# FIELD FORESTER

## VOICES FROM THE FIELD

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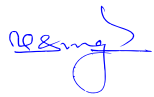
# Contents

# From the Chief Editor's Desk

The Directorate of Forest Education has always endeavoured to document and publish good practices and experiences related to forestry, wildlife and allied subjects through the educational journal 'Field Forester.' Keeping in line with the tradition, the current issue of Field Forester is also enriched with articles reflecting experiences, best practices and success stories from different parts of the country.

The November 2016 issue primarily focuses on wildlife with eight articles reflecting wildlife management and conservation in India. The authors have covered topics like *Ex-situ* conservation, rescue and rehabilitation of wild animals, man-animal conflicts and habitat management in the field of wildlife management. The issue also includes articles on forests, bio-diversity and people. An article on the innovative 'Forest Food Festival' show cases the importance of NWFPs in ensuring nutrition of forest dependent population. The impacts of much discussed *Prosopis juliflora* on environment and livelihoods has been summed up in one article while the socio-economic aspects of broom stick cultivation in Mizoram hills is lucidly narrated in another article. The role of community in conservation is highlighted by an articles on Community Forest in Mizoram and Tribal participation in conservation efforts in Andhra Pradesh. An award winning example of convergence of various schemes for afforestation works in rural areas of Andhra Pradesh is elucidated in the article 'Convergence for Greening Rural Areas.'

The present issue of Field Forester has brought together articles that throw light on various success stories worth being replicated as such or with local adaptations in other parts of the country. The authors have thoroughly presented their topics in a clear and crisp language which is appreciable. I hope the readers will definitely get enlightened by this issue of Field Forester.



**(R.P. Singh, IFS)**

# Ex-situ conservation of Nicobar Pigeon at Ahmedabad zoo

*The detailed breeding and care programme being followed by the Kamala Nehru Zoological Garden has seen an increase in the number of pigeons*

**Patel Priyank Hasmukh Kumar**

The Nicobar Pigeon (*Caloenas nicobarica*) is a strong flier and therefore has a fairly large range. It is a small island specialist, found mainly in South-East Asia and the Pacific, from the Indian Nicobar Island eastward to Thailand, Malaysia, Indonesia, the Philippines and Papua New Guinea. But, despite its wide distribution the Nicobar Pigeon is generally scarce throughout its range and is most abundant on the smaller, less disturbed island.

**Nicobar Pigeon habitat:** The Nicobar Pigeon prefers to breed in dense colonies on small, wooded, offshore island and forages on the island or on the adjacent mainland in large areas of lowland rainforest. This species is typically found at elevations of up to at least 500 metres and they prefer mangroves and lowland forest.

**Classification of Nicobar Pigeon**
Kingdom: *Animalia*
Phylum: *Chordata*
Sub-Phylum: *Vertebrata*
Class: *Aves*
Order: *Columbiformes*
Family: *Columbidae*
Genus: *Caloenas*
Species: *nicoarica*
Scientific Name: *Caloenas nicobarica*
Species name author **Linnaeus, 1758**

## Conservation status

### *NICOBAR PIGEON STATUS*

The Nicobar Pigeon is classified as Near Threatened on the IUCN Red list and listed on Appendix I of CITIES.

This species is classified as Near Threatened because throughout its wide range it is thought to be declining because of food habits, pet trade, habitat destruction and predation by introduced mammals.

### *NICOBAR PIGEON THREATS*

Although its exact population size is

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unclear, the Nicobar Pigeon is known to be undergoing a slow decline in numbers. The clearance of many small islands and adjacent areas of lowland forest for plantation has severely reduced the preferred breeding and foraging habitats of this bird. The introduction of non-native predators, such as rats and cats, on important breeding ground has exacerbated the effects of habitat loss, especially as the Nicobar Pigeon nests in large aggregation.

Hunting and trapping for food, the pet trade and possibly its Gizzard Stones have also had a serious impact on the numbers of this species.

***NICOBAR PIGEON CONSERVATION***

The Nicobar Pigeon is listed under Appendix I of CITES, which prohibits international trade in specimens of this species. Further conservation measures for the Nicobar Pigeon have been proposed, but are yet to be enacted. These include further research into population size and trends and protection of its known breeding grounds and nearby foraging areas from clearance for plantation. Educating people who live near this species has also been suggested to help prevent trapping for food and pet trade. The species would also benefit from eradication of non-native predators at key breeding sites. (*Bird Life International; 2001 Threatened birds of Asia, Cambridge, UK*)

## Housing Pattern

***CAGE***

The cages are made up of iron bars, rods and the mesh sheet, which are supported by strong iron bars. Each cage has a water bowl (reservoir) for drinking, food vessels for feeding, nesting site and an open area. The cage possesses structures like branches of tree for sitting and resting of birds—vertically placed iron bars having broad funnel-shaped structure on its upper side. Each cage size is dependent on variability of species and numbers.

The area of Nicobar Pigeon cage is:

**Length**: 25ft
**Width:** 16ft
**Height**: 12ft
**Nesting site-height**: 6-7 ft

### Difference between Dove and Pigeon:

**Dove:** Slightly smaller, pointed tails, wild, generally white in colour, symbol of peace, gentleness and prosperity
**Pigeon:** Slightly larger, round tails, mostly Urban, grey in colour, thought of more often as flying rates.

## Facilities

**Food:** Readymade food is provided to the birds. The food is processed at a processing house and is provided to birds according to their food type and preference in their natural habitat—two times in a day.
**Morning:** Wet gram in a vessel.
**Evening:** fruits.
**Bajari:** 24 hours in a vessel.

**Water:** Water is supplied from the underground boring in the zoo campus. It is supplied round the clock through

pipelines in the water reservoir at the site.

**Animal care, health and treatment:** Cleanliness of surrounding is ensured and quality of food is checked strictly to avoid epidemic of disease in birds. If any bird is found sick or injured or unduly stressed, the matter is reported immediately and proper treatment is provided.
**Supplements**: Vitamin, calcium (liquid based)
**Vaccine**: Lasota (oral), for viral protection—once in every 6 months, September and March.
**Deworming programme:** Albendazol, Piperazine and Avitrol—alternate, once in every three month.

**Nesting facility:** Materials required for preparing the nest are Khadasali grass and Neem grass. These are provided and artificial supportive structures are made to facilitate the nest building site.

**Temperature regulation:** Seasonal care is provided regularly to birds to ensure ideal conditions and to maintain the temperature.

**In summer:** Green net covers on the cage.
**In winter:** High volt lamp under the desk.
**In monsoon:** A cage structure is created to protect the birds from rains.

## Reproduction Behaviour

- Nicobar Pigeons are monogamous and pairs typically mate for life.
- Courtship can last for days with males cooing loudly and exhibiting bowing display in which the plumage is erected in front of the female. Once a female selects a mate, the male chooses an area to nest. Male gather twigs, roots and other materials.
- Females arrange the materials brought back by the males. The nests are primitive and have only a few sticks to keep the eggs from rolling away.
- The female lays a single white egg, which is long and elliptical in shape.
- One egg is produced in each clutch.
- Incubation is for 30 days and is shared by both parents.
- Chicks are nearly naked when born and are 'altricial', which means the

chicks need to be cared for, insulated and fed by parents.

