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The Impact of Shifting from Subsistence to Cash Crops on the Livelihoods of the Soliga Tribe in India

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Abstract

Efforts to protect and conserve nature are essential worldwide. However, in many protected forests, local communities have lived for centuries, relying on the environment for food, income, shelter, and cultural practices. Conservation regulations often impact their livelihoods. This study examines the challenges and opportunities for sustaining the livelihoods of Soliga tribe farmers in Biligiri Ranganatha Swamy Temple (BRT) Tiger Reserve, South India. A participatory workshop with five researchers and 25 diverse farmers (male, female, young, and old) discussed: a) current agricultural and livelihood practices; b) key drivers of land-use changes; and c) necessary actions for sustainable livelihoods. Findings showed that shifting from traditional subsistence crops to cash crops like coffee, pepper, and floriculture reduced food availability but increased cash income. Non-timber forest products such as honey, berries, nuts, and firewood significantly supplemented household needs. Challenges included low coffee yields due to disease and poor soil, changing rainfall patterns, limited land, and wildlife crop damage. The forest conservation policies enforced during the recent decades have limited their access to resources and traditional lands, affecting their food security and economic stability. Additionally, limited access to education and employment opportunities restricts their social and economic mobility. Ongoing research and support are needed to enhance sustainable farming techniques such as mulching, composting, intercropping, integrated pest management, and controlling *Lantana* spp. to achieve resilient farming systems.

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Introduction

The conflict between humans and the wild is an age-old struggle that has evolved as human civilization expanded and encroached upon forests and natural habitats of wildlife. The clash between these two forces underscores the complex relationship between humans and the environment. The expansion of human settlements, agriculture, and infrastructure has led to the destruction of natural habitats, pushing many wild animals to the brink of extinction.[1] As a result, conflicts between humans and wildlife have become increasingly prominent as wild animals are forced to compete for resources in dwindling natural landscapes.[2] Efforts are necessary for protection and conservation of nature in many parts of the world. On the other hand, human-wildlife conflict also arises when wild animals encroach upon human territories, causing damage to crops, livestock, and property and are still very common in India.[3] This often leads to retaliatory killings and endangerment of wildlife populations. However, in most protected and reserved forest areas, local people have been living for centuries and they depend their livelihood on the surrounding environment for various services such as food, income, shelter and continuation of culture and traditions. In nature reserves in South India, human-wildlife conflict still occur despite the protected status of these areas.[4] Ultimately, the goal is to find a balance that ensures the conservation of wildlife while also addressing the legitimate concerns and vulnerabilities of communities living in and around the nature reserves in South India.

Agriculture in nature reserves can pose several challenges and concerns. While agriculture is essential for food production and livelihoods, it can have negative ecological impacts when practiced within protected areas. Common problems associated with agriculture in nature reserves are habitat destruction, soil degradation, pollution, introduction of invasive species, fragmentation of habitats etc.[5,6] Addressing these problems requires a balanced approach that considers both agricultural needs and conservation priorities. Sustainable agriculture practices, such as agroforestry, organic farming, and integrated pest management, have the potential to minimize negative impacts and promote the coexistence of agriculture and nature reserves. Agroecology in nature reserves involves applying ecological principles to agricultural systems within protected natural areas. This approach seeks to integrate agricultural production with the conservation and restoration of ecosystems, promoting sustainable and regenerative practices that support both biodiversity and food production.[7] Agroecological practises can enhance the resilience of natural ecosystems within reserves, promoting ecological stability and adaptability in the face of environmental challenges such as climate change, habitat fragmentation, and invasive species.

In many rural areas of India, subsistence farming and cash crop cultivation coexist, often practiced by different households or within the same farming community. Subsistence farming provides food security and self-sufficiency for rural families, while cash crop cultivation offers opportunities for income generation and market participation. However, there can be challenges associated with over-reliance on cash crops, such as risk to household's food security, vulnerability to market dynamics and environmental sustainability issues related to intensive cultivation practices.

