

Article

Local Knowledge and Perspectives of Change in Homegardens: A Photovoice Study in Kandy District, Sri Lanka

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Abstract: Kandyan homegardens are traditional agroforestry systems that exist to support rural livelihoods in Kandy District, Sri Lanka. These agro-ecosystems have been sustained over generations of socio-ecological change and are recognized today for their biodiversity conservation and ecosystem services. The main drivers of adaption and the sustainability of homegardens are the local farmers who manage them on a daily basis. However, despite being key stakeholders, local communities have seldom been included in research, especially through participatory approaches. This study utilized a participatory and visual method called photovoice to reveal the local perspectives and experiences of socio-ecological change as viewed by 24 Kandyan homegardeners. The results highlight visual documentation and narrative that publicly displayed farmers' perspectives of their current homegardening situation and the major challenges they face. The priorities for future conservation of homegardens include addressing wildlife conflict and crop damage, the lack of land to grow, and a decline in available labor and interest in agriculture, especially among younger household members. Our results indicate that the photovoice process allowed for rich, varied, and in-depth stories of the human-ecological relationship in homegardens to emerge. Consideration of these relationships and the knowledge of local communities are necessary for understanding socio-ecological change in homegardens, and key to sustainable development. Photovoice, we conclude, is a robust method for research in agroforestry systems that can effectively engage local farmers and produce participant-driven data that are potentially well suited to complement other methods for a more holistic approach to understanding homegardens.

Keywords: homegardens; local knowledge; socio-ecological change; photovoice; visual research; participatory; agroforestry

1. Introduction

Kandyan homegardens are traditional agroforestry systems predominantly located in the Kandy District of Sri Lanka's Central Province. They can be defined as a multistrata forest garden consisting of various tree and crop species, intermixed on a small plot of land, typically no larger than 1 hectare [1,2]. Dating back over 2000 years, Kandyan homegardens have truly stood the test of time [3]. They developed as a local food system strategy and have evolved over time in response to

socio-economic, ecological, and cultural needs [4]. In the contemporary era, homegardens are known for their biodiversity and ecosystem services that span from local to global levels. In a world that is searching for sustainable food production and climate smart agriculture, scholars and practitioners argue that homegardens are just as relevant today as they were thousands of years ago [5,6].

Nevertheless, Kandyan homegardens face intense and unprecedented pressures from changing agro-ecosystems and socio-economic contexts. This includes urbanization, population growth, commercialization, and adaptation to climate change and seasonal variability of rainfall, which threaten the biodiversity of homegardens [7–11]. In recent literature, authors call for more inclusion of local communities in policymaking as they are key stakeholders to building resiliency in homegardens [6,8,12]. In fact, local farmers have had the capacity to manage risk and to adapt homegardens continually, indeed over centuries, to meet their needs. Researchers state that this human-ecological relationship is at the root of agricultural sustainability, yet it has often been overlooked in science and policymaking [7,13,14]. By understanding local perspectives and experiences of socio-ecological change, key insights into homegardening adaptation and priorities for future management can be revealed [15,16].

This paper presents the results of a research project that utilized a participatory data-visualization and communication method known as photovoice [17]. Photovoice allows individuals to share their knowledge and perspectives through both photography and narrative. This method positions the participants as experts and is adept in capturing one's relationship with their environment [18,19]. The photovoice methodology is fully explained in the second section of the paper. This research article has two objectives: (1) to document local farmers' knowledge and lived experiences of socio-ecological change within Kandyan homegarden systems, and (2) to examine photovoice as a promising method for agroforestry systems research.

Understanding Homegardens: Relevant Literature and Conceptual Approach

Homegardens are found across the globe, but are typically more predominant in tropical regions [6]. They developed to support rural lives through household food security, provision of fuelwood, and keeping resources close to the homestead [5]. Indeed, what separates a homegarden from other agroforestry practices is its direct connection to the home, and the multipurpose use of the garden to fulfill household needs. Each garden varies in size and is built and managed in a way that reflects a household's food and culinary preferences. Variations are also based on spatial configuration and other contextual factors such as species selection for traditional medicines and aesthetics [11,20]. This personal design and management relationship creates incredible diversity among homegardens, such that even within a village, no two homegardens are the same [6].

Today, modern socio-ecological trends are shifting the course of contemporary homegardening. Mohri et al. (2018) [9] reports that Kandyan homegardens have become substantially fragmented over the past two decades. Furthermore, commercialization, wildlife crop raiding and damage, and water scarcity have driven homegarden simplification and abandonment [8,10]. This has led to at least 27 plant species becoming lost or threatened in recent times [21]. Socio-ecological change in homegardens is highly complex and interrelated with diversifying rural livelihoods. As Kumar and Nair (2004) state, every homegarden and homegardener is different, and each may follow their own pathway to development and adaption to rural change [6]. This high variability and individuality make it difficult to study and generalize results about homegardens.

There is limited research on the drivers of change in homegardens. Since the first Sri Lankan study reported in 1973 by McConnell and Dharmapala, most research has centered on biophysical and functional components of the gardens, including plant taxonomies [12]. More recently, studies have focused on the ecosystem services and the capacity of homegardens to mitigate risks associated with climate change and food insecurity in Sri Lanka [22–26]. This has been beneficial in allowing the value of homegardens to be recognized at a national policy level. In Sri Lanka, some homegarden development initiatives have been incorporated into national programs, such as the “Api Wawamu Rata Nagumu” meaning “let us grow and uplift the nation” initiative starting in 2007, and the more

recent “Divi Neguma” meaning “livelihood development” in 2011 [5]. However, Landreth and Saito (2014) report that some of these programs have not met communities’ priorities and are culturally unsuitable in the local context [8].

Creating an approach to understanding contemporary homegardens must, therefore, appreciate the dynamic nature of agroecosystems as well as the social and cultural aspects of this land use. As homegardens are deeply embedded in rural livelihoods, some authors argue that more research needs to include local stakeholders for homegarden development [7,8,12,27]. Photovoice is a method that produces rich data on communities’ knowledge and perspectives [17]. Through a participatory approach, this method drives coproduction of knowledge and participant-driven data generation [28]. The use of a visual tool encourages deeper reflection on one’s environment and allows the researcher to listen to and better understand the participant’s experiences [29,30]. Photovoice is a practical “hands on” research approach that contributes to theorizing sustainability and the interplay of biophysical, socio-economic, and cultural changes occurring in the local context [18,19]. Based on our review of publications in the Web of Science and Scopus, and an extensive search for relevant studies in Sri Lanka [5,12,31], to our knowledge, this is the first research project to use the photovoice method to study Kandyan homegardens. We argue that this grounded and empirical qualitative method can be advantageous in agroforestry research by complementing conventional quantitative analysis to produce a multidisciplinary and holistic research approach.