- After about 10 days, chicks' feathers begin to grow. The chicks are almost independent before one month but they stay in the nest a bit longer.

## Breeding Programme

A Nicobar Pigeon was purchased from Bombay dealer Raft Khan on June 28, 1974. In 1991, the number had increased to 17. On January 10, 2017, the number of Nicobar Pigeons has increased to 29.

**DATA OF THIS PROGRAMME:**

| Year | Opening Stock | | | | BIRTH | | | Purchase | | | Sale | | | Disposal | | | Death | | | Closing Stock | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | U | T | M | F | U | M | F | T | M | F | T | M | F | T | M | F | T | M | F | U | T |
| 2012-13 | - | - | 23 | 23 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 25 | 25 |
| 2013-14 | - | - | 25 | 25 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 27 | 27 |
| 2014-15 | - | - | 27 | 27 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 28 | 28 |
| 2015-16 | - | - | 28 | 28 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 29 | 29 |
| 2016-17 | - | - | 29 | 29 | DO NOT DISTURB IN CAPTIVITY | | | | | | | | | | | | | | | | | | |

**APPROX MALE /FEMALE NO.**

MALE: 13

FEMALE: 5

IN STARTING AGE: 9

**DEATH IN LAST 5 YEARS:**

| YEAR | DATE | NO. | REASON |
|---|---|---|---|
| 2012-13 | - | - | - |
| 2013-14 | 30/04/2013 | 1 | Old age |
| 2014-15 | 5/9/2014 | 1 | Old age |
| 2015-16 | 6/4/2015 | 1 | Egg bound condition |
| 2016-17 | - | - | - |

# A case study on 'Forest Food Festival'

*An innovative step of the Forest Department to conserve biodiversity*

**Chaudhari G A[1], Dr Leena Gupta[2], Varma V L[3]**

Development, heritage, trust, relations, food, all have an emotional bond with mankind. Food is the base of life and forests are intrinsically linked to mankind livelihoods and heritage directly or indirectly in the form of food. Since ancient time, the kitchens of mankind as well as tribal populations have been associated with nature and largely based on forest species. But, gradually, we have begun to accept new food types and have lost the taste, value and knowledge of variety of traditional food in our life. Thus, we are also losing important wild edible plants due to such ignorance. Because of this, society has lost a big market of wild edible plants, which was a strong base for survival of the local people. While on the other hand, in today's context, with the fast developing natural resources and growing population, there is tremendous awareness on forest conservation. The focus of forest conservation has been refreshingly on biological diversity in recent times. We can learn from wild edibles, their diversity and heritage in form of recipes and can also conserve them through what they eat, earn, survive. Let's value each plant, each component of biodiversity, ecology! The wild flora of India provides a large number of plants whose fruits, seeds, tubers, gum, leaves, etc., make an important contribution to the diet of the local tribal/rural people with several other useful products like fibre, fodder, dyes, small timber and musical instruments, etc. They also provide useful genes for crop improvement.

Department's aim is dedicated to the societies residing in the rural area, culture and taste of relationships between community and wild flora. In the continuous wild recipe events, we prepare different kinds of recipes from range of wild plant species. After recipe preparation, the ecological, nutritional and medicinal value of each plant used in the recipe is discussed with the group of respective events. Thus, conservation strategies can utilise this opportunity by focussing on forest cuisines and highlighting the role of biodiversity, thereby benefitting communities as well as biodiversity conservation. Forest food festival is an innovative concept practiced in Maharashtra, Odisha and proposed as part of the initiatives of Rehabilitation of Degraded Farm Land (RDFL) scheme.

[1] *Range Forest Officer Trainee at CASFoS, Bunrnihat, Assam*

[2] *Scientist at Bahumali Bhavan, Third Floor Mehsana-3294001, Gujarat State*

[3] *Deputy Conservator of Forest, Mehsana(SF) Forest Dvs. at Bahumali Bhavan, Third Floor Mehsana-3294001, Gujarat State*

## The Forest Food Festival

In October 2013, 34 VSS from tribal community villages of Banki Forest Range of Rourkela, in Odisha, first time organised a Forest Food Festival. Actions on these lines influenced local community as well as Department of Forest, Mehsana Forest Division, Gujarat, to arrange such kind of event to showcase newly awakened understanding of conserving forests as a food basket. Finally, on December 30, 2016, a one-day festival has been organised by mother department at Udalpur nursery. Participation of local women, who make fresh collection of items from the forest and prepare tantalising food items, and village seniors/expert in the field of nutrition/ 'ayurveda practitioner' can taste the food and select items based on number of parameters like plant species used and its seasonality, method of cooking, spices used, hygiene, etc., have been made up.

Few wild recipes are mentioned here to sense their potential for conservation and a checklist of wild plants used during Forest Food Festival.

***1) Moringa oleifera* Lam. (The Miracle Tree, Senjana, Saragvo, Moringa tree):** *(pic. 1)*

Moringa tree is very helpful to solve the malnutrition problem and used to prepare range of recipes like *thepla, tikha sakarpara, mitha sakarpara, ganthiya, khakhra, mathari, bhajiya, sukhi and rasili bhaji, rayta,* etc. Ingredients of shown recipes are *moringa* tree leaves, *jwar* flour, wheat flour, salt, turmeric, chilli and oil.

***2) Cassia fistula* Linn. (Amatlas, Garmalo):**

Amatlas is used to make healthy sweets, tonic, juice, soup, *khakhra*. its pod pulp is naturally sweet and purgative. Ingredients of shown recipes are Amaltas pod pulp, mix flour, cow ghee, very little jaggery.

***3) Madhuca* indica J.F.Gml (Mahua, Mahudo):** *(pic. 2)*

Mahua is frequently used to make healthy sweets, tonic, sweet soup in tribal populations around the district of Mehsana. Ingredients of shown recipes are flower pulp, wheat flour, cow ghee.

**(pic. 1)**

**(pic. 2)**

***4) Emblica officinalis* Gaertn. (Anwala):**
Anwala is used to prepare pickle, *sabji*, sweet and *chatpata* candy, *jalebi* etc. Ingredients of shown recipes are anwala fruits, spices, *sonth*, sugar, oil. These recipes are useful in vitiated conditions of *tridosha*, diabetes, cough, asthma and bronchitis as well.

***5) Rivea hypocrateriformis* Choisy (Fangvel):** *(pic. 3)*
This *Rivea* plant is analgesic, anti-inflammatory and used to prepare *thepla, muthiya, dosa,* pancake, pizza filling, etc. Ingredients of shown recipes are *Rivea* leaves, wheat flour, *bajara* flour, salt, turmeric, chilli and *hing*.