A good example for human living in harmony with nature for generations is the Soliga tribe who nestled in the lush forests of southern India. Many of them are concentrated in the Biligirirangana Hills. The region is called Biligiri Ranganatha Swamy Temple (BRT) Wildlife Sanctuary (see Fig. 1) located in Chamarajanagar district of Karnataka State. This region with an area of 540 km^2 and located at an elevation 1550 metres above sea level was declared as a protected Wildlife Sanctuary in 1972 and as a Tiger Reserve in 2011 in pursuit of conservation of the rich flora and fauna biodiversity found in this region.The Soliga tribe has a strong cultural heritage deeply connected to the forests they live in, with customs and traditions that honor nature and reflect a deep respect for the environment.[8] They worship nature gods who are believed to protect their lands, and celebrate festivals such as "Budde Habba" through dances, music, and offerings to the forest spirits. Their society values a communal lifestyle, strong social bonds, and respect for elders, while they pass down traditional knowledge, like using medicinal plants and forest resources, through generations, promoting harmony with nature.[9] In recent times, the conservation goals along with modernization and external pressures have implications on local people's way of life, leading to changes in livelihood activities, erosion of their

cultural heritage and the degradation of their natural habitat.[8,10] It is crucial to find solutions that prioritize the long-term preservation of biodiversity and the ecosystem services provided by nature reserves while also supporting the needs and livelihoods of local communities involved in agriculture. However, there is limited knowledge about the implications on sustaining livelihood among farmers of Soliga tribe in the BRT Tiger Reserve in response to changes in socio-political and bio-physical conditions.

A diagnostic study will help to understand and plan for sustainable land use and responsible wildlife management, to minimize the impact of human-wildlife conflict and improve livelihood in this nature reserve.

Through a participatory stakeholder discussion, the study aims to

- Evaluate the effect of current agricultural practices on livelihood of Soliga tribe
- Identify key drivers for changes in land use and socio-economic conditions, and
- Determine possible needs and actions required to promote sustainable livelihood

Materials and Methods

A participatory rural appraisal (PRA) workshop was carried out with 25 stakeholders from the farming community along with five researchers from Ashoka Trust for Research in Ecology and the Environment (ATREE) field station in the BRT Tiger Reserve in September 2023. Invitations were sent out to different villages residing in the Tiger Reserve and farmers belonging to both sexes and in different age groups attended the workshop (see Fig. 2). The workshop was conducted in local language and with the help of interpreters; information was freely exchanged between all the participants.

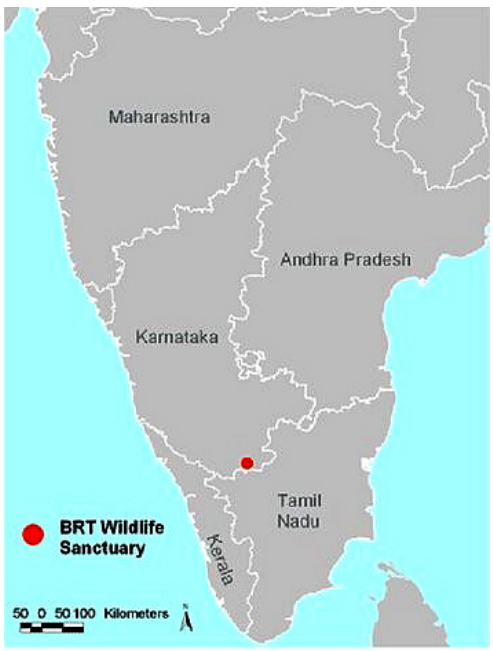

Fig.1: Map of South India indicating the study location[10]

Fig. 2: Participatory workshop at BRT Tiger Reserve in 2023 involving different gender and age group (Picture taken by ATREE staff)

Using PRA tools was ideal for engaging the Soliga tribe in the BRT Tiger Reserve, as it allowed for gathering in-depth information that are grounded in local knowledge and experiences. We chose the following four PRA tools to ensure that the assessment reflects the local participants'

perspectives and encourages active participation, making the findings more accurate and actionable.

