

Baree (Homestead Garden) as a Socio-Ecological System in Rural Assam-A Review

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Abstract— The traditional Baree, or homestead-based production system, is an important component of rural landscapes in Assam. Often perceived simply as a household garden, Baree is in fact a multifunctional socio-ecological system where biodiversity, food production, livelihoods, traditional knowledge and human well-being are closely interconnected. A typical Baree may contain many plant species including fruit trees, vegetables, spices, medicinal plants, bamboo and other multipurpose species, together with birds, insects, soil organisms and other associated biodiversity. These components collectively provide food, income, ecosystem services and cultural benefits. This review examines the Baree from a socio-ecological perspective with a focus on its contributions to biodiversity conservation, food and nutritional security, livelihood diversification and human well-being. It also discusses emerging pressures such as commercialisation, land-use change, biodiversity loss, changing lifestyles, erosion of traditional knowledge and climate change. The review argues that the value of Baree should not be assessed only through its direct economic output. Its ecological, nutritional, social and cultural functions must be considered together. Recognizing Baree as a multifunctional socio-ecological system can support more sustainable, biodiversity-friendly and climate-resilient approaches to rural development in Assam.

Keywords— Baree, socio-ecological system, biodiversity, food security, livelihoods, Assam.

I. INTRODUCTION

In rural Assam, the Baree (homestead garden) holds a special position in every household. It represents a multifunctional homestead-based agroforestry and food-production system. In the context of Assam, the term Baree has a broader meaning than the conventional concept of a home garden as it includes agroforestry systems associated with the household compound. In Assam, 'Baree' refers to a traditional land-use practice where a variety of plant species, such as timbers, firewood, vegetables, fruits, plantation crops, spices, herbs, ornamentals, and some other elements of farming systems, such as livestock, poultry, fisheries, sericulture, beekeeping, etc., are maintained by the members of the farm family with the primary goal of fulfilling various household needs, livelihood resources, biodiversity and ecosystem services (Barua et al., 2019).

The Baree system has deep historical roots in Assam. According to literature, the practice has existed since time immemorial and was associated with Hiuen Tsang and the Mughal-era historian Shihabuddin Talish. The system became more organised during the Ahom period, particularly during the reign of Swargadeo Pratap Singha (1603–1641 AD), when Momai Tamuli Borbarua, a chief of the Revenue office, re-organised villages and promoted Baree as a self-sufficient household production system contributing to the economic well-being and self-reliance of farming families. Thus, the historical development of Baree reflects not only an agricultural practice but also an institutional approach to household-level food production, resource management and rural self-reliance (Barua et al., 2019).

Baree in Assam is not a uniform system; it takes different forms depending on its location and how the land is used. Broadly, it can be classified into three types: Integrated Baree, Meroni and Paam. Integrated Baree is the common homestead-based system, where a variety of trees, vegetables and other useful plants are grown around the house, mainly to meet household needs. Meroni, often referred to as a fenced Baree, is generally found on relatively higher land and may be used for growing seasonal crops along with timber, bamboo, citrus and other useful plants. Paam, on the other hand, is usually found in riverine areas, where cultivation practices are adapted to the seasonal flooding and changing conditions of the land (Barua et al., 2019).

The diversity and multifunctionality of Baree make it particularly relevant to contemporary discussions on biodiversity and ecosystem processes. A proper Baree provides food and nutritional security, livelihood diversification, traditional ecological knowledge and human well-being. The interaction between ecological components and household activities makes Baree an example of a socio-ecological system (SES). A socio-ecological perspective is particularly useful because humans are not external to the Baree ecosystem. Decisions on planting, conservation, harvesting, selling or replacing affect biodiversity and the ecosystem services that affect household food, income and well-being. In India, Assam is the state with the highest concentration of these Baree/homestead systems (Sharma et al., 2022). An ICAR report estimated that Assam has around 6.4 million homesteads, covering nearly 85% of all households in the state (Barua et al., 2019). However, in recent times, increasing urbanisation, land fragmentation, commercialisation and changing lifestyles are transforming traditional multi-species Baree systems. Against this background, the present review conceptualizes Baree as a 'socio-ecological system' and examines its interconnected contributions to biodiversity, food, livelihoods, human well-being and resilience in rural Assam.