***6) Aloe barbadensis* Mill. (Kunvarpatha, Dhrutkumari):**
Aloe is blood purifier and used to prepare *sabji*, pickle, *halva, laddo*, biscuits, juice, soup, *paratha,* etc. Ingredients of shown recipes are Aloe leaves, chilli, turmeric, salt, oil, *ilaychi* and *hing*.

***7) Gymnema sylvestre* R.Br. (Madhunashini, Gudmar):**
*Gymnema* is used to prepare *khakhra, saravada,* etc. Ingredients of shown recipes are leaves, oil salt, turmeric, chilli and *hing*.

***8) Tylophora indica* (Damvel, Anantmool, Jungli pikvan):** *(pic. 4)*
Damvel is anti-inflammatory, anti-allergic, diuretic and used to prepare *sabji, sakarpara, khakhra, vadi,* etc. Ingredients of shown recipes are leaves, chilli, turmeric, salt, hing.

## Learnings & Way Forward:

1) It accords recognition to role of women in understanding food resources and its conservation.
2) It also accords recognition to forests as source of food—this concept needs be extended to Eco-Development Committees/Joint Forest Management Committees/ Van Panchayat/ Biodiversity Management Committees.

**(pic. 3)**

**(pic. 4)**

**Table-1. checklist of wild plants used during Forest Food Festival**

| S.No. | Plant's Local Name | Plant's Scientific Name | Habit | Part used |
|---|---|---|---|---|
| 1 | Gular | *Ficus glomerata* Roxb. | Tree | Fruits |
| 2 | Dhamna | *Grewia subinaeqnalis* DC. | Tree | Fruits |
| 3 | Kerdo | *Capparis aphyla* | Tree | Fruits |
| 4 | Jamun | *Syzygium cumini* | Tree | Fruits |
| 5 | Banyan tree | *Ficus bengalensis*. | Tree | Fruit |
| 6 | Anzeer | *Ficus carica* Linn. | Tree | Fruits |
| 7 | Amatlas, Garmalo | *Cassia fistula* Linn. | Tree | Fruits |
| 8 | Timru, (Tendu) | *Diospyros melanoxylon* Roxb. | Tree | Fruits |
| 9 | Anwala | *Emblica officinalis* Gaertn. | Tree | Fruits |
| 10 | Saragvo | *Moringa oleifera* Lam. | Tree | Leaves |
| 11 | Kanchnar | *Bauhinia purpurea* Linn. | Tree | Leaves |
| 12 | Bathua, Chil | *Chenopodium album* Linn. | Herb | Leaves |
| 13 | Kankoda | Momordica dioica | Herb | Leaves |
| 14 | Bhaji | *Amaranthus spinosus* Linn. | Herb | Leaves |
| 15 | Fangvel | *Rivea hypocrateriformis* Choisy | Herb | Leaves |
| 16 | Kunvarpatha | *Aloe barbadensis* Mill. | Herb | Leaves |
| 17 | Madhunashini | *Gymnema sylvestre* R.Br. | Herb | Leaves |
| 18 | Damvel, | *Tylophora indica* | Herb | Leaves |
| 19 | Agasti phool | *Sesbania grandiflora* Pers. | Tree | Flowers |
| 20 | Indrajav | *Hoarrhena antidysentrica* | Tree | Flowers |
| 21 | Imali | *Tamarindus indica* Linn. | Tree | Flowers |
| 22 | Mahua, Mahudo | *Madhuca* indica J.F.Gml | Tree | Flowers |

3) Such events will promote local food items as food security and in turn will promote retention/ planting of these plant species, in forest assigned to committees or protected by committees.
4) This will, incidentally, promote biodiversity conservation.
5) The process need be extended to other areas so that the forest species that are sources of food items are cultivated in nurseries/ planted and

utilised by the people.

6) It will spread message that forest foods are very nutritious and organic (and are better than junk food) and such events can be linked to eco-tourism.
7) This programme will encourage the villagers to conserve, sustainably harvest and utilise such species.
8) One-time effort will not suffice and thus be repeated every year in different places and different seasons to cover the whole range of species.
9) Learning be integrated into micro plans/ its revision as a component of ANR under-planting in a systematic manner and executed by SHG/BMC members.
10) Such efforts are precursors to adoption of institutional framework expected under the Biodiversity Act 2002 and rules made under by the state government.

# The brown bear rescue

*A wild animal on the loose is one of the worst crisis one can face in a zoo*

**Praveen Sharma**

It was a foggy monsoon morning and I and my friends were quite excited as it was one of the friends' marriage. I will not forget the morning of July 2016, when I was posted as a Range Forest Officer in Himalayan Nature Park, Kufri in Shimla, Himachal Pradesh. It was a small zoo housing western Himalayan fauna, primary among whom is the Himalayan Brown Bear. This zoo enjoys the status of "coordinating zoo" in respect of the Brown Bear.

As I had to leave for a far off place in district Shimla with my friends to attend the marriage, I woke up early and got ready by 7:30 am. I told about my leave to my SFO and left a written leave application with my subordinate. As I walked down the stairs after saying "bye" to my wife to meet my friend, who is a doctor by profession, I was full of excitement. He called me up and said that he would come to pick me up in 10 minutes. Just at that point, one of the night attendants of the zoo came running and told me that a part of the enclosure wall of the brown bear enclosure had collapsed and all the three brown bears had come out of the enclosure and roaming outside. I was speechless as nothing worse can happen in the zoo than the animal coming out, posing a threat to life and property.

I immediately called all the staff members and directed all, specially women and children, to stay inside the house till further directions. All the excitement for friend's marriage was gone and I called my friend to leave alone as it was a "crisis" like situation in the zoo. With the concerted efforts of all staff members, we somehow managed to drive two of the animals into the enclosure from the collapsed area and I directed three staff members to man that point and not let the animals come out at any cost.

I informed my DFO about the matter and, at the same time, called the police to come immediately with arms so as to avoid any loss to human life in case the one animal left out strayed out into the adjoining forest. I immediately called my veterinarian to come with the tranquilising gun so that "Manku" (as the animal was called by this name), if cornered in any part of the zoo, could be immobilised and brought back safely. The drugs for immobilising the animal were not available in abundance at the zoo veterinary hospital and had to be brought from our Rescue Centre, which is at Tutikandi some 20 kms away from the zoo. We could not afford even one

*Assistant Conservator of Forest*

minutes delay. I was busy coordinating things and praying to God to avoid any untoward incident.

But to my dismay, one of the staff members come running and informed me that Manku had escaped out of the lower side of the zoo to the adjoining forest. I was again speechless as such a big animal was out of the zoo boundary and from the adjoining villages the children as well as the people were now heading towards the roadside to catch buses to reach schools and their work places, respectively. All of us headed towards the forest in order of find Manku. The captive animal was feeling free and enjoying the lush green forest. The visibility was affected due to dense fog. Different groups started searching different parts of the forest. Good thing was that it was not raining. One of the groups comprised of Babu Ram, the animal attendant, who used to feed the brown bear daily. He started calling Manku by its name, as he usually did during the feeding time.