- Focused group discussions encourage collective insights into current livelihood practices and challenges, fostering open communication within the community
- Historical timeline provides a way to identify and understand long-term changes and key events that have shaped their agricultural practices and lifestyle
- Identification and ranking of future opportunities and challenges helps prioritize areas of concern and aspirations, making planning more targeted and relevant to the tribe's needs, and
- Identification of needs and interventions for adopting agroecological practices supports the co-creation of feasible, community-driven solutions for sustainable agriculture.

All the participants took part in the workshop actively. The moderators also did probing of the information by asking follow-up questions and made sure that voices (answers, comments) of all the participants were heard equally.

Results and Discussion

The following sections describe the current livelihood practices, problems, drivers for changes in the nature reserve and possible solutions to addresses the challenges faced by both the Soliga tribe and the wildlife in the BRT Tiger Reserve.

Management of Current Agricultural and Livelihood Activities

Despite the ease of growing subsistence crops like millet, sorghum, and pulses, their cultivation has significantly declined over the past two decades. Currently, farmers report focusing more on cash crops such as coffee, black pepper, flowers, fruit plants, and turmeric. Only about 25% of the land is now used for growing subsistence crops like millet, pulses, and pumpkin, with the majority devoted to cash crops within the Podus or settlements. Outside forest areas, the Soliga primarily cultivate coffee and pepper. This shift has resulted in low diversity of subsistence crops, which are typically not sold in the market but exchanged among villagers, fostering strong social bonds and mutual support.

Participants noted that a significant portion of their staple foods, such as rice, sugar, pulses, and cooking oil, are provided at reduced prices through government programs and schemes. This shift from subsistence crops to cash crops presents a challenging trade-off. While cash crops provides immediate income, they often replace diverse subsistence crops that are crucial for local food security. This switch have made the community more dependent on subsidies, market fluctuations, reducing their resilience to price changes and external economic pressures. Additionally, as reported by the respondents, these new cash crops require new knowledge and management practices, which strain local resources (especially as soils fertility declines) and impact the sustainability of traditional practices. Balancing income from cash crops with the cultivation of subsistence crops seems to be essential for the Soligas to maintain both food security and ecological stability in the long term. Similar trends have been observed in Northeast India, where shifts in land use among forest-dwelling communities have promoted cash-crop cultivation, encouraged mono-cropping practices, altered dietary habits, and exposed farmers and consumers to market volatility, impacting food security.[11,12] As government provisions are insufficient for year-round food security, families purchase additional food from markets in Yelandur and Marali, including almost all vegetables.

This reliance on external markets for vegetables and other staples increases vulnerability to price fluctuations and food availability, potentially undermining household food security.[13] However, another study[14] reported contrasting findings which indicated a positive relationship between cash crop farming, such as cocoa, household crop income, and food security, suggesting that the impact of cash crops on food security may vary by context.

The workshop participants reported that they practice agroecological farming, avoiding agrochemicals by using ash from burning plant biomass to improve soil fertility and plant litter for composting and mulching. They prefer natural farming methods because they believe agrochemicals degrade the soil and lack the financial resources to purchase seeds and other external inputs. However, they also noted a decline

in soil fertility due to insufficient organic fertilizers. Many villagers maintain their own seed banks for certain crops.

Several participants highlighted the benefits of the Malabar plum (*Syzygium cumini*), which provides shade for coffee trees, fruits for household consumption, and additional cash income from selling the fruits. They have reported increased cash revenue since transitioning to coffee and pepper production. However, cropping patterns have also changed due to increased wildlife populations in the BRT, such as wild boars, which damage crops. Consequently, they have shifted from food crops to horticultural crops.

