

Human-Centred Tool Design for Domestic Cashew Cutting: A Case Study from North Central and North Western Provinces, Sri Lanka

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Abstract – Cashew (*Anacardium occidentale L.*) is both an economic crop and a culturally significant ingredient in Sri Lanka, particularly valued in home-cooked dishes. However, traditional household-level cashew processing is in decline due to health risks, time intensity, and ergonomic challenges. This study employed a Human-Centred Design (HCD) approach, guided by IDEO.org (2015), to investigate these challenges and propose context-sensitive design interventions. Data were collected through the Observation, Engagement and Interview, involving 34 purposely selected housewives from Sri Lanka's North Central and North Western Provinces. Participants were observed and interviewed in their natural environments, supported by tools such as card sorting, empathy mapping, and user journey mapping. Thematic analysis revealed three core barriers: physical strain from manual processing, exposure to hazardous cashew nut shell liquid, and the inadequacy of existing tools. Despite these issues, strong cultural and emotional ties to cashew preparation remain evident. The study concludes with design recommendations for safer, more efficient, and ergonomically improved tools that preserve traditional practices while addressing modern household needs. These findings aim to bridge the gap between tradition and practical usability, ensuring the continued relevance of cashew in domestic lifestyle and the broader Sri Lankan culture.

Keywords: Cashew Cutting; Traditional Practice; Domestic Consumption; Experience; Tools; Product Design; Human-Centred

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I. Significance of Domestic Cashew Processing in Sri Lanka

Cashew, a tropical plant, is commonly found in gardens within Sri Lanka's dry zone. Both commercial cultivation and domestic consumption of cashew hold significance across the country. Cashew has long been considered a traditional food, fostering connections among various religious, ethnic, and social groups. It remains a central dish during almsgiving ceremonies, particularly among Sinhala Buddhists. In rural wedding celebrations, cashew-based dishes are often served as a symbol of social status. Cashew also features as a vital ingredient in culturally significant dishes such as the Sinhalese *Hatmaluwa*, the Tamil *Muruthen Bath*, and a variety of sweets including *Vatalappan*, *Dodol*, and *Kanji*, all of which reflect the island's diverse culinary traditions. For many villagers, the consumption of cashew at home evokes fond memories and strong cultural connections. Beyond its role in cooking, the cultivation and processing of cashew have created employment opportunities, particularly for women and small-scale producers in rural areas, thereby embedding cashew deeply within village life. Traditional methods of preparing cashew curry exemplify the creativity and resilience of rural households. The nuts are typically sun-dried, roasted, hand-shelled, and peeled to extract the edible kernel. Although these processes are time-consuming and labour-intensive, they are highly valued for preserving flavour and authenticity and passed down through generations.

These traditional practices pose challenges; The extraction process exposes workers to skin burns, while roasting over open flames leads to smoke inhalation. Despite such occupational hazards, many communities continue to rely on traditional tools and methods. Nevertheless, the physical discomfort associated with cashew processing has led to a gradual decline in participation and engagement. This underscores the urgent need for empathetic design interventions aimed at enhancing the quality of daily livelihood practices—safeguarding traditions while addressing present-day challenges. By recognising both the tangible and intangible values inherent in cashew-processing, designers have the opportunity to co-develop solutions that honour culture and improve community wellbeing.

II. Research Problem

Cashew nuts are encased in a hard double shell containing toxic oils like anacardic acid and urushiol, which can cause severe skin irritation. Traditional processing methods, though culturally significant, expose individuals to these hazards and require intense physical effort. In today's fast-paced lifestyles—particularly for housewives—these challenges have led to a decline in household-level preparation. This study explores domestic cashew processing in rural Sri Lankan communities, focusing on the cultural importance of cashew consumption, especially in dishes like cashew curry. By engaging with community members lived experiences, the research seeks opportunities for product design innovations that enhance safety, comfort, and efficiency, while preserving cultural heritage.

III. Present day Practices and Challenges

Cashew is an integral part of Sri Lankan culinary and cultural traditions, widely featured in festive dishes and religious rituals across diverse communities (Mihiranie et al., 2020). Despite its cultural

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significance, the processing of cashew presents serious health hazards due to the presence of caustic cashew nut shell liquid (CNSL), which can cause severe skin irritation and burns (Balasubramanian et al., 2016). Traditional methods typically employ rudimentary village tools such as the *Manna* and *Kaththa*, yet these require awkward postures and repetitive manual actions, contributing to musculoskeletal disorders (Wijesinghe, 2016). Globally, research has led to the development of semi-automated or ergonomically designed shellers for industrial applications (Ogunwusi, 2019); however, such solutions are often unsuitable for domestic or small-scale contexts (see Figure 1). Participatory and community-based design approaches have shown success in rural settings by embedding cultural relevance into tool innovation (Johnson et al., 2024; Utami et al., 2022). This highlights a notable research gap: the need for human-centred, culturally sensitive design solutions that enhance safety, comfort, and efficiency, while preserving traditional practices.

