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Short Communication
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Sericulture for Sustainable Livelihood, Where Humans and Elephants Co-exist in Karnataka, India

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Introduction

Two-thirds of the global Asian elephant (*Elephas maximus*) population is in India, and the elephant is regarded as the country's 'National Heritage Animal'. Elephants are found in 32 Elephant Reserves in northeast, central, northwest, and south India, covering 65,270 km^2 of forest (MoEF 2019). Of the total Indian wild elephant population, 44% is in southern India. The state of Karnataka has witnessed a remarkable increase in the elephant population with the number of elephants increasing from an estimated 6,049 in 2017 to 6,395 in 2023, making it the State with the highest elephant population in the country (KFWD 2023).

Human-elephant conflict (HEC) arises due to land use change, habitat fragmentation, and increase in cultivation, settlements, and livestock grazing (Nelson *et al*. 2003). About 400 humans and 100 elephants are killed each year in India due to HEC, while agricultural losses affect nearly 500,000 families (MoEF 2010). The most common type of HEC incident is crop raiding.

Sericulture is a low-investment, environmentally friendly, and high-income-generating enterprise that includes on-farm (mulberry cultivation), off-farm (silkworm rearing), and industrial (reeling and spinning of silk) activities. Sericulture can be used for rural poverty alleviation as it offers a periodic income throughout the year and generates home-based employment opportunities for marginal and small farm holdings. India is the second-largest producer of silk in the world after China. In India, sericulture has traditionally been practiced in Karnataka, Tamil Nadu, Andhra Pradesh, and West Bengal, and to a lesser extent, in the temperate areas of Jammu and Kashmir. Karnataka is India's major sericulture state, accounting for 40 % of the country's total mulberry silk production (CSB 2022). Mulberry (*Morus* spp.) is mainly cultivated for the sericulture industry, as the leaves constitute the only food source for the silkworm, *Bombyx mori*. Also, the mulberry fruit can be used to make jams, juices, and fruit wines. Besides many pharmaceutical uses, mulberry leaf may be used as a beverage (Wen *et al*. 2019). The leaves can also be used as a supplement for dairy cattle and as primary feed for sheep, goats, and rabbits. Here we report on an assessment of sericulture for sustainable livelihood in the boundary villages of the Cauvery Wildlife Sanctuary (CWS), Karnataka, where elephants regularly raid crops.

Methods

The study was conducted from 2017 to 2021 in selected boundary villages of the CWS. There were 46 villages along the CWS boundary, of which 31 villages were selected for the study, based on the presence of sericulture. The distance between the boundary and selected villages ranged from 200 m to 7 km. The CWS lies in the districts of Ramanagara, Mandya, and Chamarajanagar. The average temperature of the study area ranges from 20–38°C, with summer temperatures reaching 40°C. Rainfall occurs during both the Northeast and Southwest monsoons, with an annual rainfall of 750–800 mm. Data on crops damaged by elephants were recorded in the study area from 2017 to 2021 through field visits, in-person interviews, and phone interviews with farmers. The area of mulberry cultivation was obtained from the Sericulture Departments of each district.

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Figure 1. Sericulture activities.

Results and discussion

The study villages were in areas that traditionally practiced sericulture (Fig. 1), with sericulture farmers constituting from 3–51% of the village population. We observed losses of agricultural, horticultural, and dairy forage crops due to raiding by elephants in the selected villages (Fig. 2). However, elephants did not raid or damage the mulberry plants (Table 1). Mulberry is a foliage crop for many species of livestock but is not preferred by elephants (Kumara & Yogendra 2022).

Mulberry is a high-biomass foliage plant and under irrigated conditions, the leaf yield is more than 60,000 kg/ha/year. Mulberry is propagated through cuttings, is comparatively resistant to environmental fluctuations and grows in tropical and sub-tropical climates and in different soil types. It can be cultivated both under rainfed and irrigated conditions. Therefore, it has wide application as a crop species.



Figure 2. Crop raiding elephants.

Role of sericulture for sustainable livelihood

The cultivation area of mulberry has been increasing in two of the three districts of CWS (Fig. 3). The increase of mulberry cultivation is mainly due to its high-income generation, and the absence of damage from elephants is an added advantage. Mulberry sericulture can provide farmers with an income of 961 – 1,561 $/acre/crop from the sale of cocoons and provide five to six crops per year.