II. METHODOLOGY

This study adopts a narrative review approach to examine Baree as a socio-ecological system in rural Assam. Emphasis is given to literature from Assam and Northeast India, while relevant studies from South Asia and other regions are used for conceptual comparison. The selected literature is thematically reviewed and discussed under four major dimensions: (i) biodiversity and ecosystem services, (ii) food and nutritional security, (iii) livelihoods and economic contributions, and (iv) human well-being, traditional knowledge and resilience. Driving factors, emerging threats and research gaps are also synthesized. The findings are integrated into a conceptual socio-ecological framework showing the interactions and feedbacks.

III. CONCEPTUAL FRAMEWORK: BAREE AS A SOCIO-ECOLOGICAL SYSTEM

The framework presents the Baree as a social–ecological system consisting of two closely connected components: the social system and the ecological system. The social system includes household members, labour, livelihood needs, cultural values and indigenous farming knowledge. The ecological system consists of soil, water, crops, trees, livestock, birds, insects and other organisms. These two components come together through management practices such as multistoreyed cropping, crop selection, organic matter recycling, seed preservation, water management and the integration of crops, trees and livestock. These interactions may contribute to food and nutritional security, household income, soil health, biodiversity conservation, ecosystem services and the preservation of traditional knowledge related to farming. The framework also explains how indigenous and traditional farming knowledge is practiced and passed down through the everyday management practices of a Baree. In many Assamese folk songs, reflections of natural farming practices and indigenous knowledge can be seen in the traditional Baree system of Assam. Mazumdar et al. (2022) documented the role and relevance of 36 Assamese Bihu Geet across 24 districts of Assam in the management of the Assamese Baree system. The framework draws on Ostrom's (2009) Social Ecological Systems framework, which explains that people, natural resources and management practices are closely connected. Further, the framework is synthesized from the reviewed literature and adapted to the ecological and cultural characteristics of the Assamese Baree documented in studies of homestead biodiversity and plant use practices in Assam (Das & Das, 2005; Saikia et al., 2012). Since the framework is based on existing literature, the feedback is explained as a potential feedback pathway which represents possible ways in which social and ecological outcomes may influence future household decisions, management practices and ecological conditions, rather than relationships directly tested in the present study.