In traditional domestic settings, various tools, methods, and protective techniques are used to reduce the harmful effects of cashew nut shell liquid (CNSL) during cashew cutting. The process typically begins with soaking raw nuts in water for about 24 hours to soften the shells. Commonly used tools include the *Manna*—a curved, heavy-bladed knife—and the *Kaththa*, a low-level curved bench knife. Some households also use standard hand knives or areca nut cutters, locally known as *Giraya*.

Due to the hazardous nature of the task, protective measures are essential. Workers often rub ash on their hands to prevent slipping and act as a barrier against the toxic oils. During cutting, the nut is placed on the blade and struck with a hard object—usually wood or a coconut shell—to split the shell. A small knife tip or coconut stick is then used to extract the kernel, which may be held in the hand or placed on the ground depending on the household.

To counter the corrosive effects of CNSL, materials such as ash, coconut oil, polythene, or gloves are used. However, these are not always reliable: coconut oil can cause slippage, while gloves may reduce grip and precision. After cutting, hands are cleaned with coconut oil or dust. The kernels are boiled, the soaking water discarded, and the inner skin peeled before cooking. Despite these measures, prolonged exposure to CNSL often results in skin damage, typically appearing after one to two weeks of regular processing.

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Figure 1

Present-day methods used in cashew nut processing



Note. Captured by the author

IV. Methodology

The research design was guided by the Human-Centred Design (HCD) framework proposed by IDEO.org (2015). Selected strategies from the framework were applied during the data collection and analysis phases and were further reinforced through prototype testing.

The data were collected using the OEI framework—Observation, Engagement, and Interview—capturing the perceptions, emotions, preferences, beliefs, behaviours, response, tools used, protective measures, time invested, and associated physical risks within their natural environments. The full sequence of traditional cashew processing was observed and documented. The researcher directly engaged in the process to understand the overall user interactions. In addition to experiential feedback, interviews with housewives, elders, and vendors explored the cultural value of cashew, safety practices, the decline of traditional methods. Visual card sorting, were used to explore how participants organise and relate information.

The analysis comprised user journey mapping and empathy mapping for each participant to identify patterns in user priorities, touchpoints, and mental models based on the initial data. Subsequently, a thematic analysis was conducted using an inductive coding approach. Emerging themes were developed into insight statements, which then guided the focus of brainstorming and prototyping.

A purposive sampling strategy was employed to select 34 housewives from Sri Lanka's North Central and North Western Provinces—areas known for extensive cashew cultivation and deeply rooted domestic processing traditions. Participants were chosen based on their lived experience with cashew processing to ensure a broad range of perspectives. Sampling accounted for diversity

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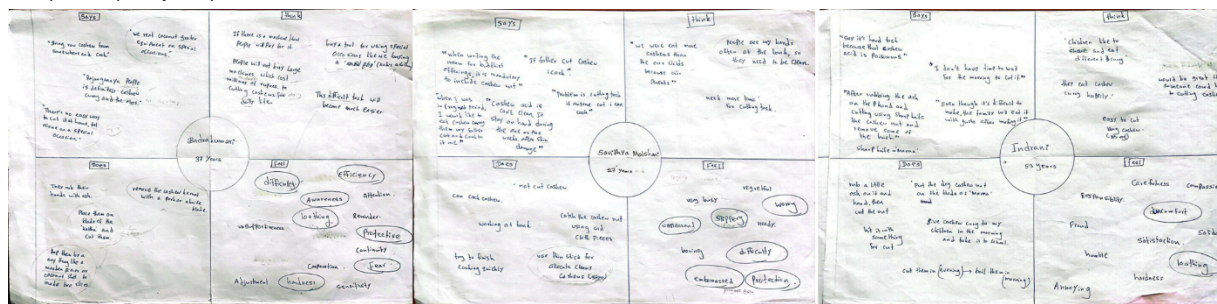
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in age groups (25–35, 35–45, 45–55, and 55–65 years) and occupations/lifestyles, including farming, teaching, healthcare, vending, entrepreneurship, and non-working women. This variety ensured representation from younger housewives balancing work and home responsibilities as well as older women possessing extensive traditional knowledge of cashew processing methods.

V. Design Implementation Through Analysis and Ideation

Women involved in cashew kernel peeling continue to face significant occupational challenges, particularly related to ergonomics and workstation design (Shinde & Tapase, 2023). Mallampalli, Dhar, and Pal (2023) developed a user-centred sheller to reduce musculoskeletal strain, and insights from such occupational studies were incorporated into the analysis. Findings revealed that participants consistently preferred cashew curry during both busy and relaxed periods, reflecting its cultural significance alongside practical and emotional challenges—such as pride and enjoyment, but also skin irritation and fatigue. Empathy mapping (see Figure 2) showed that while women highly value tradition, they face notable issues including time constraints, physical discomfort, and safety risks. These insights highlight the need for tools that improve ergonomics, protection, and efficiency without compromising cultural authenticity or emotional connection.