Sericulture also offers many employment-generating activities such as silk reeling, silk weaving, and handicraft manufacturing from waste cocoons, and women are involved in almost all the activities. Therefore, mulberry cultivation and sericulture could help prevent and mitigate HEC and improve the livelihood of people in areas with elephants, while also providing many social benefits.

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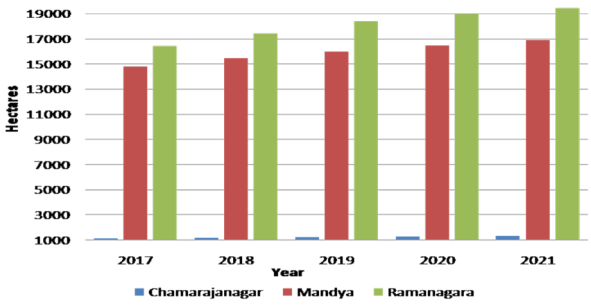


Figure 3. Mulberry cultivation area in hectares from 2017 to 2021 in the study districts.

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Table 1. Crop plants in the surveyed area and damage (D) by elephants from feeding, trampling or breaking.

Common name	Scientific name	D*
Aloe vera	*Aloe barbadensis*	D
Amaranth	*Amaranthus* spp.	D
Amla	*Emblica officinalis*	D
Areca nut	*Areca catechu*	D
Ash gourd	*Benincasa hispida*	D
Banana	*Musa* spp.	D
Bean	*Phaseolus vulgaris*	D
Betelvine	*Piper betle*	D
Black-eyed bean	*Vigna unguiculata*	D
Bottle gourd	*Lagenaria siceraria*	D
Brinjal	*Solanum melongena*	D
Cashew nut	*Anacardium occidentale*	D
Castor	*Ricinus communis*	D
Chili	*Capsicum* spp.	D
Chrysanthemum	*Chrysanthemum indicum*	D
Coconut	*Cocos nucifera*	D
Coriander	*Coriandrum sativum*	D
Crossandra	*Crossandra infundibuliformis*	D
Cucumber	*Cucumis sativus*	D
Custard apple	*Annona reticulata*	D
Dolichos bean	*Lablab purpureus*	D
Garlic	*Allium sativum*	D
Ginger	*Zingiber officinale*	D
Ground nut	*Arachis hypogaea*	D
Guava	*Psidium guajava*	D
Holy basil	*Ocimum tenuiflorum*	ND
Horse gram	*Macrotyloma uniflorum*	D
Jack fruit	*Artocarpus heterophyllus*	D
Jasmine	*Jasminum* spp.	ND
Lemon	*Citrus limetta*	D
Lemon grass	*Cymbopogon* spp.	ND
Maize/corn	*Zea mays*	D
Mango	*Mangifera indica*	D
Marigold	*Tagetes* spp.	D
Mint	*Mentha piperita*	D
Moringa	*Moringa oleifera*	D
Mulberry	*Morus* spp.	ND
Napier	*Pennisetum* spp.	D
Okra	*Abelmoschus esculentus*	D
Onion	*Allium cepa*	D
Paddy/rice	*Oryza sativa*	D
Papaya	*Carica papaya*	D
Pigeon pea	*Cajanus cajan*	D
Pomegranate	*Punica granatum*	D
Pummelo	*Citrus maxima*	D
Pumpkin	*Cucurbita pepo*	D
Ragi / finger millet	*Eleusine coracana*	D
Ridge gourd	*Luffa acutangula*	D
Rose	*Rosa* spp.	ND
Sapota	*Manilkara zapota*	D
Sesame	*Sesamum indicum*	D
Sorghum / jowar	*Sorghum* spp.	D
Spinach	*Spinacia oleracea*	D
Sugar cane	*Saccharum officinarum*	D
Sweet potato	*Ipomoea batatas*	D
Tamarind	*Tamarindus indica*	D
Tomato	*Solanum lycopersicum*	D
Tuberose	*Polianthes tuberosa*	D
Turmeric	*Curcuma longa*	D
Watermelon	*Citrullus lanatus*	D

* D = damaged; ND = not damaged