2. Materials and Methods

2.1. Research Context and Community Selection

In Sri Lanka, homegardens play a significant role not only in supporting the lives of rural people but in the environmental landscape of the country as well. Homegardens cover about 15% of Sri Lanka’s land area and are mostly found in rural regions [32]. The majority, 85%, of Sri Lanka’s 20 million population reside in rural areas, of which 70% of these households maintain a homegarden [32].

What makes the Kandyan homegarden often exceptional is its thick tree canopy and plant layers encompassing structural complexity and biodiversity that are comparable to natural tropical forests. For this reason, they are sometimes called Kandyan Forest Gardens [1,33]. They are predominantly situated in the Kandy district which has a high population density and wet zone climatic conditions, and they are characterized by the steep slopes of the area [33]. Kandyan homegardens are usually accompanied by other land uses such as paddy field farming and tea plantations, and they may border natural forests and protected areas. The homegarden is usually made up of tall timber trees in the top canopy layer, followed by fruit, ornamental, and/or spice trees in the layers below. Vines spread throughout the garden as well, such as pepper (*Piper nigrum*) that climb *Gliricidia* trees (*Gliricidia sepium*). In the lower strata, vegetables, tubers, and various medicinal plants cover the ground. For a list of common species found in Kandyan Homegardens see [1,21]. All together, the landscape surrounding homegardens forms a distinct socio-ecological agroforestry mosaic [33].

The site and community selection for this research was based on recommendations from staff members at the University of Peradeniya. The research was conducted in three neighboring villages: Elladetta (latitude 7.215443, longitude 80.577747), Petiyagoda (latitude 7.217104, longitude 80.584694), and Lankatikala village (latitude 7.233482, longitude 80.568335) in Kandy District, in the Central Province of Sri Lanka (Figure 1). All three villages are in the agro-ecological region of the midcountry (elevation range of about 500–550 m amsl) wet zone (annual rainfall > 2200 mm) of MW2b. Average annual maximum, minimum, and mean temperatures are around 28, 20, and 24.5 °C, respectively. The terrain is mountainous, with a steeply dissected, hilly, and rolling topography. Major soil types in the regions are Low Humic Gley soil, Red Yellow Podzolic soil, Mountain Regosol soil, and Lithosol soils [34,35]. All three villages are located approximately 15 km from the city of Kandy and are densely populated. These villages were purposively selected as study sites based on the criterion that local residents rely on homegardening, in varying degrees, to meet their livelihood needs.



Figure 1. Map of Study Area: (1) Elladetta village, (2) Petiyagoda village, (3) Lankatikalaka village. Source for study setting: ArcGIS. Version 10.7.1 Redlands, CA: Environmental Systems Research Institute 2019.

We used a combination of purposive criteria and snowball sampling to recruit study participants. Our initial contact was established by a faculty member at the University of Peradeniya who was familiar with the local area and surrounding villages. Recruitment flyers were distributed to all homegardening households throughout the respective villages, and interested community members were invited to attend an information session on the project. Participation in the photovoice research was voluntary, with the only criteria for inclusion being that (a) the participant must have or be involved in a homegarden, (b) they must be physically able to take a photograph or have a trusted helper to take photographs on their behalf, and (c) they have a willingness and interest to participate. There was a total of 24 participants in the study, with 8 participants per village. All participants gave their formal informed consent before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Research Ethics Board of the University of Guelph (protocol #18-11-004).

The fieldwork took place from early December 2018 to March 2019. The participants ranged from 23 to 85 years old, with an average age of 56 years. There were 9 participants currently employed or in school, while the remaining 15 had retired or had never worked outside the home. This study had 8 male and 16 female participants. Their homegardens ranged from approximately 379.4 to 6070 m² in size. The unit of analysis for this study was initially the individual homegardener; however, 10 participants completed the photovoice project with other family members. This was understandable as homegardening is often a family or household activity.

2.2. Photovoice Method

Photovoice is a Participatory Action Research (PAR) method developed by Wang and Burris (1997) [17], who summarize that it “entrusts cameras to the hands of people to enable them to act as recorders, and potential catalysts for change, in their own communities” (p. 369). Wang and Burris (1997) derived photovoice from three underpinning theories: Freire’s concept of critical consciousness (1970) [36] combined with feminist standpoint theory and applied through a documentary photography

approach. In photovoice, individuals are free to identify and record the strengths and concerns in their environment, through the use of photography. The participants then “give voice” to their photographs through narrative and critical group dialogue. In the final stage of the method, the photovoice results are shared with the community and local decision-makers. This method has the ability to capture the knowledge and perspectives of often underrepresented people, and uses their insight to inform local policy [17].

Photographs used in PAR research have the unique ability to mirror or depict the everyday realities of people’s lives [17]. In turn, researchers are able to gain more valuable insights into the participant’s perspective and knowledge in ways that words alone cannot [37,38]. By entrusting cameras into the hands of participants, photovoice allows the researcher to have access to an individual’s natural social and behavioral settings. It can reveal places, moments, and ideas that may not be available if the researcher was present. Here, the opportunity for new insights about the participants’ relationship with their environment can emerge that would not be likely in other methods [17,18].

The success of photovoice lies in enabling participants to take control over the research process. The goal of the main researcher is to become merely a facilitator of the method, while the participants lead their own data collection and analysis [28,39]. In this way, they become coresearchers in the study. Through continuous reflective thinking, photovoice helps fuel critical consciousness of one’s environment [38,40]. Moreover, the individual concerns brought forward are further analyzed as a group and can create a sense of collective vision [37]. It is only through a participatory method such as photovoice, where participants can learn from each other and build capacity on their own local strengths and issues [17,41].

The literature suggests that photovoice, as an exploratory approach that generates large amounts of visual and narrative data, can make it difficult to draw finite conclusions, especially if participants have a wide interpretation of the research topic [18,19,42]. This method generates open-ended questions and conversation about the data which are highly contextual; therefore, it lacks transferability as the research is situated with often a limited timeframe and sample size. However, many authors argue that photovoice produces richer information in lieu of traditional interviews or survey methods. Furthermore, by sequencing photovoice with other methods, it can add depth to follow-up surveys or interview data collection [19,43,44]. This method developed primarily in health studies; however, photovoice is gaining recognition in socio-ecological and environmental management research. Some noteworthy examples include [39,43,45–47].

Photovoice Process

When adapting and designing the photovoice method for this study, we found guidance in Palibroda, 2009 [48] and Jongeling et al., 2016 [49]. The collaborative nature of photovoice was fundamental to the design of this project. Therefore, we utilized a flexible and emergent research approach in order to better suit the needs of the group throughout the process [50]. Figure 2 shows the steps taken in our photovoice project. Throughout the entire project, an interpreter was present to translate between Sinhala and English.