In addition to agricultural activities, the Soliga Tribe collects non-timber forest products (NTFP) like honey, wild berries, and soap nut (*Sapindus* spp.). These products are either sold for cash or exchanged for staples such as rice, sugar, wheat, and pulses. The bark of certain trees (e.g., *Senegalia rugata*) is collected from the forest or agricultural land and used for washing and bathing. This aligns with findings in another study in North-East India[15] that NTFPs are a vital source of income and livelihood for people living in nature reserves, emphasizing the importance of sustainable management and harvesting.

The participants noted a clear division of labor within their households. Men were primarily involved in agriculture, selling crops, collecting non-timber forest products (NTFPs), and purchasing household necessities. Women mainly handled cooking, washing, cleaning, and also participated in NTFP collection and coffee and pepper cultivation. Children contributed by collecting honey and firewood, weeding in family agricultural plots, and herding small ruminants.

Parents with small or no land holdings expressed hopes for their children to receive education, migrate to towns for stable jobs, and support the family financially. In contrast, larger landholders preferred their children to stay and help expand the family farm business. It was reported that about 75% of the children attend school, but many drop out after the 7th grade. These dropouts sometimes idled and became a nuisance, although some helped with household chores and agricultural activities.

The general sentiment was that young people were reluctant to engage in agriculture and faced limited job opportunities. This lack of employment for young people is a significant social and economic issue in many rural areas of India, leading to various social problems.[16] To address this issue, it is necessary to provide education and create new job sectors in rural areas, including agriculture, allied activities, and other sectors such as manufacturing and hospitality. Despite the favorable conditions for growing subsistence crops like millet, sorghum, and pulses, these crops are not cultivated extensively due to limited land availability.

Key Drivers for Changes in Land-Use and Socio-Economic Condition

Farmers revealed that before the introduction of coffee and pepper 30-40 years ago, they grew a variety of subsistence crops such as finger millet, sorghum, maize, various pulses (*e.g.*, pigeon pea), banana, mustard, pumpkin, and sweet potato. A significant change occurred in 1971 when the region was designated as a wildlife sanctuary. Since then, slash-and-burn agriculture, also known as shifting cultivation, has been banned, leading the Soliga tribes to adopt cash crops like coffee and pepper.

The Soliga believe that shifting cultivation helped them control pests and diseases in crops, facilitated seed dormancy, and supported the regeneration of plants for both animals and humans. Numerous studies have reported the benefits of slash-and-burn agriculture for controlling weeds and pests and improving soil fertility by releasing nutrients.[17,18] However, other research highlights its negative impacts on species biodiversity,[19, 20] beneficial soil microorganisms,[21] and its contribution to climate change.[22]

The participants expressed concerns about the spread of Lantana (*Lantana camara*), an invasive species introduced as an ornamental plant during British rule, which has since proliferated, displacing native vegetation. Lantana now covers approximately 40% of the Reserve area, reducing the availability of food for herbivorous wildlife due to its toxicity. This scarcity forces wild animals to encroach on agricultural lands in search of food, leading to crop damage. Additionally, Lantana's dense, impenetrable thickets limit movement and resting spaces for wildlife and restrict access for

local forest-dependent communities to non-timber forest products (NTFP), impacting their livelihoods.[9]

Another study[23] reported similar findings, noting that the spread of Lantana has increased since the ban on slash-and-burn agriculture in the BRT Tiger Reserve. The dense Lantana bushes obstruct visibility, close off the grassy understory, and force wildlife such as tigers and elephants to use the same forest paths as people, heightening the risk of human-wildlife encounters. However, Lantana has recently been repurposed for making furniture, baskets, and other items, providing a new source of cash income for farmers.[24]

When the Soliga began practicing settled agriculture, they started using the same patch of land intensively year-round for producing both staple and cash crops. Traditionally, the Soligas grow their crops without agrochemicals or tillage, but they acknowledged that the amount of organic fertilizers used was insufficient, leading to declining soil fertility. They also noted the abundance of leaves and plant litter available for composting or mulching but lacked the knowledge or technology to utilize these resources effectively.