To everyone's surprise Manku responded to Babu Ram's call and came towards the part of the forest where he was calling from. A part of the forest was once fenced with interlink chains for pitching tents for eco-tourism activities, but was lying abandoned for years. Babu Ram along with other staff got Manku into the fenced area. Now I experienced a sigh of relief as the zoo veterinarian was on the spot and another senior veterinarian was on the way with tranquilising drugs. The police too was on spot with arms.

The zoo veterinarian successfully injected one dose into the animal to which the animal started responding within five minutes. I called the staff in zoo who were at the collapsed wall to stop the two brown bears from coming out. I was happy to learn that they had managed to shift the animals into the adjoining separation enclosure, which was now safe. Police personnel were quiet active in not allowing the people passing by to stay at the spot and making any noise. Disturbance of any kind makes the impact of the tranquilising drug less. Manku now had stopped moving and was looking drowsy, but still not unconscious.

Fortunately, the senior veterinary office came with additional dose of drugs and without any delay injected another dose with the help of the tranquilising gun. Everyone around was looking towards the animal and finally within 7-8 minutes Manku was fully unconscious. I was feeling relieved now. The animal was carried on a stretcher to the road side and then transported in a vehicle to the zoo and finally and put into the same separation enclosure where the other two were put. I thanked God for this successful rescue then I thanked the police personnel for their active cooperation.

There was no loss to life and property but now my concern was the health of Manku who was still unconscious. While we were busy looking after another arrangement, we closed the zoo for that day. There was some drizzle hampering the works but good news was that Manku was conscious and had started moving. I was feeling happy now because as a zoo manager, we had successfully

handled a crisis—our coolness, dedication and hard work had paid. I thanked the entire staff, especially Babu Ram, for this successful rescue operation. These situations comes very rarely in life and if something were to happen, it can hamper your career as a forester and your self esteem as a human being. After this successful operation, I share my experience with all fellow foresters and ask them to be prepared and maintain their cool when such incidents happen.

# The success at Polo Forest

*Income generated though eco-tourism has benefitted the locals in Gujarat's Sabarkantha district and they have diversified their livelihood opportunities*

**Patel Parimal Ramjibhai**

Polo Forest is located in Vijaynagar taluka of Sabarkantha district of North Gujarat. It is situated between Ahmedabad and Udaipur. It is 150 kms from Ahmedabad and 117 kms from Udaipur. It is a very popular tourist spot in this part of the State. The ancient polo-city was built around the river Harnav. It is believed to have been established in the 10th century by the Parihar king of Marwar and was then conquered in 15th century by Rathod Rajput of Idar state.

The name is derived from '*pol*', the Marwari word for 'gate' signifying its status as gateway between Gujarat and Rajasthan. It is also the site of successful eco-tourism project, example of which is difficult to find in mountains. It has been established that properly planned eco-tourism can change fortunes of people in remote and less developed regions. Eco-tourism has various criteria such as benefits to local people, support for conservation and low scale development. If a region develops as an eco-tourism centre, it can bring various economic benefits to local people.

Primarily a tribal area, Polo forest is located in the Aravalli mountain area, in around 400 sq km area of Vijaynagar taluka. There are 114 villages in Vijaynagar taluka and total population is 90,766 comprising of 17,231 houses.[1] Polo Forest is an important tourist spot of Sabarkantha and also of North Gujarat.

## Economy of Vijaynagar (Polo Forest area)

Nearly 80 per cent of population depends for its livelihood on agriculture and comprises either cultivators or agricultural labourers. Animal husbandry and minor forest produce are other significant economic activities in Vijaynagar.

There is high pressure on forest land in the form of illicit cutting and grazing. About 35.65 per cent[2] of total land is available for cultivation, which also is situated on slope with uneven terrain. Major cultivation is done during monsoon and due to this farmers can grow only a single crop and their agriculture produce includes maize, *tuvar* (pigeon pea), groundnut, cotton and castor. Maize is the main crop in Vijaynagar.[3]

The forest land in Vijaynagar falls under the Reserve Forest and it is richest forest in Sabarkantha. The forest is a rich source of around 450 medicinal plants like *baheda, sag, khakhro, shatavri, tulsi*, etc.[4] The forest provides sustainable

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livelihood and employment for the village people. Animal husbandry has increased business opportunities for local people of taluka. The dairy federation is associated with the world famous Amul brand. Eco-tourism is the other supporting part of rural economy. Plantation and nursery development activities have the potential to generate maximum wage employment.

## Eco-tourism activities

Eco-tourism is defined as responsible travel to nature area that conserves the environment and improvises the well being of local people

**NEC facilities:** NEC camps are being run by the Department since 1996. Till date, 434 camps have been held at this site. More than 20,000 students and staff members have benefitted from the camps. At present, there is an elevated platform over which loose brick, temporary structures have been made which serve as the camping facility.

**Rock climbing/ Rappelling:** The site suitable for this activity is on the southern bank of Harnav river, just downstream of the check dam.

**Bicycling:** Bicycling is an eco friendly, pollution free and healthy activity, which has been popularised by a very popular event, 'Tour de Polo', since last two years. Fifty-five bicycles with gear mechanism have already been procured by the Forest Department and have been allotted to local eco-tourism committee as a income generation source through rental services to tourists.

**Night Trek-cum-stargazing:** It is proposed to take small groups of tourists from the campsite to the echo point, under the watchful eye of local guide where the theme could be "Listen to the sound of the jungle" and "Star gazing".

**Nature trails:** There is already a designated nature trail of about 2600 m which originates from the campsite, goes to the temple complex after river crossing, and then again involves a river bed crossing before climbing a hilltop. There is an "Echo point" at the top where a watchtower has been proposed. From here, one can return by the same route or climb down the hill and arrive on the road.

**Walkways:** It is proposed to have an elevated river top cum treetop walkway of about 470 m originating and ending at the interpretation centre.

**Interpretation Centre:** The centre provides information on the biodiversity value of Polo Forest as well as on the ancient temples and rich cultural heritage of the area.

**Facilitation for exposure to local culture:** It is proposed to construct a riverside multipurpose hall over the existing smaller training hall. This hall would serve as a platform for showcasing the local tribal culture in the form of folk dances, *ghummar* dance, *bhavai* performance and any other theme-based performances. In all the performances, an in-built message for nature conservation is a must.

This hall would also double up as a centre for meditation, yoga and nature based films, etc.

**Manufacture and sale of souvenirs:** The visitor centre at the entrance would have a souvenir shop so that the visitor can purchase memories of his/her visit.

Also, souvenirs would be available for sale at the adjoining tribal *haat*. The list of souvenirs include bamboo crafts, poshina horse, products manufactured by SHGs, T-shirts, caps, key chains, pens, fancy items, etc.

Canteen and catering facilities for tourists are run by Eco-tourism Development Committee (ETDC). Three AC and four non-AC cottages for tourist have been built by the Forest Department and now run by ETDC.