The first step was an introductory workshop where the participants learned about photovoice and the project intent. At the outset, in an effort to mitigate power dynamics, the participants were positioned as experts on their homegardens and the main researcher as a learner and facilitator of the process. After a discussion around the theme of socio-ecological change, the participants received a few prompts to aid in their reflection on their own homegardens. The questions posed by the main researcher were (1) how has your homegarden changed, both socially and environmentally, over your lifetime? (2) What issues do you currently face in your homegarden? (3) What would you like to teach others about your homegarden? These questions were only a guide and the participants, as experts and coresearchers in the study, were encouraged to explore and photograph what they wanted to share as part of the project. Each participant then received a digital camera and basic photography training

and ethics (see [48]), as many had never used a camera before. Next, the participants were given two weeks to take photographs on their own time.

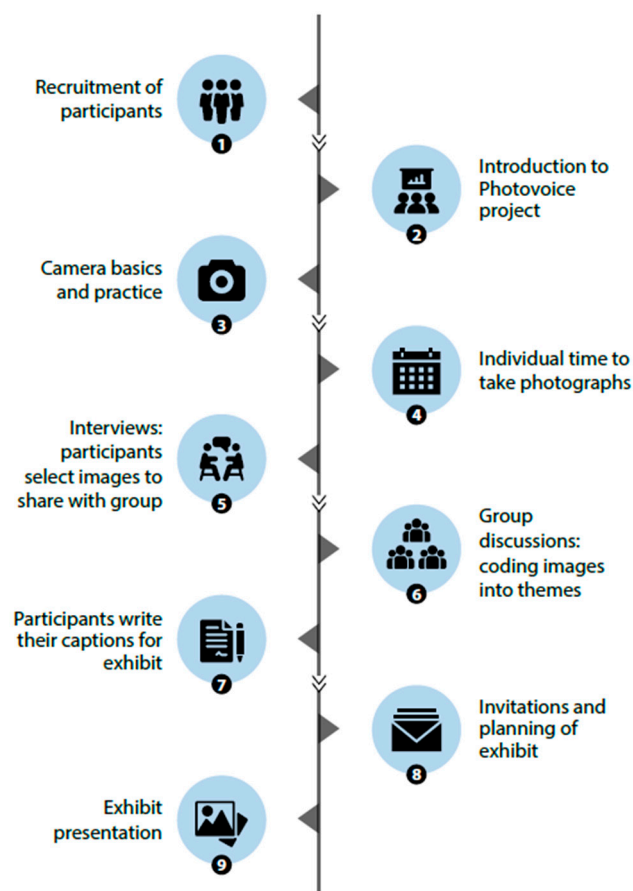


Figure 2. Steps in photovoice. Adapted from [47].

The fifth step of the project was a semistructured interview with each farmer. We modified the original photovoice process to include interviews, as suggested by Castleden et al., 2008 [28] and Jongeling et al., 2016 [49]. The interviews allowed the researcher to build a rapport with each participant and for participants to formulate individual ideas and narrative on their photographs before sharing them in the group discussions. Their photographs were displayed on a laptop, and the participant led the interview, as they chose what photographs to discuss, in the order of their liking. Some follow-up questions were also utilized if needed. Examples of questions that were intentionally asked include: Why do you think this issue began? How would you like to see this addressed? What do you predict for the future of your homegarden? The interviews took between 30 min and 4 h in length. Afterwards, on their own time, the participant selected their most important 10 photographs to share in the group discussions.

Sixth, each village participated in a group discussion. After critical dialogue through sharing their images, the participants identified and analyzed the major patterns that emerged and categorized (coded) the images into themes. There was also one combined group discussion (with 4 volunteer representatives from each village), which created the opportunity for participants to engage with individuals from other villages. At the end of each discussion, the details of the photography exhibit were deliberated as a group such as which photographs to present, where and when the exhibit would take place, and who was invited to attend. The discussions lasted between 3 and 4 h. Both the interviews and group discussions were audio-recorded and transcribed in the following weeks. Further analysis of the photographs and corresponding narratives was completed in NVIVO software (a qualitative

analysis program); however, no photographs were analyzed that were not discussed by the participants, as the photographs were not meant to be interpreted by the researcher alone.

Finally, the participants wrote captions for each of their images in the exhibition. The photographs and captions were then enlarged and printed on seventy-five posters for display. The public photography exhibition was held at the University of Peradeniya and was open for anyone to attend; however, university faculty, staff, and students from the agricultural department, as well as family members, were specifically invited. The visitors were able to freely explore the exhibit on their own and were welcome to provide informal feedback. The exhibition allowed the knowledge generated by the research to be shared with the community, where agricultural scientists and students engaged with participants and reflected and deliberated on the results of the study. For many staff at the university, photovoice was also a new method, and they were interested in learning the process. At the end of the project, the cameras were left with the community and the participants received a small honorarium of LKR 5000 for their time. All the materials needed to host a second photography exhibition were left with the participants, if they chose to do so.

3. Results

Photovoice participants explored and presented a variety of social and environmental changes that they experienced in their homegardens. A complete list of these changes are recorded as trends in Table 1. The trends were further categorized by participants as a positive change, a negative change, or both a positive and negative change to homegardens. Due to the exploratory nature of photovoice, many themes emerged as participants focused on different aspects of the homegarden. They discussed “change” on a microscale, such as the growth and development of their personal homegarden over time, and on a macroscale, such as land fragmentation in the village. Through photovoice, the participants were able to share their experiences in their homegarden as a “story”. This created a natural flow of conversation during the interviews. They brought forward memories of the past and discussed present-day realities in their homegardens. Repetitions of specific changes, which emphasized the importance of the change to participants, were found (Table 1).

Table 1. Social and environmental changes in Kandyan homegardens categorized as positive and negative trends, listed by the number of times discussed during the research (in parenthesis).

	Environmental Changes	Social Changes
Viewed as Positive	Growth and development of homegarden (90) Improved or rare plant varieties (37)	Infrastructure development (to house and village) (65) Increase in income generation (54) Education development and access (4)
Viewed as Both Positive and Negative	New water sources (National Water Supply) (40) Changing cultivations (15)	Change in government regulations * (52) Technology development (29)
Viewed as Negative	Increasing wildlife disturbances (188) More pests and diseases (41) Soil erosion (35) Decreasing resourcefulness and use of homegarden (33) Increasing pesticide usage (16) Increasing garbage (12) More invasive plants or weeds (8) Climate change (4)	Less labor and skill availability (71) Land fragmentation (53) Loss of traditional knowledge (46) Land abandonment (41) Changing culture and attitudes towards agriculture (37) Fluctuating market prices (15) Increase in imported foods (12) Increase in middlemen (3)

* mostly in reference to wild boar hunting prohibition and repeal, as well as imported goods.

The photographs provided visual representations of the challenges homegardeners were facing and gave the participants confidence that their message was understood by the researcher. Photovoice was also found to create a less intimidating environment and a more voluntary approach to sharing

knowledge about homegardening, as compared to direct interview questioning. Rather than being the “subjects” of the interview, the participants led the discussion. The focus was on their photographs and visual meaning representation. The following results presented below summarize the favorable changes and contemporary relevance of the homegarden, and adverse changes to the homegarden, as described by the participants.