Pests and diseases have begun to affect coffee and other staple crops, and the farmers expressed a desire for organic pesticides, ideally made from locally available resources and herbs. Table 1 outlines the key drivers of change in the study region reported by the workshop participants.

The introduction of metal agricultural implements and bullock-ploughing has led to more intensive soil tillage for weeding and sowing, further altering traditional farming practices.

Table 1: Timeline of important events in the BRT Tiger Reserve obtained from the workshop.

Timeline	Important Events
3 generations	Practice shifting agriculture using slash and burn method
50 years ago	Settled Agriculture on fixed area after the declaration of Wildlife sanctuary. Restrictions, Resettlement and migration. Prior to this, about 1075 acres were used as a common agricultural/forest area for economic activities/ collection of NTFP
30-40 years ago	Introduction of Coffee and pepper with loans and supports. Introduction of agricultural equipment
1990	Access to markets of NTFP via Large Adivasi Multipurpose Cooperative Society (LAMPS)
25 years ago	Rice and finger millets were tried, but did not succeed due to damage by wild boars and other herbivores. Started using bullocks for farm operation *e.g*. ploughing, transporting. Lantana cover increasing
15 years ago	New restrictions based on wildlife protection act
12 years ago	New businesses *e.g*. shops and restaurant catering to the tourist coming to Tiger Reserve. More than 1000 families got land ownership right. Won rights to collect and sell NTFP
10 years ago	School started with Vivekananda GirijanaKalyana Kendra (VGKK). Designated as Tiger Reserve. Started selling directly through a community cooperative brand called Adavi. Horticulture department started training on coffee and pepper growing, processing and marketing. Acute problem with Lantana (covering nearly 40% of Reserve area in 2021).

Workshop participants also reported another significant change in socio-economic conditions: while coffee and pepper cultivation have brought increased cash income, they have also led to greater dependency on government schemes for household staples. Due to limited agricultural land and restrictions on

expansion, many young people are unable to find work in agriculture, leading to unemployment or migration in search of jobs.

Training provided by Vivekananda Girijana Kalyana Kendra (VGKK) and the government's forest and horticulture departments has equipped the Soligas with essential knowledge, enabling them to use their land and forest resources more sustainably. The establishment of LAMPS (Large Adivasi Multi-Purpose Societies) and their cooperative brand "Adavi" has facilitated direct sales of agricultural products and NTFPs to larger cities, providing higher income compared to local markets. However, this access to external markets has also increased competition among them for resource collection.

Possible Needs and Actions Required to Promote Sustainable Livelihood

The villagers face significant challenges such as declining soil fertility, increased pest and disease incidence, and highly variable climatic conditions in recent years. Farmers express a keen interest in learning techniques like mulching, composting, and intercropping to address these challenges. They recognize the need to diversify their crops further to enhance self-reliance and resilience against external factors such as climate change, pest attacks, and price fluctuations. However, limited knowledge and financial constraints hinder their ability to acquire seeds, particularly for vegetables like eggplant and tomato.

Another significant constraint is the scarcity of agricultural land and land ownership, which precludes access to loans and government schemes for farm expansion. This land tenure system, akin to that observed in nature reserves in Madagascar,[25] contributes to improper forest management and land degradation, mirroring the challenges faced by villagers in the BRT Tiger Reserve. Despite these obstacles, farmers aspire to increase honeybee boxes/hives and expand horticulture crops like jackfruit and sapota (*Manilkara zapota*) in forest land, although they encounter challenges posed by elephants. Policy interventions for the Soliga tribe focusing on securing land rights and access to forest resources are essential for the continuity of their traditional livelihood and cultural practices. The specific needs identified by workshop participants to enhance their capacity, income, and well-being are detailed in Table 2.