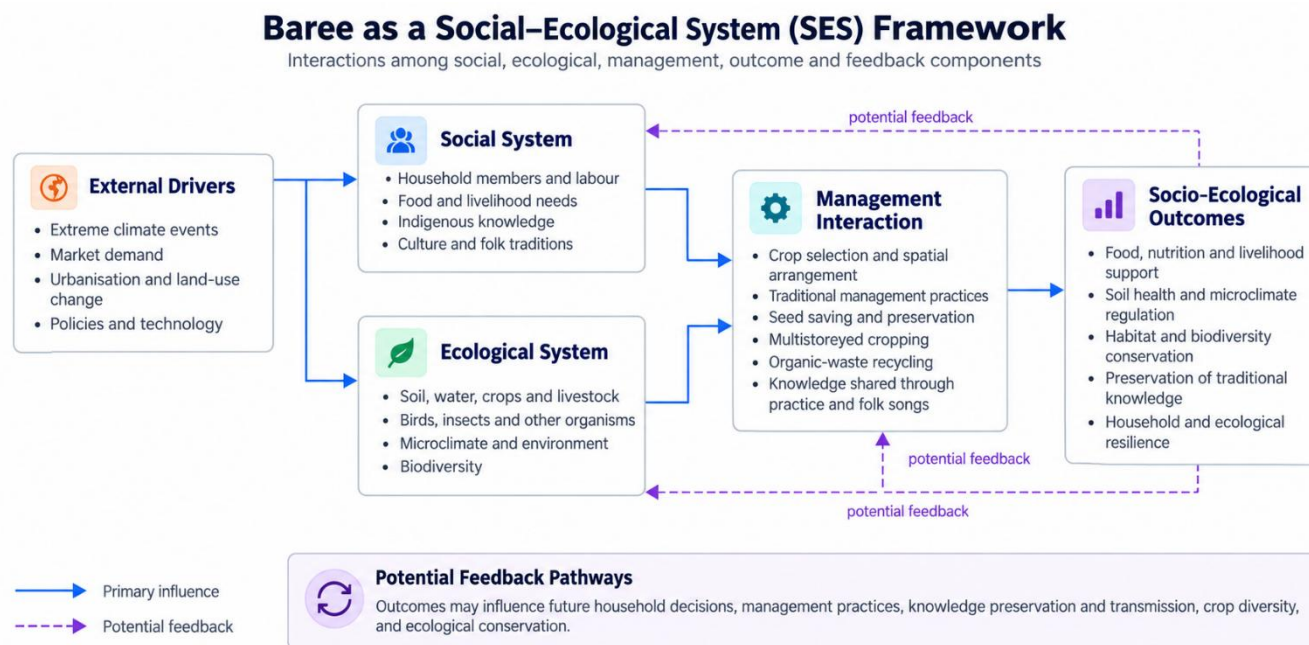


FIGURE 1: Conceptual representation of the Baree as a social ecological system based on the reviewed literature

IV. RESULTS AND DISCUSSION

4.1 Thematic Discussion

4.1.1 Biodiversity and Ecosystem Services

Biodiversity is one of the important characteristics of a traditional Baree. Unlike monocultural agricultural fields, a diversified Baree may contain several types of vegetation, including trees, shrubs, herbs and climbers. Such plant diversity creates habitats for insects, birds and other organisms. In a study by Deb et al. (2014), traditional agroforestry systems in Tripura, Northeast India, were found to be diverse with multistrata composition and high species diversity, supporting biodiversity conservation by creating habitats for various organisms.

The rich biodiversity of a Baree supports several important ecosystem services. It supplies households with fruits, vegetables, spices, medicinal plants, bamboo, fuel and many other everyday resources. At the same time, its diverse vegetation provides shade, regulates the local microclimate, protects the soil and supports nutrient cycling. Birds, insects and other organisms living within the Baree also contribute to pollination and the natural control of crop pests. Cultural services include traditional food practices, medicinal knowledge, aesthetic values and cultural associations with plants. Nicholls and Altieri (2004) reported that diversified agricultural systems like traditional Baree, with multiple layers of vegetation, can reduce crop failure and pest infestations by creating habitats for beneficial organisms, as supported by strategies like intercropping and agroforestry. Thus, the value of Baree extends beyond the market value of its products. Biodiversity itself contributes to the ecological functioning and resilience of the household environment.

The ecological and cultural dimensions of biodiversity available in Baree are also reflected in Assamese Bihu Geet. Mazumdar et al. (2022) documented several folk songs that refer to the presence and spatial arrangement of different plant species within the traditional Baree. For example, "Tamulot bagale, Bareer jalukjupi, Modarot bagale paan" indicates black pepper growing on arecanut and betelvine growing on Indian coral tree. These types of references indicate the traditional practice where trees and climbing crops are combined in the same homestead space. From a socio-ecological perspective, this represents multistoried vegetation, spatial complementarity and efficient utilisation of vertical space, and thus it contributes to the structural diversity of the Baree within a limited space.