3.1. Favourable Change and Modernization of the Homegarden

Nearly 75% of participants chose to start their interview “story” with a photograph that displayed a positive change over their lifetime. Often it was a development to the homegarden that the participant had implemented themselves, such as various kinds of restructuring, adapting, or changing of cultivations within the garden. They shared images of the growth of their plants, the replacement of crops with new improved plant varieties, and their fruitful harvests (Figure 3b). These photographs were generally accompanied with a great sense of pride and a keen willingness to share. Many photographs emerged to celebrate what the homegarden is today and how it had brought value to their life (Figure 3a–c). For example, Participant 4 (P4) shared:

Earlier, our homegarden did not exist. I wanted to show both the garden and the house in this picture because from nothing we created all of this. We transformed our garden into tall, big trees and plants that are all useful for our life. We have created a good Kandyan homegarden system. I can get an income from every plant. It gives us everything we need.—P4



Figure 3. Photographs displaying favorable change, from left to right; (a) “My homegarden is like the foundation for my life”—P20; (b) “Our abundant Areca Nut [*Areca catechu*] harvest that’s why I wanted to show it”—P10; (c) “Nutmeg [*Myristica fragrans*] is our most profitable crop”—P9.

The participants were keen to share their daily work practices and teach other farmers the strategies they have used to improve their homegarden. Many photographs displayed how they have increased income generation, enabled the growth of new plants, reduced competition of plants, managed shade, built a new house, and made the homegarden a “safer place” (for example, by managing mosquito breeding or using organic fertilizers).

Another common image that was shared at the beginning of interviews was infrastructure developments that participants had witnessed in their village (P1, P3–P6, P12, P20, P21). One participant began his interview sharing the significance of a new road. He stated:

My village is very ancient. 30 years ago, there was no roads here [. . .] No electricity, no water, no telephone, no easy access to the town [. . .] But in 1978 we got this road, and everything changed. It was a kind of turning point for us. We were able to develop our houses more and build. People started leaving the village to work in offices. Families began making more money, which meant they could also develop their homegarden.—P6

For many, the road in their village was a symbol of a new lifestyle that evidently shifted the course and function of homegardening to what it is today. It generated a series of changes such as electricity, new technologies, and more income through greater accessibility to job opportunities, cities,

education, and markets. The participants reported that this greater accessibility meant farmers began spending less time in the village, and it allowed them to rely less on their homegarden for everyday needs. With better access to markets, the homegarden generally became more about income generation rather than food sustenance, as one stated, “there’s a clear difference, . . . (before) this homegarden was only for our personal use, but now there is more of a trend to get an income” (P2, also P6, P7, P11, P20, P22). Showing the economic value of the homegarden was a common photograph in the research shared by almost every participant. Specifically mentioned species as important sources of income were: vanilla (*Vanilla aromatica*), areca nut (*Areca catechu*) and coffee (*Coffea arabica*), and spice crops such as nutmeg (*Myristica fragrans*) (Figure 3c), pepper (*Piper nigrum*) and clove (*Syzygium aromaticum*), as well as ornamental species such as anthurium (*Anthurium andraeanum*).

In this study, photovoice was adept at capturing nuanced meanings. There was a lot of ambivalence regarding modernization affecting Kandyan homegardens. For instance, the participants were proud to share that their villages were developing. However, after further reflection and a critical group dialogue many participants began describing how modern developments have also had negative consequences for homegardens (Figure 4). For example, after P5 shared Figure 4a, P19 further commented: “There is constant competition between agriculture and development and the case is that development is always put first, it overcomes agriculture [. . .] So, we have to find a balance”.



Figure 4. Photographs displaying change that was viewed as modernization with negative consequences; (a) “The positive changes in development in my village [electricity], but the consequences the environment faces”—P5; (b) “An abandoned well”—P9; (c) “Should we choose plastic or our own resources for the future?”—P19; (d) “Garbage is increasing”—P6.

This ambivalence of modernization manifested through comparing photographs of various modern practices in the homegarden versus traditional methods. The participants discussed old and new methods of cooking (from firewood to gas stoves, or mortar and pestles to electric blenders, etc.) as well as water collection (from well-water to the National Water Supply). For example, many participants showed photographs of shower heads and flush toilets to celebrate their access to the National Water Supply in the last decade. However, during the group discussions these images were contrasted with other participants’ photographs of traditional well-water systems and clay collection

pots. This generated dialogue on the past and present use of water, and the changing relationship homegardens have with water-use. For example, with a photograph of an abandoned well (Figure 4b), P9 explained:

[...] water was the most important resource for our ancestors, but today wells are no longer being used. So, we need to protect that because water is the best resource that is available for planting and growing [...] Our ancestors used to collect large amounts of rainwater, but now we don't think this way anymore. We don't have the same mentality towards water, and I think it's costing us many environmental issues [...] We need to protect.—P9

When P9 originally shared this photograph in his interview, he gave only a simple description stating, “this is an abandoned well”. However, during the group dialogue, he added more meaning to the image as he conversed with others about traditional water conservation methods. We found that the photovoice process allowed participants to continually reflect on their photographs, to learn from each other, and to share knowledge through their images. In this way, as the photovoice process developed, the themes evolved much further as the participants added deep insight and narrative to their images.

For example, another discussed facet of modernization was the introduction of plastic materials. The participants described how many plastic items have replaced materials sourced from the homegarden (Figure 4c). Plastic was viewed as “convenient” but has caused an increase in garbage in the villages (Figure 4d), while the participants described materials made from the homegarden as “free and environmentally friendly” (P12, also P6, P10, P19, P24). With Figure 4c, one participant explained these concerns using the example of a plastic bag:

This picture shows a plastic bag that is used today, and a homemade item from the garden that was used like a bag in the older days. Before 1977, Sri Lanka had a closed economy [...] but now we are getting cheap imports from other countries coming into our markets like these plastic bags. During this time, we didn't realize the importance of the materials made from our own homegardens. There has been a change in culture, and it is not environmentally friendly. The question mark in the photograph is suggesting, ‘what will we choose to do next? Will we choose to use the resources from our own homegarden or plastic goods from the market?’ We are forgetting the importance of our homegardens [...] Some of these materials are bound to cultural practices [...] We already had everything we need in the homegarden, but now our resources are being lost to plastic.—P19

Accompanying these conversations were evident feelings of nostalgia and remorse. The participants shared stories of how multifunctional species such as “kithul” (*Caryota urenus*), “tala” (*Corypha umbraculifera*), and coconut (*Cocos nucifera*) were once utilized for many everyday needs in the homegarden; however, plastic is replacing the materials made from these cultivations. They reflected on how modernization has substituted traditional knowledge, skills, and cultural and religious practices. They wanted to highlight that even though development has been “good”, it is shifting their relationship within the homegarden, as P19 continued: “we can't just think we are moving forward [...] we are leaving behind a lot of good things that our ancestors taught us”.