Main attractions of the area are a tent city (during Polo Utsav), Vanaj dam, Atarsumba ayurvedic garden, Polo campsite, historical temple of Vireswar, Sarneshwar and Abhapur Jain Derasar.

There have been number of benefit for people of the Polo Forest area. People have developed alternate livelihood opportunities and have found employment as guides and drivers and in activities like housekeeping, trekking, security, catering facility, canteen, bicycling, photography, handicraft for sale as souvenir. They also engage in vermin composting, organic honey collection, gum collection, tendu patta collection, etc.

Keeping in mind the heavy inflow of the tourists, the following activities are proposed in future:

1. NEC film shows
2. Meeting/ convention hall,
3. Meditation centre
4. Pottery making
5. Face painting
6. Registered home stays
7. 12-month plant distributions counter

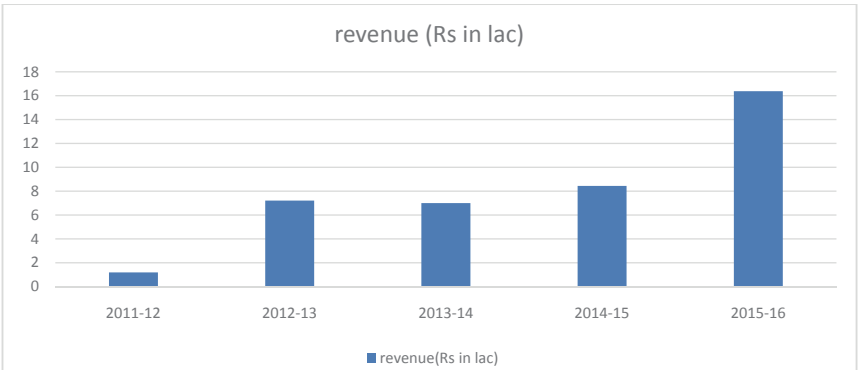
**INCOME OF ECO-TOURISM DEVELOPMENT COMMITTEE**

| YEAR | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|
| REVENUE (LAC) | 1.19 | 7.21 | 7.0 | 8.44 | 16.38 |

**NUMBER OF REGISTERED TOURISTS**

| YEAR | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|
| NO. OF TOURIST | 3015 | 9770 | 13949 | 13525 | 11384 |

*(Source: DCF Office, Sabarkantha Division, Himmatnagar)*



8. Souvenir shop
9. Photography in traditional dress
10. Adventure activities (Rappelling/ Rock climbing)

## Positive observations on eco-tourism in Polo Forest

Income generated through eco-tourism has benefited the locals and they have diversified their livelihood opportunities. As per provisions of the Government of Gujarat GR of October 13, 2008, the money earned through eco-tourism activities, such as room rent, dining charges, etc., is ploughed back into the ETDC society account. This helps create a better life for the local people through development of better livelihood opportunities. The most valuable contribution of eco-tourism is the preservation of biodiversity. Biodiversity is increasingly looked upon as a sustainable asset. Eco-tourism provides an educational glimpse of a pure, natural world which is quite different from the urbanscape of most visiting tourists. The value of local products has been enhanced and business initiated through eco-tourism. Ventures have become self-sufficient within a short span of time and can enhance long-term economic prospects of the community. Eco-tourism has helped to create jobs and also create interest and awareness among local people, especially among school and college students. Conversely, the eco-tourism initiative has also helped the eco-tourist to discover various aspects of nature, the importance of conservation and also has helped in providing a glimpse of tribal culture to the tourists.

## Negative observations on eco-tourism in Polo Forest

Conversion of undeveloped land into profitable space for tourism may result in wilderness areas be compromised by influx of tourism. Coordination needs to be enhanced for proper management by the ETDC. The training by the Forest Department is not adequate. More infrastructure needs to be developed for attracting more tourists as well as creative innovations. A close eye needs to be kept on the pollution levels, especially plastic pollution which is increasing alarmingly day-by-day. Lack of proper marketing chain has a negative impact on livelihoods.

## Conclusion

Developing of area as eco-tourism has helped increasing livelihood opportunities and economic condition of local people. With the help of eco-tourism, Polo Forest become well known so that the tourist traffic is more than the carrying capacity of the polo site. For control of plastic pollution and traffic, the Department will have to use parking system out of the site area and also use shuttle system in the camp site. The Department should also ban plastic from the site.

SOURCE: (1), (2), (3) District Panchayat of Sabarkantha, Statistics' Department, census 2011
(4) DCF Office, Sabarkantha Division, Himmatnagar.

# *Prosopis juliflora*: Effect on local environment and livelihoods

*The case study, based on field observations in Gujarat's Patan district, finds that invasion outside arid areas needs to be checked*

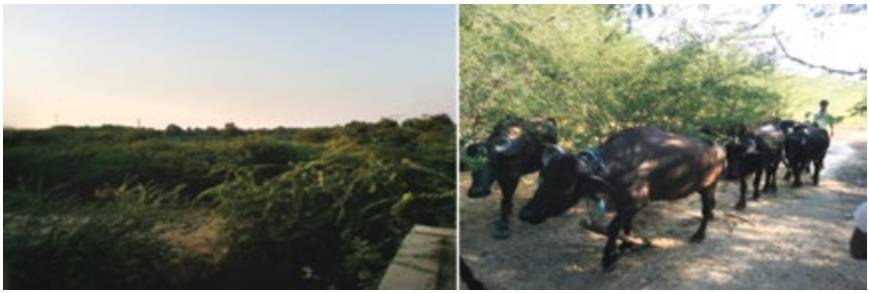
**Patel Chetankumar Shankarbhai**

*Prosopis juliflora* is an evergreen tree native to South America, Central America and the Caribbean. It was introduced first in India around 1877 with the aim to check encroaching desert sands. The first large-scale plantation was done in Gujarat in about 1894—in Gujarat it is known as *Ganda baval*. It is fast growing, nitrogen-fixing and tolerant to arid conditions and saline soils. Under the right conditions, *Prosopis juliflora* can produce a variety of valuable goods and services: construction materials, charcoal, soil conservation and rehabilitation of degraded and saline soils. Concern about deforestation, desertification and fuelwood shortages prompted a wave of projects that introduced *Prosopis juliflora* and other hardy tree species to new environments across the world.

Where other tree species have failed to grow, *Prosopis* can easily survived and also in many cases become a major nuisance. *Prosopis juliflora* has invaded, and continues to invade, millions of hectares of rangeland. The study focuses on the *Prosopis juliflora* invasion in the local area, the level of public and government concern about that invasion, and the general nature of the problem across where poor people in arid and semi-arid areas benefited from the sale of *Prosopis juliflora* fuelwood and charcoal.

## Field observation

- During my visit of Patan territorial forest division I observed good patches of *Prosopis juliflora* forest. When we move from Patan to



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Harij, Sami, Radhanpur, Varahi and Santalpur, hundred of hectares of land is without green vegetative cover. The main reason is high percentage of salinity. Salinity is the main factor, a big hurdle for vegetation and its growth.