Similarly, the song "Bareer pisfale ouu gos ejupi / Lole bor moue baah" refers to an elephant apple tree at the rear of the homestead where bees establish a colony (Mazumdar et al., 2022). This cultural reference illustrates the interaction between vegetation and other organisms within the Baree. Another Bihu Geet referring to bats feeding on litchi fruits, "Bareer lisujoopa

rongakoi pokise / Raati hole baduli pore," indicates the presence of wildlife within the homestead landscape. Although such organisms may sometimes cause crop losses, their presence also demonstrates that Baree functions as a habitat and interaction space for plants, insects, birds and other animals. These cultural references therefore reinforce the understanding of Baree biodiversity as part of a functioning socio-ecological system rather than merely a collection of cultivated plants (Mazumdar et al., 2022).

4.1.2 Food and Nutritional Security

Baree can make an important contribution to household food security by providing diverse food products throughout different seasons. Fruits, vegetables, leafy greens, tubers, spices and traditional edible plants can supplement purchased foods and improve dietary diversity. A study carried out in South African home gardens (Ngcaba & Maroyi, 2021) documented 32 edible plant species including fruits/seeds, leafy vegetables, bulbs, roots, tubers, cereals, herbs and spices; the study revealed that gardens provide diverse, nutritious alternative foods.

The importance of food diversity within the traditional Baree is strongly reflected in Assamese Bihu Geet. Mazumdar et al. (2022) documented several songs referring to a wide range of vegetables and edible plants maintained in the homestead. For example, "Lai r maje maje / Lofa dali dali / Tare majot khutura xaak" refers to lai (mustard greens), lofa (Chinese mallow) and khutura (green amaranth) being grown together in the kitchen garden. The reference demonstrates how different leafy vegetables could be maintained simultaneously within a small homestead space, contributing to dietary diversity and continuous household access to food. These references demonstrate that the traditional Baree was not dependent on a single food crop but maintained a diverse portfolio of edible resources (Mazumdar et al., 2022).

4.1.3 Livelihoods and Economic Contributions

Its contribution to livelihoods occurs through both income generation and expenditure reduction. Surplus products can be sold, while food produced for household consumption reduces expenditure on market purchases. Baree can therefore act as a small but diversified livelihood option. Diversification is particularly important under conditions of uncertainty. Dependence on a limited number of commercial crops can expose households to market fluctuations, pest outbreaks and climatic risks. A diverse Baree provides multiple products and functions, potentially increasing household resilience. Fernandes and Nair (1986) reported that the Baree (homestead garden) can be termed a land-use system where multipurpose trees and shrubs are maintained along with annual and perennial agricultural crops and invariably livestock within an individual Baree system, and the whole unit is intensively managed by family labour. In another study, the main objective of maintaining an agroforestry system in a Baree was reported to be ensuring the availability of multiple products such as food, fuel, vegetables, fruits, fodder, and medicines, besides generating income and employment (Kumar and Nair, 2004).

The livelihood significance of the Baree is also reflected in Bihu Geet. Several of the songs documented by Mazumdar et al. (2022) refer to crops that have both household consumption and income-generating potential. The song "Aagbari suani kakini tamule / Pachbaree suani paan" refers to areca nut and betel vine as prominent components of the homestead where areca nuts are planted in the front side of the home garden and betel vines are planted in the back side. These crops have traditionally provided households with products that can be consumed, exchanged or sold, and thus contribute to household income and financial flexibility.

Similarly, the reference to matured arecanut preservation in songs such as "Poka tamul thook pari moi anilu / Gatot goraboloi buli" illustrates the traditional practice of storage, where ripe areca nuts are preserved under soil for later use or sale. This practice indicates that the Baree was connected not only with production but also with post-harvest management and value retention. Such practices can reduce post-harvest losses and allow households to derive economic value from products beyond the immediate harvesting period (Mazumdar et al., 2022).

The multistoried cropping system such as growing climbers like black pepper and paan (betelvine) on existing trees like modar (Indian Coral tree) also has livelihood implications. This type of cropping system allows multiple products to be obtained from the same limited area. Such vertical diversification can increase the economic productivity of limited homestead land without requiring expansion of cultivated area. Therefore, the livelihood contribution of Baree can be explained in broader terms than direct cash income. The contribution of Baree is the combination of food production, sale of surplus, storage of products, provision of household materials and reduction in market expenditure.