3.2. Adverse Changes to the Homegarden

Findings indicated that there was more emphasis on socio-ecological changes that were described as “negative” influences for homegardens, rather than “positive”. The photovoice process did not ask participants to prioritize issues per se but to critically analyze their photographs and choose the most important messages to share as part of the research and photography exhibit. Nevertheless, three trends were clearly viewed by participants as the most threatening to Kandyan homegardens, as displayed in Table 2. These trends are discussed below in order of significance, and this is followed by the remaining adverse changes brought forward in the research (as indicated in Table 1).

Table 2. Described as the greatest threat for the future of Kandyan homegardens according to participants.

Greatest Threat to Kandyan Homegardens	Number of Participant Responses
Wildlife Crop Raiding and Damage	17
Lack of Labor and Interest in Agriculture	10
Lack of Land to Grow	6

The most heavily discussed issue during the research, mentioned by every participant, was the increasing wildlife attacks on homegardens and paddy fields. The participants shared photographs of the damage wildlife had caused (Figure 5a), or their protection mechanisms for plants in the homegarden, such as sheets of metal (Figure 5b). The wildlife associated with causing the greatest and most frequent damage to homegardens were wild boar and porcupines. As P10 summarized: “they come and rip up the roots and chew on the plants”. Some participants shared stories of their loss of entire crop yields due to wildlife (P1, P4, P16, P17, P22, P24), as P1 shared:

[...] I planted 1500 yam plants to put in my homegarden. But unfortunately one night I went to the temple for some meditation, and when I came back, I found that everything was damaged, all by wild boars. They are very destructive and can cause a lot of damage very quickly. It was a huge loss.

Issues with macaques, rats, mice, and squirrels were also mentioned by participants. According to this study, damage to crops from wildlife has drastically increased “over the last 10–15 years” (P1–P24), but even more so in the “last few years” (P1–P24). The participants explored how the wildlife issue, in particular wild boar, was attributed to many interrelating causes. Some reasons mentioned were the fast reproduction rate of wild boar, and the declining presence of their main predators (jackals) “because of all the use of pesticides” (P1, P5, P6, P12, P19, P24). Further, wildlife lacks habitat due to deforestation, as one stated: “they come to find food in the homegardens because they can no longer find it in the forest” (P9, also P3, P4, P20, P21, P24). Lastly, abandoned land areas in the village are turning into “overgrown jungle” which has created more suitable places for wildlife to invade closer to homegardens (P1, P3, P6–P9, P12–P17, P21, P24). The participants also mentioned the law prohibiting the hunting of wild boar, and how this likely increased the population. However, they were hopeful as this ban had just recently been repealed.

During the research, many participants discussed how homegarden cultivations had shifted from tuber and fruit crops to more animal-resilient species, often described as ornamental and spice crops (see Figure 5c). One stated: “we can’t cultivate anything anymore because of all this damage from animals” (P4, also P1, P16). Wildlife attacks have also caused a reduction in revenue from the homegarden and have made it more labor-intensive. The participants generally all agreed that “the struggle with wildlife is going to continue and it’s going to get worse”. Many expressed the need for more government action on this issue. Some participants were hopeful given the recent removal of the prohibition law for hunting wild boar. However, they felt that other solutions given by extension officers were not practical, such as P17 who stated:

The only solution they gave was to give electric shocks to the animals. But this electric device is really expensive, it’s like Rs.25000 [~\$137 USD] who can afford that in the village? [...] plus, we don’t want to harm the animals because many of us are Buddhist.

Overall, the participants were discouraged and felt that they could “not control this issue at all” (P15, also P9, P11, P19, P23).

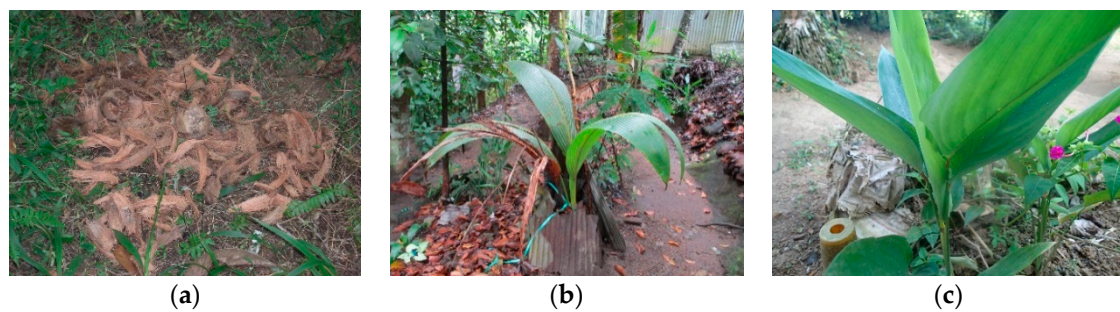


Figure 5. Photographs displaying effects from wildlife, from left to right: (a) coconut destroyed by porcupines—P3; (b) protecting coconut from wildlife—P4; (c) “Aruaka”, a rare tuber crop because of wildlife these days—P16.

The second major threat identified was the lack of labor and interest in homegardening. This issue was discussed by 17 participants during the research and highlighted as the “greatest risk” by 10. The lack of labor and interest in homegardening was at the center of many relating consequences for Kandyan homegardens. First was the inability to cultivate or harvest crops that were labor-intensive or required a particular skill. During the research, these were specifically identified as clove (*Syzygium aromaticum*) (Figure 6a), fish-tail palm “kithul” (*Caryota urenus*), and paddy rice (*Oriza Sativa*). Some participants mentioned that these species had become “essentially useless in my homegarden” (P24, also P1, P9, P10, P12). The labor needed to harvest these species was described as difficult to find or too expensive to hire. The participants stated that these cultivations were not as economically viable anymore and felt they would be forgotten in homegardening, which would then cause a loss of traditional and cultural knowledge and products.

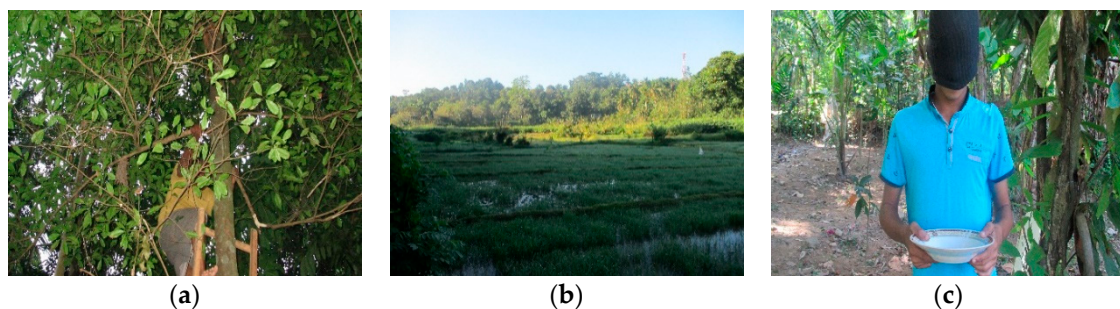


Figure 6. Photographs displaying labor issues, from left to right: (a) “Picking clove, a painful and difficult task”—P13; (b) “Abandoned paddy fields turning into jungle”—P9; (c) “The young people don’t know how food comes to the plate, we have to involve and teach them about homegardening”—P19.