Table 2: Participatory identification and Priorities of Needs to improve capacity, agriculture, income and well-being (created by the authors based on information provided by the workshop participants)

Rank	Needs to improve capacity, agriculture, income and well-being
1	More land for expanding agri/cultivation
2	Trenches for protection from Elephants and wild boar
3	Training on different cropping and soil management techniques
4	Education to kids / Access to schools with Employment generation
5	Guidance and training programmes/pilot plots to carry forward with research
6	Provide support to pest control by neem oil, neem cake, other organic products
7	Fetches better prices for cash crops in the future
8	Access to Sal trees for extraction of herbal resin 'Sambrani' (Gum benzoin)
9	Improve the growing technique of coffee, black pepper and fruit trees and support their marketing
10	Litter fire to be allowed (permission from Forest Dept)
11	To encourage and support to kitchen gardens to cultivate vegetables
12	Apis cerana honey bee keeping training and support for more bee boxes

A significant discovery was the pervasive threat posed by Lantana to the villagers, as its uncontrolled spread hindered the growth of new fruit trees and plant seedlings. Participants observed that Lantana's dense understory cover was so extensive that even elephants struggled to navigate through,

increasing the frequency of encounters between humans/domestic animals and wildlife. Other authors [26] corroborated these findings, highlighting how Lantana's spread reduces forage availability, restricts movements of humans and livestock, and limits access to native medicinal plants in Tanzania. Implementing controlled burns of forest litter, a practice employed prior to the area's designation as a nature reserve, could potentially curb Lantana's spread. However, alternative methods to control and/or utilize Lantana are also needed. Policies supporting kitchen gardens to reduce reliance on purchased vegetables and rural employment schemes, particularly for youths engaged in cultivating their own agricultural gardens, are crucial for improving the villagers' livelihoods. Policies that support sustainable harvesting of non-timber forest products and recognize their traditional knowledge in forest management are essential. Additionally, ensuring access to education, healthcare, and alternative livelihood opportunities is crucial to improving their quality of life while preserving their cultural identity.

Conclusion

The findings highlight significant trade-offs faced by the community between economic gain and food security, as well as between wildlife conservation and local livelihoods. Shifting to cash crops has increased cash income for villagers, but it has also heightened their dependence on purchased food, affecting food sovereignty. Additionally, conservation policies aimed at protecting wildlife have restricted access to natural resources, challenging traditional ways of life and economic activities. These trade-offs underscore the need for balanced, community-informed policies that support both protection of nature and the socio-economic well-being of local communities. Engaging local community members and providing alternative livelihood options can help mitigate human-wildlife conflicts and garner support for conservation efforts. Conservation education and awareness programs can also play a crucial role in fostering a culture of coexistence and stewardship among local residents.

It is important to conclude that every reserve may have its unique set of challenges, and addressing these issues requires tailored strategies that consider the specific socio-economic, environmental, and cultural contexts of the area. Policies promoting agroecological practices and offer financial or technical support can help the Soliga transition to sustainable farming methods, improving their food security and resilience against environmental changes. There is a need for continued research and targeted interventions to enhance farmer's knowledge and skills for sustainable farming techniques such as mulching, composting, intercropping, integrated pest management and effective control of *Lantana* spp for building resilient farming systems that sustain both livelihoods and environmental protection.

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Conflict of Interest

The authors do not have any conflict of interest.

Data Availability Statement

The manuscript incorporates all datasets produced or examined throughout this research study.

Ethics Statement

This research did not involve human participants, animal subjects, or any material that requires ethical approval.

Informed Consent Statement

Consent for using pictures and information in the workshop was taken from all participants prior to start of the workshop.

Author Contributions

- **Chongtham IR and Badiger SM:** Formulated the objectives of the project and applied for the project. Badiger took notes, contributed to questions for in-depth discussion in the workshop and contributed in results analysis. Chongtham IR was responsible for drafting the manuscript, analysis of data and coordination of the writing process.
- **Shahi S:** Contributed in workshop organization, provided input while deciding the themes of

discussion in the workshop and contributed to summarizing of results and writing of the manuscript.

- **Chikkanjegwoda M and Boraiah:** Main responsible for gathering the workshop participants, animated the workshop as they speak local language, translated the workshop discussion and provided input and feedback in the results and discussion section of the manuscript.

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