4.1.4 Traditional Knowledge and Human-Nature Coexistence and Resilience

Baree is also an important repository of traditional knowledge. Knowledge related to seed selection, seed preservation, plant propagation, seasonal cultivation, medicinal plants, food preparation and plant use is often transmitted within households across generations. In Assam, among communities such as the Thengal Kacharis, women play a crucial role in managing the Baree and preserving knowledge related to crop selection, multi-layered planting, seed conservation, soil fertility, water management and natural pest control. Practices such as selecting seeds from healthy mother plants, recycling kitchen and farm waste, applying ash and fish-wash water to crops, conserving rainwater and storing seeds in bamboo containers demonstrate an effective use of locally available resources (Barooah & Pathak, 2009). Their study also discussed that in rural Assam, people traditionally stored seeds above the fireplace (termed Dhuachang in Assamese) and in bamboo containers. Scientifically, this type of storage may reduce moisture and limit fungal and insect damage. In the traditional Baree system, household practices are shaped by an awareness of seasonal changes; certain traditional customs generally discourage operations such as harvesting during flowering or eating fish during the monsoon. Rooted in cultural beliefs, these practices scientifically give plants and aquatic species enough time to reproduce and renew their populations. Barooah and Pathak (2009) found that Thengal Kachari women played a central role in preserving and passing on this knowledge, especially in crop management, seed conservation, post-harvest practices and the careful use of Baree resources. The Baree, therefore, is more than a household garden. It is a living system where traditional knowledge supports biodiversity, soil fertility, climate resilience and household food security.

The contribution of Baree to human well-being is multidimensional. It provides material benefits such as food and income, physical benefits through access to fresh and diverse foods, and social and cultural benefits through knowledge sharing and traditional practices. The presence of vegetation around the household can also provide aesthetic and psychological benefits and strengthen people's connection with nature. A study conducted in Sivasagar district by Das et al. (2024) showed how the traditional Assamese Baree reflects the close relationship between people and nature. In homestead gardens of rural Assam, people maintain a wide variety of fruit trees, vegetables, medicinal plants and other useful species, which provide food, medicine, shade, income and materials for daily use. This diversity also helps households cope with environmental and economic difficulties by offering different foods and livelihood options throughout the year. Such support is particularly important in flood-prone areas. However, the study noted that market-oriented farming and other modern influences are gradually replacing indigenous plants and traditional practices, leading to the loss of both biodiversity and local knowledge. Conserving the Baree is therefore important for sustaining human-nature coexistence and strengthening the resilience of rural households in the face of change.

If we observe the Baree system from the perspective of resilience, the diversity of plants maintained in the Baree, combined with knowledge of their seasonal availability, uses and management, provides households with multiple options during periods of environmental or economic stress. As documented by Mazumdar et al. (2022), the Bihu song "Bharalar tupate kerela bagale, komora bogale salat," meaning "the bitter gourd vine climbs over the granary, while the ash gourd spreads across the roof," offers a simple picture of how food crops were traditionally grown around the homestead in rural Assam. This may also suggest that crops grown in the Baree served as readily available sources of food during difficult times. This role becomes especially important in flood-prone areas of Assam. When fields are inundated and roads or markets become temporarily inaccessible, the vegetables, fruits and other resources available within the homestead can provide much-needed support to the household.

Birds, insects, squirrels and other small animals are a familiar part of homestead ecology. Although they may occasionally damage crops, their presence is not always harmful. Many of these organisms pollinate flowers, disperse seeds and participate in food-web relationships that help keep the ecosystem functioning. A Baree, or homegarden agroforestry system, is particularly suitable for such fauna because its diverse, multilayered vegetation provides food, shelter, nesting materials and breeding sites throughout the year (Griffith, 2000; Kehlenbeck & Maass, 2004).