The second consequence of a lack of labor was related to the abandonment of land in the village, specifically paddy fields (Figure 6b). Nearly all the participants discussed a major change in the village landscape as abandoned land was turning into an “overgrown jungle”, as one participant further explained:

You can imagine that when you combine all these abandoned fields together, then I can’t cultivate my field alone even if I wanted to. Because combined, the rodents and wild boars and weeds start invading in the unmanaged land. So, it starts in one place and expands from one paddy field to the next and it becomes a community issue rather than just a one-person decision.—P24

Third, many participants expressed concern that the future of homegardening may be compromised. The young generation was seen as less willing to engage in agriculture, and some predicted that this would be the greatest threat to Kandyan homegardens (Figure 6c). As one participant stated:

My children's attitude towards the homegarden is the biggest risk. Because for the wild animal issue, we can take precautions towards that, but for future generations, if they don't want to work in agriculture then what do you do about that? There are a few reasons for this, one is the economy and the low income from agriculture, and the second is the common attitude towards agriculture, like being a farmer is inferior to something else.—P22, (also P5, P8–P11, P19, P24)

Consistent with other themes that emerged, this topic evolved much further during the group discussions. The participants deliberated why this issue exists and suggested possible solutions such as the need for incentives and agricultural subsidies, changing the discourse of agricultural work, and including homegardening in education paradigms.

The third greatest threat to Kandyan homegardens was viewed as the lack of available land. Half of the participants highlighted this during the study, and five described it as the “greatest risk” to homegardens. The participants described a high population density in the villages with little space to expand from land-use change and encroaching urban areas. (Figure 7a). Fragmentation of homegardens, mostly through family inheritance, was deemed as changing what and how farmers can grow. A few participants noted a reduction in biodiversity, which is causing an increase in pest attacks and reduction in income, making homegardens “not a sustainable system” (P3, also P6, P19). During a group discussion, P6 further explained the effects of land fragmentation:



Figure 7. Photographs displaying land availability issues, from top left to right: (a) “Tight living space, we don’t have the room to grow like we used to”—P18; (b) “With soil erosion, the land is even more limited”—P14; (c) “Bagging plants for maximum land-use”—P6.

Kandyan homegardens are full of biodiversity [...], it is almost like a forest with perfectly stratified layers. But today that is changing, it is becoming less and less like this. Today, I have a small and very simple garden [...] there is less number of plants [...] Before *everywhere* there were big trees and all were useful, but we had to cut them down because we used those timbers to build houses. Now the issue is limited land area, so instead of planting trees I have small plants like anthurium, where I can get about Rs.600 from one plant. So, with limited space this is the best thing for my homegarden.

Land availability was also connected to the on-going struggle of soil conservation (Figure 7b). As one participant highlighted: “We are constantly protecting the soil, if we lose it, we can’t bring it back” (P1). During the study, 13 participants highlighted this issue. Many reiterated P8 who said: “the lands in Kandy are all hillsides, so the biggest problem is erosion and the conservation of the soil and that gets more difficult over time”. A myriad of photographs displaying soil conservation strategies emerged, such as terraces, “lock and spill” drains, composting, mounds, and self-made irrigation pipes. One of the most popular strategies to combat infertile soil and the lack of land to grow was through the bagging of plants (Figure 7c).

In addition to these three “greatest risks” to homegardens, the participants presented many other adverse changes that were also a major part of the research and photography exhibit (as seen in Table 1, and examples in Figure 8). Many of these adversities were interrelated and further exacerbated the “greatest risks” to homegardens. Half of the participants presented a photograph of a pest or disease infected plant in their homegarden (Figure 8a). This was understood as an on-going issue, yet some noted that pests were becoming more frequent. Others discussed fluctuating market prices, an increase in intermediaries who tend to buy at lower prices from producers, and an influx of imports that had decreased the value of homegarden crops (Figure 8b). As one participant explained:

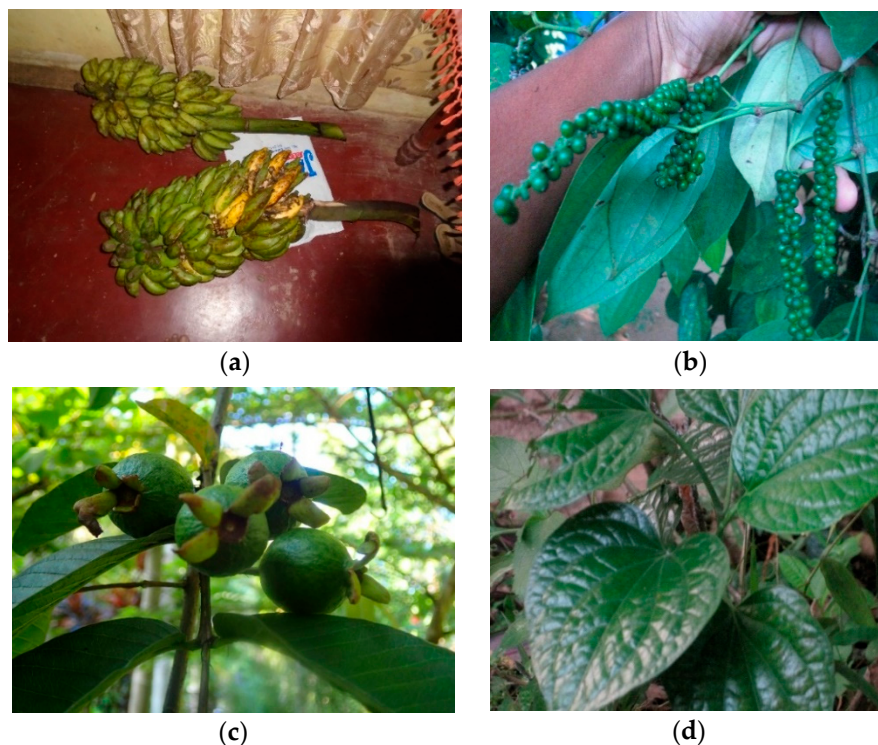


Figure 8. Photographs displaying other adverse changes, from left to right: (a) “Banana disease in my homegarden”—P10; (b) “Pepper prices have reduced because of imports”—P2; (c) “Safe to eat guava fruits”—P16; (d) “‘Thippili’ [*Piper Longum*], a medicinal plant I enjoy sharing it with everyone in the village”—P21.