Figure 2
Sample empathy maps



Note. Created by the author.

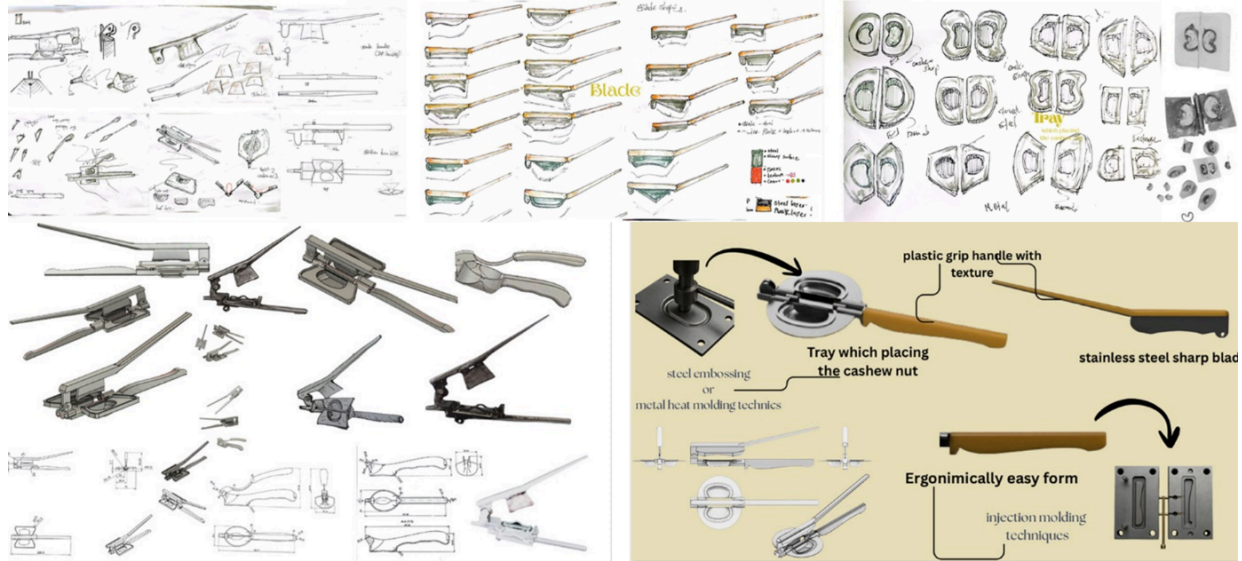
Key themes—protection, difficulty, loathing, cultural value, and ergonomics—guided design ideation for tool development focused on domestic settings, typical cashew quantities, and user comfort during the cutting phase (see Figure 3). Considerations included acid removal, ease of collection, cleanliness, and storage. The design aligned physical features with familiar user actions and relevant anthropometric data. Specifically, enhancements to the shelling blade, tray features, and an acid removal mechanism were introduced to improve user engagement.

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Figure 3
Brainstorming, sketching and prototype development



Note. Created by the author.

Low- and high-fidelity metal prototypes of cutting and roasting tools were tested with housewives. Feedback showed they made preparation safer, easier, and less physically demanding. Visuals such as a user journey map (see Figure 4) and a comparative table (see Table 1) illustrated users' emotional and physical responses to traditional methods versus the new tools. The results showed improved safety, comfort, and efficiency, while respecting traditional domestic preferences.

Figure 4
Prototype testing and feedback analysis



Note. Created by the author.

Table 1*Ethical Considerations in the Prototyping Process*

Measure	With traditional methods	With the proposed design
User' posture	A posture that is awkward and cannot be maintained for a long period.	A posture that can be maintained in any position (sitting or standing).
Cashew acid affect	Hands become dirty and unpleasant due to exposure to ash and cashew acid.	No need for ash; hands remain clean and pleasant.
Physical damage and difficulty	The task is very difficult and often requires 1-2 attempts to cut a single cashew nut.	A simple task, usually requiring only one attempt to cut a single cashew nut.
Loathing experience (after 1-2 weeks)	Cashew acid causes damage to the skin on the hands.	Does not cause any damage to the skin on the hands.
Time	It takes approximately 21 to 26 seconds to cut one cashew nut.	Takes approximately 15 to 18 seconds to cut one cashew nut.
Other	No other work can be done while performing this task.	Other tasks can be carried out simultaneously while performing this task.

Note. Created by the author.

Conclusion

Cashew remains integral to Sri Lanka's cultural and economic fabric, yet household-level processing is in decline due to three key challenges: the labour-intensive nature of traditional methods, health risks from shell liquid exposure, and poor ergonomic design of existing tools. This study highlights a clear gap between cultural significance and practical usability. Through a human-centred design approach, it advocates for safer, more efficient, empathetic and ergonomically improved tools that honour tradition while supporting modern domestic needs. Such innovations are crucial to preserving the lasting relevance and presence of cashews in everyday life.

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