- Patan Forest Department planted three species in the saline area—*Prosopis juliflora, salvadora persica,* and *Psudo nodifolia* are the species of saline desert ecosystem. These species are locally known as *Ganda baval, Pilu* and *Untmarod,* respectively. I observed that in this area, survival rate of only *Prosopis* is good.
- Other two plant species do not survive due to high summer temperature which goes up to 46 to 49 centigrade and high speed saline wind burns the leading shoots of the species.
- The RFO of Sami Range he told me that only *prosopis'* survival rate is good.
- There is very dense forest of *prosopis* in Rasulpur and Chandrala village and it is increasing in tree cover.
- Local people use *prosopis* in a variety of ways—for fuel, fodder for their cattle, for fencing material of their farms and cattle farms.
- Some people are involved in charcoal making and fuelwood collection and earning money from it.
- Some people are transporters and some are traders of charcoal and fuelwood.
- I found that gradually *prosopis* comes in the fertile land and becomes invasive.
- *Prosopis* on the side of the roads comes on the road and in agriculture farms, it becomes costly for the farmers to remove it.

## Issues studied

1. *Prosopis* introduction in the region.
2. Costs and benefits to local communities from *Prosopis*.
3. What are feasible solutions to the *Prosopis* problem.

## *Prosopis juliflora* as an economic resource

*Prosopis juliflora* is very useful in dryland agroforestry systems, controlling soil erosion, stabilising sand dunes, improving soil fertility, reducing soil salinity, providing fuel energy resources, supplying feed and forage for grazing animals, furnishing construction timber and furniture wood, supplementing food for humans, and promoting honey production.

It produces fuel of high quality calorific value, which burns well even when freshly cut. It also produces high quality charcoal and its heartwood is strong and durable. Its branches are widely used as fencing posts, while its pods, which are high in protein and sugars, may be important fodder for livestock.

It has also been used to shelter agricultural crops from wind, to reduce the movement of soil and sand and also to reduce the speed of wind in arid region like Kutch, Patan and Banaskantha district of Gujarat.

It constitutes a large percentage of vegetative cover, producing about 25 to

30 tonnes of biomass/ha/year at a short rotation age of 4 to 5 years

There is also considerable improvement in soil texture and soil organic matter under the tree canopy, with soil under the canopy having higher total nitrogen and available phosphorus, and lower pH than soils in the adjacent open field.

The importance of *Prosopis* as a dryland resource is illustrated in India where it is considered a valuable tree species of the desert ecosystem.

In 1990-2000, the Gujarat Agricultural University (GAU), collected about 2,000 metric tonnes of pods, generating about 100,000 man-days of labour. During the same period, the university collected, processed and marketed about 300 metric tonnes of honey, which generated about a half million man-days of labour, an important source of employment and income for local people. In addition, GAU manufactures charcoal from *Prosopis juliflora* for the government of Gujarat. Between 1990-1995, it manufactured about 300,000 bags of charcoal and generated about 300,000 mandays of labour demand.

Gujarat Forest Corporation, Gujarat Agricultural University, Anand, and the Vivekenand Research and Training Institute, Mandvi-Kutch, have developed programmes for collection, processing and marketing of various products from different parts of *Prosopis juliflora*, to providing employment to the rural poor.

## *Prosopis juliflora* as an alien invader

*Prosopis juliflora* tends to form dense, impenetrable thickets, associated with unfavourable impacts on human economic activities. Millions of hectares of land have already been invaded.

It is most likely to germinate when its sugary seed pods are consumed by domestic livestock; the seeds get scoured while passing through the animals' digestive tract. The aggressive invasion in pastoral areas is displacing native trees, forming impenetrable thickets and reducing grazing potential. Agricultural lands and protected areas are highly affected by this and the natural ecosystem of the area declines.

## Problems associated with *Prosopis juliflora*

Over the last 10-20 years, there's been a general increase in the tree's density, both on grazing areas and on individual land such as cultivating fields. The increase of *Prosopis* on 'individual' land was attributed to several factors, including difficulties in controlling the spread of the trees and the dispersal of seed by both livestock and water. However, it was acknowledged that *Prosopis* density had increased tremendously primarily because there were no organised attempts at controlling its spread by the government. Further, the tendency of livestock to graze and concentrate on the communal grazing fields, transported the seeds there through their droppings. Soil fertility was enhanced by livestock droppings, creating good conditions for *Prosopis* growth.

The most severe problems were reduction of pastures for livestock grazing, reduced farmlands and associated opportunities for cultivation, and the disfiguration of livestock gums (especially goats) and tooth decay, both of which result in deterioration of livestock health and sometimes death.

The dense stands of *Prosopis* are a favoured habitat of mosquitoes and other insects; malaria incidence are associated with its high dencity. The sharp, strong and poisonous thorns of *Prosopis* were cited as a major problem. Thorns make it difficult for individuals to penetrate the dense thickets to harvest fuelwood. More commonly, thorns cause serious inflammation that may take a week to subside. In some cases, if left untreated, infections may require amputation of limbs.

In India, *Prosopis juliflora* is a pioneer species that rapidly colonises denuded / abandoned ravines. Inva-sions into riverine areas and degraded rangelands have resulted in high-density populations. It effects water resources and infrastructure. *Prosopis juliflora* leaves dropping on water makes the water bitter. *Prosopis juliflora* stands interfere with drainage, blocking watercourses of river and are responsible for flooding.

Nowadays in Gujarat, *Prosopis* has blocked roads and road sides used by both humans and livestock, requiring longer times to get to desired destination. It also damages tyres of vehicles and bicycles. A large number of labour and fund is required to clear dense *Prosopis* thickets from roads every year in Gujarat. *Prosopis* is also alleged to have killed off other important and useful native trees of region.

## Controlling the invasion

The Gujarat government legalised the business of making charcoal from wild *babool*. Any person can make charcoal from it, except in RF or PA and within two kms of the coast and also areas bordering the desert. The government should make policy for it in RF and PA also for controlling of *Prosopis* invasion. Also, all *Prosopis* forest, except the ones in arid and semi-arid regions, should be replaced with other species.

## Conclusion

More than 100 years ago, *Prosopis juliflora*, among other tree species, was

introduced into the State of Gujarat. It is now well established and is extremely invasive. It is an important species to prevent expansion of desert and also for livelihood of local people.

It also creates major threats by invading in large area of land and responsible for harmful effect on local ecosystem.

So, the government should permit the cutting of *Prosopis* stands in protected areas. Beyond the arid region, the government should make a new policy for controlling this invasive species.

The three main conclusions of the study is that *Prosopis juliflora* can be a very valuable resource for the arid and semi-arid regions of Gujarat; the government should take initiative for it's invasion outside the dry area; and, *Prosopis juliflora* can be managed to be a very valuable source of commercial products and livelihoods in the dry lands.