A long time ago when the economy was more based on agriculture, farming was a total job to make income, but around the 1970’s we got new policies like free trade [. . .]. Now, we are not producing anything anymore, not even our own rice. We import everything. There is no clear policy for the farmers and the crops [. . .]. That’s on the bigger level. But what happens at the top affects the bottom level people, like us farmers.—P8

Discussants, primarily women, also identified the increase in chemical and pesticide usage in agriculture. They expressed anxiety towards market produce because they “do not know what kind of

chemicals are in the food” (P20, also P5, P8, P18, P19, P22). In contrast, photographs of the homegarden harvest were described as “safe to eat” (P5, P7, P14, P20–P22) (Figure 8c). The participants stressed the need to conduct organic farming, as some agro-chemicals were associated with kidney disease and harmful for their bee colonies.

Women in the study were also the main participants to discuss changes in community culture. They felt that their neighborhood relationships were weakening, as people had become “more individual” (P4, also P2, P9, P24). The participants commented on the past open and communal feel of the village, where now fences border homegardens emphasizing private ownership of land. They also discussed the reduction in the “*Attham* method” culture. One participant explained:

It’s a cooperative method. When one person needs help, we all go to that person’s land [. . .] I think these types of values are disappearing from the culture. I suspect that it’s because people are chasing after money and have less time these days.—P24, (P5, P6, P9, P19, P20)

Nevertheless, the participants proudly emphasized the sharing culture that is still very prevalent in their village communities (see Figure 8d).

3.3. Underlying Themes

Three underlying themes were identified through the photovoice process. First, changes in homegardens were described as complex, interrelated, and socio-ecological. The participants linked social changes to environmental impacts, and vice versa, where environmental changes were connected to shifts in the social realm. For example, the increase in wildlife damage to homegardens was linked to shifting homegarden crop species (Figure 5c), the decrease in revenue, and loss of traditional and cultural knowledge. The group discussions allowed the participants to further analyze these issues and explore the interconnections.

Second, the homegarden was viewed as generally becoming less sustainable and less sufficient for the participants’ daily livelihoods. The relationship between people and their homegardens is changing, and they feel less reliant on their homegarden. This concept emerged through many photographs. Towards the end of the photovoice process, P19 decided to draw a picture that captured this theme (seen in Figure 9a); he explained:

It’s a symbolic photograph. The outer most circle symbolizes complete self-sufficiency from the homegarden. It’s what the Kandyan homegarden system used to be like, as it provided everything that the household needs. But because of many effects like land fragmentation, attitude changes, environmental changes, and even developments, we have lost some traditions, and the self-sufficiency of the homegarden has reduced. You can see gaps in the circles of the drawing as you go in, the gaps represent what we have lost. So, self-sufficiency from the homegarden keeps reducing over time. We don’t use our homegarden like we used to [. . .] Now, Kandyan homegardens are in some kind of danger, we are at the red circle.—P19

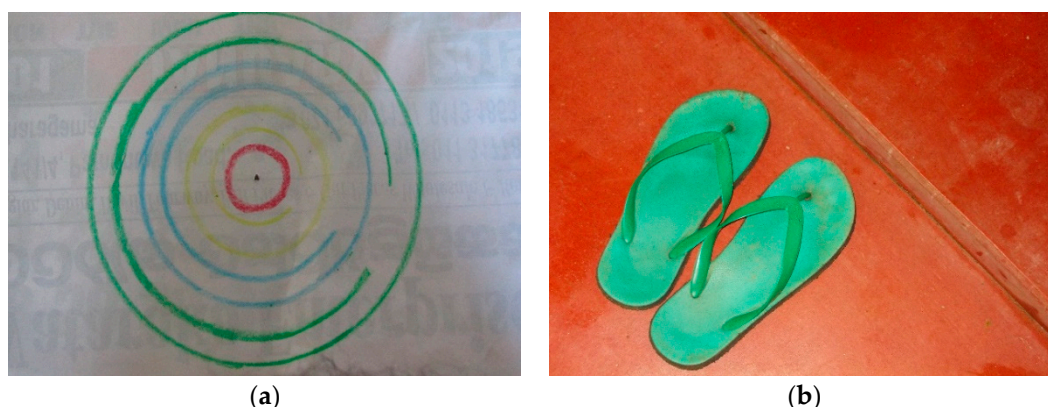


Figure 9. Photographs displaying underlying themes, from left to right: (a) drawing of reducing self-sufficiency in the homegarden—P19; (b) “Homegardens have come very far, but today we face obstacles, we have to keep working”—P6.

Third, the participants expressed a sense of hopelessness and worry towards the overwhelming adverse challenges to homegardens. One participant stated, “I think Kandyan homegardens will disappear from this world [. . .] and that is a very bad thing” (P24). Despite these feelings, the majority of discussions ended with messages of resiliency and adaption to change through local action. For example, with Figure 9b, one participant shared:

I am trying to show a symbol. These slippers represent the long journey that has been completed already by farmers in their homegardens, but now the slippers have hit a sort of obstacle [the staircase]. It has to overcome it to continue. So even though homegardening can be really harsh, still this pair of slippers moves forward as a farmer does through life. The slippers know the hardships the farmer goes through, but it has to take the next step. We have to somehow overcome the situation to make the homegarden a success.—P6

The participants were eager to teach one another ways to overcome issues. This knowledge transfer was made easier during the research with the visual tool of photographs. Overall, throughout the study, a sense of pride in owning and managing a homegarden was evident in all the participants. They described the many ways that the homegarden had benefited their livelihoods, and many were hopeful their homegarden would be inherited by future generations.

4. Discussion

An important part of adapting and conserving Kandyan homegardens for the future is to first understand the diverse array of changes that homegardens are facing [5,6]. Our study revealed both favorable and adverse cycles of change, as well as social and environmental changes, and the interplay between them. Photovoice was useful for exploring these complexities through the eyes of the farmers, and understanding the interconnections of changes within their livelihoods. As authors note, every homegarden and homegarden dweller is unique [6] and each will adapt based on their perceptions of socio-ecological change [16,51]. Therefore, our study suggests that research on homegarden dynamics is not complete without the knowledge of local communities who experience and adapt to change daily.

Our findings build on existing knowledge of socio-ecological change in Kandyan homegardens, such as previous work from Mohri et al., 2018; Wiersum, 2006; and Landreth and Saito, 2014 [8–10]. However, the socio-ecological trends presented in our research are not particularly new, as that was not the focus of this study. Instead, through photovoice we (1) took a participatory approach to explore and reveal the local perspectives and current experiences of change in Kandyan homegardens; (2) presented the data through narrative and visual representations of change; and (3) revealed how this combination of a participatory and visual approach allows for new and deeper insights to emerge that would

not be likely in other methods. The following discussion builds on these points to demonstrate how photovoice can be advantageous in homegarden research.

