opportunities for experiential learning were not fully integrated. As Chawla 2020 and Donaldson 2009 suggest, the integration of the garden into course modules, lab activities, or research projects is more likely to promote structured thinking and learning about sustainability.

Theme 3: Nutritional and Cultural Value of Guava

Guava is important both culturally and nutritionally. One participant stated: "Guava is grown in many of our gardens. It is cultural and traditional to preserve these varieties."

Guvava gempalasm Conservation Garden at University of Sri Jayewardhanapura is an example of Cultural Ecosystem Services and supports SDG 2 and SDG 3 as it is nutritionally rich and conserves local cultural knowledge.

The gardens illustrate that germplasm gardens can integrate socio-ecological outcomes. However, participants stated that interpretive signage and descriptive labeling lead to inadequate public contact, resulting in barriers to recognition of the cultural values by the community (Ratnayake et al., 2020; FAO, 2019; Department of Agriculture Sri Lanka, 2020).

Theme 4: Environmental Stewardship and Sense of Responsibility

Fostering environmental responsibility and ethical stewardship was a significant outcome of engagement with the garden for both staff and students. A postgraduate student expressed this the most clearly:

"Working in the garden changed how I think about conservation—it is no longer abstract; I feel personally responsible for these plants."

The experiential engagement described in this case study resulted in the predicted significant pro-environmental behavioral change, a key element of environmental education theory (Tilbury, 1995). This also supports the findings related to the attainment of SDG 12 (Responsible Consumption and Production) and SDG 15 (Life on Land) with emphasis on the sustainable use and stewardship of plant life.

Attitudinal stewardship is evident, but the lack of volunteer opportunities, absence of formal recognition, and the limited integration with research fractures the audience engagement stewardship continuum. The greatest long-term stewardship impact would likely result from the targeted preparation of structured student programs, internships, or citizen-science projects.

Theme 5: Operational and Infrastructural Constraint

Participants mentioned several barriers that prevented the full use of the garden, including the absence of educational signage and interpretive frameworks, limited integration of the garden into educational programs, insufficient outreach with the local community and schools, and lack of resources to maintain garden activities, with one academic staff member noting, ‘Many students pass by without realizing the garden’s scientific and educational significance

These barriers demonstrate the infrastructural and operational deficits that diminish the garden’s potential as a living laboratory. It is important to better align the university garden with the SDGs, especially SDG 4 (Quality Education), SDG 11 (Sustainable Cities and Communities), and SDG 17 (Partnerships for the Goals), such deficits must be addressed. Options that may enhance experiential learning and stewardship include integrating the garden with undergraduate and postgraduate curricula, developing interpretative signage and digital resources, outreach to schools and the community, and creating formal volunteering or internship programs.

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Synthesis and Theoretical Implications

The Guava Germplasm Conservation Garden exemplifies the potential to function as an integrated sustainability hub for the triad of conservation and the education and socio-cultural benefits that come with it. The findings suggest that:

The intersection of conservation science and experiential learning is beneficial to the enhancement of knowledge and the protection of biodiversity. The cultural ecosystem services of plant conservation are of the intangible and of the unmeasured that must be recognized in the landscape of the university.

Organizational, infrastructural, and institutional dynamics shape SDG outcomes, illustrating the necessity of regulatory frameworks, organizational structures, and community interrelations.

This study, in conjunction with Kolb's Experiential Learning Theory, the Cultural Ecosystem Services Theory, and the Environmental Education Theory, illustrates the potential of university germplasm gardens to contribute to a number of SDGs (Tian et al., 2021; O'Donnell & Sharrock, 2017; Turner et al., 2023).

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CONCLUSION

The Guava Germplasm Conservation Garden is undeniably multifaceted and contributes across educational, conservation, and socio-cultural dimensions, as evidenced in the qualitative study and is aligned to several Sustainable Development Goals (SDGs). The garden protects plant genetic resources (SDG 2, SDG 15), enhances experiential learning and engagement with the curriculum (SDG 4), sustains cultural and nutrition awareness (SDG 2, SDG 3, SDG 11), and promotes environmental and institutional sustainability (SDG 12, SDG 13, SDG 15). However, the benefits of the garden remain obscured and challenges remain in terms of the garden's visibility, assimilation into formal curricula, and interpretive infrastructure, which limit the full realization of its SDG-linked potential. To address these challenges, the study recommends formally integrating the garden into course modules and practical sessions to ensure consistent engagement and SDG-aligned learning outcomes, enhancing interpretive signage, labeling, and documentation to communicate scientific, cultural, and conservation significance while supporting SDG 4 and SDG 17, providing training programs for student volunteers and technical staff to strengthen conservation stewardship and SDG-related awareness, and developing outreach programs with schools and the broader community to foster engagement in biodiversity, nutrition, and sustainability (SDG 11, SDG 12). Additionally, the study encourages interdisciplinary research to support the garden's use as a living laboratory and advance the SDGs related to food security, biodiversity, and climate change education. Overall, the study posits that university germplasm gardens can serve as integrated sustainability hubs to support local conservation, education, and socio-cultural outcomes, while positively impacting global SDGs.

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