The Baya Weaver (*Ploceus philippinus*) offers a useful example. Research suggests that homegardens can provide this bird with water, feeding areas, nesting materials and appropriate host trees. Its survival is also encouraged when household members are willing to tolerate and protect wildlife. Thus, even within landscapes shaped and managed by people, homegardens can serve as small but meaningful spaces for conservation (Yashmita-Ulman et al., 2017).

The relationship between people and other organisms in a Baree, therefore, cannot be understood simply in terms of whether a species is "beneficial" or "harmful." A socio-ecological perspective offers a more balanced understanding by considering both the effects of wildlife on household livelihoods and its wider role in maintaining the ecosystem.

4.2 External Drivers for Changing Baree and Emerging Threats

In recent years, the Baree agroforestry system has undergone a significant decline as a result of multiple external pressures. These include the effects of climate change, rapid urbanization, changing land-use patterns, population growth, conversion of household land for construction, replacement of diverse crops by economically preferred species, migration, and loss of traditional ecological knowledge and use of external inputs. Studies reveal that plant and animal species and the nature of land-use practices have undergone significant changes in recent years. As reported by Saha et al. (2022), this change is accelerated by many factors including growing population pressure and changing behaviour and perceptions of rural people under the influence of modernisation and urbanization. As families grow and settlements expand, homestead land is often divided, reduced or converted for housing and other purposes. The remaining space may be used for a smaller number of commercially valuable crops, replacing the diverse mixture of trees, vegetables, medicinal plants, spices and livestock traditionally maintained in the Baree. A comparable change was observed by Prihatini et al. (2018) in West Java, where population growth and the growing influence of the market economy contributed to the conversion of traditional homegardens into commercially oriented systems. Although this conversion increased household income in some cases, it simplified vegetation structure and reduced several ecological and socio-cultural functions. Other studies also reveal that under the threats of population pressure, migration and commercialisation of agriculture, the homestead gardens of Assam are declining in productivity, agrobiodiversity and socio-economic importance (Kumar and Nair, 2004; Patric et al., 2020), and many indigenous plant species are on the verge of extinction (Bargali et al., 2016; Vibhuti and Bargali, 2019).

4.3 Research Gaps and Future Directions

Despite its importance, Baree remains relatively underexplored as an integrated socio-ecological system. Future research should focus on:

- 1) Documentation of plant diversity and associated biodiversity.
- 2) Economic valuation of both marketed and household-consumed products.
- 3) Links between Baree diversity and household nutrition.
- 4) Women's role in Baree management and knowledge conservation.
- 5) Contribution of Baree to climate resilience.
- 6) Human-wildlife interactions and ecological coexistence.
- 7) Changes in Baree biodiversity under urbanisation and commercialisation.

V. CONCLUSION

The discussion demonstrates that the Baree system is much more than a space for homestead farming. It is a living socio-ecological system in which people, plants, animals, birds, and other organisms coexist and interact. Through these interconnected relationships, rural households obtain food, nutrition, livelihood support, and social security. The system also helps preserve and transmit indigenous agricultural knowledge, much of which continues to be practiced by rural communities across Assam. Furthermore, rural homesteads in Assam serve as important repositories of diverse plant species and local biodiversity. These features make the Baree a multifunctional socio-ecological system with considerable potential to strengthen rural livelihoods. Greater recognition and institutional support for Baree-based activities could create local employment and income-generating opportunities, including for migrant youth who wish to return to or remain connected with their communities. From the above discussion, it can be concluded that conceptualizing the Baree as a socio-ecological system offers a more comprehensive foundation for rural development and agroecological planning. Strengthening the Baree system could also give rural youth a reason to take an interest in their homestead garden. With training, access to markets and support for small enterprises, young people could turn Baree-based activities into viable work close to home. That may help reduce migration driven by a lack of local opportunities. Thus, strengthening the Baree can build a more sustainable and resilient rural Assam.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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