## Acknowledgements

I convey my gratitude to Shri JJ Rajput, ACF, Patan forest division and Shri SS Chaudhari, RFO, Sami normal Range, Harij, and the field staff of Range Office for helping me and providing guidance. I would like to acknowledge contributions of Shri Tusar Desai and Bhavesh Sindhav, Forester, Sami Normal Range, Harij, Were, who assisted with the field work. I am also thankful to all personnel of Patan Forest Division office for their co-operation and help.

# Rescue and rehabilitation activities at Sasan Gir

*Pressure on forest and wildlife habitats leads to habitat loss and fragmentation of wildlife populations and increases human-wildlife conflicts*

**Pratik Joshi**

India has the second largest population in the world and its economy is largely dependent on agriculture. Conserving the biological resources in India is thus a big challenge. Due to forest degradation, industrialisation, urbanisation, availability of land for agriculture, mining and unplanned infrastructure development and other such issues, we are losing natural resources. Pressure on forest and wildlife habitats leads to habitat and fragmentation of wildlife populations and increases human-wildlife conflicts.

In such adverse scenario, in Gir Protected Area (Gir PA), due to better management practices, population of wildlife is increasing gradually. The rise in the population resulted in dispersal and migration of carnivore population outside PA.

Lions have big territories and an increase in lion population has forced them to search for new territory. Leopards are highly adaptable and live in and around human-dominated agricultural landscape. Rise in population of herbivores has resulted crop damage. In addition, road (570.6 km) and railway line (153.03 ha) passing through PA and human habitation around the sanctuary area has resulted in conflict directly or indirectly. Annually 1,700 cattle are killed in and around Gir PA; this fairly indicates the level of conflict and need of a rescue centre.

Better management practices at Gir have raised the population of wildlife. Anthropogenic activities are growing rapidly compared to the previous era. This has placed man and animal on the opposite sides to fight for resources.

As Sasan (Gir) is the one and only home of Asiatic Lion (*Panthera leo persica*) in the world, it has to tackle the tremendous pressure to fight for the survival of the species. Generally, rescue operations are performed in following situations.

1) **Orphan:** After pregnancy, mother animal dies or mother animal dies accidentally and infant animal is not in a condition to survive naturally.
2) **Abandoned:** Sometimes group leaves the weaker animal or animal gets accidentally separated from the group.
3) **Threat to animal:** The animal accidentally enters the human

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habitation and is not able to escape. The animal in natural habitat is trapped in mud pit or trench.

4) **Threat to human/human habitation:** If a carnivore become man-eater or is involved in human injury. In case of herbivores, it means crop raiding, or damaging of agriculture fields.
5) **Research:** To know about which diseases or problems are afflicting the animal, to tie radio collar, and for sample collection to create gene pool.
6) **Treatment:** for treating ill / injured animals. To medicate animals.

Natural injury causing factors include in-fighting and illness. While on the other side, human are responsible for poisoning, electrocution and accident—fracture or other injuries due to road accident and falling in open well. On an average, 250-300 cases of rescue and allied activities related cases are dealt at Sasan (Gir) during a year, which includes birds; snakes; crocodiles; monkeys; herbivores (Blue bull / cheetal / sambhar); and, carnivores (lion / leopard / hyena / jackal / fox).

The rescue operation process can be divided into three segments. 1) Capture (includes physical and chemical restrain); 2) Treatment (on field and at rescue centre); 3) Release (release into wild; Rehabilitate into zoos or safari parks; death).

Animals are caught by using special cages depending upon their nature. In physical restrain methods, ring cage is used to catch lions; automatic cage is used to catch leopards; nets / ropes are used to catch crocodiles; tongs are used to catch snakes and dip net is used to catch birds and small animals.

Chemical restrain method is used as a last option as it may harm the animal's health in the long run. Drug selection is done on the basis of physical condition and health of the animal, objective of restraint, species and breed, available route of transportation, facilities and equipment available, type and duration of surgery, familiarity, knowledge and experience and based on economic considerations by the Veterinary Officer. Forest personal play an important role in any rescue operation. He / she should possess the following for better execution of rescue operation:

- Knowledge about the area
- Idea about how to capture animal (place and time of rescue should be decided properly)
- Having good contacts with local people
- Mob management skill / public control skill
- Coordination with other department / agencies
- Basics of animal behaviour
- Whether animal lives in group (also have to consider group dynamics —status of animal in group) or is solitary (age, sex have to be considered) in nature.
- How it will react during various conditions? (mating / food / with cubs)
- Whether animal is prone to stress or not? (particularly in case of herbivores)
- Whether the animal is able to control its body temperature or not? (rescue time (in harsh sunlight)

/ tranquilisation drug (effect on body) / snakes / crocodiles are cold blooded animals)
- Safety of animal / public / staff in different situations.
- Time Management (response time to reach the rescue location and speedy removal of animal in case of emergency or adverse situation due to mob.)

Treatment is done by the Veterinary Officer. Following are some of the conditions which can be observed on field in animals by forest personal and should be conveyed to the Veterinary Officer: Stress; bleeding/ haemorrhage; fractures; shock; burns; breathing; dehydration; hyperthermia / hypo-thermia; oil contamination; parasites; emaciation; wounds. Treatment is done either on field or at rescue centre, depending upon the situation. For the safe release of an animal, the presence of Veterinary Officer or a certificate of VO is required.

Different protocols is followed for the different species. Lion is generally released near its pride. If it is captured from location A and during the treatment pride moved to location B, then, at the time of release, it is released at location B.

In the case of leopard, method is different. It is released at a new location; it is not released near the location from where it is captured. Some pre-decided location has been identified based on the availability of food/water/ population of lions.

While releasing the animal with an infant, special protocol is followed. A shallow pit is dug behind the vegetation and the animal is placed in the pit along with infant under mild dose of a tranquiliser. After that either reversal dose is given or animal is monitored till it comes to full consciousness.

Animals which are orphaned, injured, aged, permanently disabled, man-eater / involved in man injury are not released again into the wild. They are kept in a zoo or a rescue centre or a safari park.

In case of natural death, post-mortem is done in presence of at least two gazetted officers. In case of unnatural death, there is a provision of panel post-mortem, where more than two VOs are present and all the samples collected during post-mortem are sent to Forensic Science Laboratory. Post-mortem is done either on field or at the rescue centre followed by cremation.

There is a saying in Gujarati which means that world is not only for humans; animals, birds, flowers and forest have equal right to survive. Let's become selfish, let's save them for our existence only.

## Acknowledgements


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- Dr Chirag Bhadesiya, Rescue Centre, Sasan (Gir)
- All the staff members of Wildlife Division and Rescue Centre, Sasan (Gir)

# Broom stick cultivation and economic benefits in hilly areas of Mizoram

*Cultivation of broom grass can be a good profitable enterprise along with the added benefit of soil conservation*

**Israela Hauhnar**

Broom grass (*Thysanolaena maxima*) belongs to Family Poaceae. It is about 2 – 3 m in height, leaves 5 cm wide and 30 cm long. The part that we use for sweeping is usually around 50 cm long. They are drought and heat tolerant and thus one of the most important species among the pioneer species. It is a multipurpose species which provides brooms, fuel, and fodder and has high soil conservation value. The growth and productivity are found to be better on the lower altitudes (150-1000 m) on slopes with an east and west aspect. It serves as a good soil binding plant and is useful for roadside protection. The flowering cycle is about 8 to 10 months and hence, within a year broom can be harvested and the production increases with advance in growth. It can be grown on marginal lands, wastelands and *jhum* (fallow) lands. It grows well on a wide range of soils varying from sandy loam to clay loam.