First, photovoice is a participatory method that shifts the power from the researcher to the participants [28]. In our study, this approach positioned the farmers as experts on their lived experiences of change in homegardens. In fieldwork, the researcher was then positioned as a learner, and the participants led the visual data collection and narrative process. This method created a voluntary approach for individuals to share their experiences in the homegarden. For example, rather than having to answer specific questions in an interview, the participants had weeks to reflect on what they wanted to share and were not limited on the number of photographs they could take. The participants also chose which images to discuss with the researcher, in the order of their liking. Our study found that this approach enabled interviews to be told as a “story” which is more congruent with traditional rural Sinhala culture [3]. Through a participatory approach, the group discussions allowed for the coproduction of knowledge. It ignited a sense of community and brought individual experiences together to form a collective experience in homegardens [37]. One participant shared: “we should continue to learn from each other like this. When one of us has a problem in the homegarden, we should share what is happening, and teach each other our ideas” (P19). Through a community-embedded approach, such as photovoice, where participant-driven data are generated but also grounded in local knowledge, sustaining the mobilization of knowledge is possible.

Second, the use of photographs prompted valuable learning and reflection on participants’ homegardens and livelihoods, in ways that words alone could not [19,41]. Throughout the photovoice process, Liebenberg (2018) [37] suggests that individuals reflect on images multiple times throughout the study, which generates more critical thinking, (i.e., when they first take a photograph; when they choose to share that image; when they attach meaning to the image; and when the group responds, interprets, and discusses it). In our study, photovoice allowed the participants to create awareness and re-examine their everyday environments and relationships with their homegarden. Many described that “they learned something from this research” (P23), and it made them “think about [their] homegardens in a new way” (P1). The combination of visuals and narrative also allowed the researcher to see homegardens through the eyes of the participant. Moreover, it allows the researcher to accurately understand the essence of an issue [29,38]. For example, we not only heard about the damage wildlife can cause but also saw visuals of what that damage can look like in the homegardens (e.g., Figure 5a). In turn, the participants felt that their message was better conveyed. During the group discussions, the photographs provoked questions, emotions, and rich engagement. Finally, the use of images in this research offered an immediate and transferable way to disseminate the results within the community [19]. Rather than only an academic report, for example, the photography exhibition allowed the research to be understood by a wider audience [17].

Third, this combination of a participatory and visual approach allowed new insights to emerge that would not be likely surface in conventional methods, such as surveys or interviews [18,44]. For instance, our findings report that as the photovoice process evolved, the participants were more reflective and added meaning to their photographs. As mentioned, when the participants shared their photographs as a group, it allowed them to learn from each other and widen their perspectives on issues. This process generated a more in-depth narrative on the changes in homegardens and how they have impacted their livelihoods. One example was P19’s, drawing near the end of the study in Figure 9a, where he highlighted the concept of reduced self-sufficiency from the homegarden. Photovoice allowed participants to reflect on how homegardens are deeply embedded into many aspects of their lives, from income generation and food sustenance to their health, history, culture, community, and social relationships. In this way, when the participants analyzed and connected their photographs, they revealed how one element of change could have ripple effects in homegarden systems. For example, this was discussed around the influx of plastic materials (Figure 4c,d). This trend was connected to the reduced utilization of certain species in homegardens, contributing to a loss of traditional knowledge and practices, and increased garbage in the villages. Photovoice is a useful

method for unpacking these dynamics, and it allowed our findings to reveal rich insight into the human-ecological relationship in Kandyan homegardens.

In recent years, scholars have recognized that this relationship is key to sustaining biodiversity and resiliency in agricultural systems. Authors are calling for the inclusion of local knowledge systems, and a more collaborative approach to homegarden research and agricultural development. [5,8,14,52]. The research available on Kandyan homegardens is generally limited, and most studies are grounded in scientific methods and quantitative approaches [12]. Yet, Kandyan homegardens are rooted in complex cultural and behavioral contexts, and this reality may skew the practical value of quantitative methods. Steinke et al. states: “[c]omplementing quantitative approaches with participatory research may help cut through this complexity and link the analysis with reality on the ground” (2019). The intricacy of homegardens requires adding value to quantitative methods through a visual, participatory approach such as photovoice. Our in-depth and varied findings from the local perspective suggest that there is a lot of potential for photovoice research to be sequenced with quantitative methods. By combining the strengths of quantitative approaches and geographic information systems (GIS) mapping with methods such as photovoice, research on homegardens can provide a more holistic analysis. Photovoice can also be used as a form of triangulation of data [43]. However, it must be noted that photovoice does not only add rigor to the data, it adds rigor through the methodology itself. The process of participatory inclusion, building trust with communities, and the coproduction of knowledge is powerful in shaping the results of research. Nevertheless, there are some important limitations to photovoice [17], particularly as it was used in this study. We had a relatively short project timeframe of 3 months. This is not representative of a Kandyan homegarden’s annual growing season. In addition, more time or perhaps linking with a local non-governmental organization, could have been beneficial in establishing a stronger foundational relationship as a group, and in allowing the community to fully participate in the initial design phases of the project. Lastly, mobilizing the knowledge and results produced in the study through multiple photography exhibits was intended, but time and resources were limited.

Authors agree that conserving homegardens for the future will need to be a combined effort from local communities to national governments [8,12]. As Landreth and Saito (2014) [8] report, some national homegarden initiatives in Sri Lanka have not met local needs and have, therefore, not been very effective. In order to ensure more uptake and sustainability of programs, researchers agree that policies for homegardens need to be informed by local communities and be context specific [8,22,27]. We agree with this view and, furthermore, call upon researchers to include farmers through participatory approaches such as photovoice. Our findings suggest that photovoice is a valuable tool to engage homegarden dwellers. Through visual documentation, it can reveal overlooked aspects of everyday life in the homegarden and transfer this knowledge to establish a dialogue between homegarden communities and policy makers.

5. Conclusions

Kandyan homegardens have endured over centuries, and the main driver of their existence is the local farmers that manage them. Despite the pressures of agroecosystem change, homegardens continue to provide immense benefits and offer a promising approach to achieving multiple Sustainable Development Goals [12,24]. This remains possible from the daily practices and decisions of local homegarden communities.

This article presented empirical data generated through the photovoice method by farmers in three Kandyan homegarden villages. The iterative process of photovoice allowed the participants to reflect in increasingly conceptual ways on the changes they have observed in their homegardens. This resulted in the coproduction of knowledge and in-depth data from the local experience. The findings of this article are significant for homegarden research as we present visual documentation of socio-ecological change from the local perspective, and this has seldom been studied in Kandyan homegardens.

Photovoice is a promising method for researching local knowledge systems and human–ecological relationships within homegardens as complex agroforestry systems. Photovoice, we conclude, is a robust method for agroforestry systems research with strong potential to supplement conventional quantitative methods such as surveys and GIS mapping.

Author Contributions: R.D. conducted fieldwork, collected resources, developed methodology, performed the analysis of results, drafted the original manuscript, and finalized it. H.H.O. supervised the entire study, provided suggestions for the research framework and methodology, and reviewed and edited the draft manuscript. N.T. co-advised the entire study, helped identify the study area for fieldwork, and reviewed and edited the draft manuscript. S.P.N. helped with community selection for the fieldwork, provided suggestions on methodology and dissemination, helped with research assistants, and conducted proofreading. All authors have read and agreed to the published version of the manuscript.

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