## Uses

It is usually available in large quantities (January to February) and is used as cattle feed during periods of fodder scarcity. The decoction of roots of this plant is used as mouth wash during fever. The fibrous root system of the plant is very useful in checking soil erosion on steep slopes. The sticks have also been tried by paper and pulp industries for the manufacture of paper. The cultivation of this grass can wean away the practice of shifting cultivation and reduce the dependence of people on forests.

## Site Preparation

i. The site is first cleaned and this is followed by burning of the area.
ii. Contour terracing for soil and water conservation as well as for easy movement in management and harvesting.
iii. Spacing between plants is 9 feet.
iv. Number of seedlings / hectare is 4000 and pits are of size 3′×3′×3′. Planting should be done at the edge of terrace on the downhill slope.
v. In the second year a drying house is constructed for drying and storage and of brooms.

## Preparation of Planting Material and Cultivation

Cultivation of broom-grass is

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comparatively easy and requires less financial inputs. It can be cultivated by rhizome cutting (4 stems of 6 inch shoot portion). The planting can be done by seeds or rhizomes. Vegetative propagation material should be planted within 3 days of preparation. It should not be put under sunlight and if not planted immediately should be store under shade and covered with banana leaves. If rhizome cuttings are used, rootlets should be removed. Only mature rhizomes should be used for planting. If dry juvenile broom shoot is contained in rhizome it should not be used. Planting of rhizomes should be carried out during the rainy season (June-July). Broom grass also regenerates through seeds under natural conditions. The seeds mature during February to March and can be maintained with proper spacing and cut back after 1 year.

## Management

Broom grass can be planted with rice for one year. It can also be planted with silk cotton tree (B*ombax ceiba*) – 100 plants per hectare. Weeding should be done regularly. The growing plant should not be covered by climbers or by tree shade. Fallen leaves should not be allow to decompose under theplant. The base of the plant should be always clean. If natural regeneration occurs in *jhum* land then they are cut back in June / July. Cut back dry stems are burnt with other removed weeds. If planted in June/July they should be cut back in August and should not cut back September onwards due to the onset of flowering. Cut back operations are done to increase number of new stems and to decrease the height of stems.

## Harvesting

Harvesting is carried out in the period from December to February, after 8 months of cultivation. Harvesting is done by pulling out mature flowers by hand. Harvested stalks / stems are cut and can be sold to paper mills. For the buyer broom grass harvested in December is best for buying due to low weight. For the cultivator harvesting in Jan/Feb is best for selling due to heavy weight.

## Processing

Cut broom grass should be spread and dried in the sun for at least 5 days. It should be cover in the evening to avoid wetting by dew or rain. It should be completely dried to prevent attack by fungus. Around 10-15 flower stalks tied together make one broom.

## Economic Benefit

Flowers, leaves and stems can be sold. Leaves are used as fodder for cattle. Stem (71% cellulose) can be used for manufacturing paper like bamboo. Dried leaves and stems can be used for manufacturing of organic manure. It can also be used to develop a silvi-pastoral agriculture system. Cultivation of broom grass in 2 ha of area can support the basic needs of a family.

## Marketing

Brooms are required in each house, therefore, it has sufficient demand throughout the country and marketing is not a problem. The majority of the

**Site preparation and preparation of planting material**

**Processing and broom making**

Table 1: **Yield per Hectare/ Year**

| Particulars | 1st Year | 2nd Year | 3rd Year |
|---|---|---|---|
| Number of Stalks / Culms | 27 | 69 | 145 |
| Fodder Yield | 5,920 kg | 8,060 kg | 28,670 kg |
| Stalks / Culms for Paper Manufacturing | 3,600 kg | 9,140 kg | 19,290 kg |
| Flower / Broom (Yield in terms of Rupees @ Rs 22/ kg (MIFMA*) | Rs.25960 | Rs.34540 | Rs.90200 |

**MIFMA – Mizoram Forest Produce Marketing Agency**

Table 2: **Chemical content (MIFMA)**

| Chemical Composition | Leaves (per 100g) | Stems (per 100g) |
|---|---|---|
| Crude protein | 8.72 | 1.45 |
| Crude fibre | 27.66 | 47.85 |
| Acid detergent fibre | 47.62 | 69.68 |
| Cellulose | 29.95 | 70.84 |
| Lignin | 8.19 | - |
| Ether extract | 3.42 | 1.04 |
| Total Ash | 12.4 | 3.21 |

production is from subsistence farming areas and dispersed collection from the forest, which are inaccessible to transport networks and markets. Broom grass is a high volume crop and during the harvesting season, there is more supply which reduces the local price. Also whole sale trading of brooms is in the hands of traders and middlemen who make most of the profit. The farmer gets very meagre amount, usually 35% of the retailer's price. Mizoram has a potential of harvesting 7000 quintals of dry broomstick every year.

## Conclusion

Regular weeding is required for success. Cut back operations and burning of cut stems is important for rejuvenation. Broom grass is very good for reclamation of waste lands and newly exposed soil. Can provide subsistence income and is a good agro-forestry practice for hilly areas and denuded land. Marketing and price should be properly controlled.

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# Showcasing Thol Sanctuary

*Effectiveness of measures taken for development of eco-tourism is reflected in the number of tourists visiting and the revenue generated*

**Chavda Viralsinh Raysinh**

Over the past 15 years, eco-tourism has become one of the fastest growing sectors of the tourism industry. At the same time, eco-tourism is being increasingly viewed by local and indigenous communities as an important tool for promoting sustainable livelihoods, cultural preservation and biodiversity conservation. Conventional tourism impacts the environment, both physically and culturally. Tourism has increased by more than 100 per cent between 1990 and 2000 in the world's biodiversity hotspots, regions richest in species and facing extreme threats.

Thol Wildlife Sanctuary is situated in Mehsana district of Gujarat, between 23° 15' to 23° 30'N latitudes and 72° 30' to 72° 45'E longitudes. It is 25 km northwest of Ahmedabad. Thol Sanctuary is a shallow water reservoir. It has predominantly open water areas, devoid of islands and reed beds, and this give it a distinct ambience. Thol water body occupies a total area of 699 ha (6.99 sq km) and its periphery is 5.62-km long. Originally, Thol tank was constructed for irrigation purposes by the Gayekwadi State rulers during the reign of the then Baroda State in the year 1912. It was built to prevent erosion and flooding and to store rainwater for irrigation. Initially, the area was declared as "Game Reserve" vide Government notification dated May 29, 1986, by the Forest and Environment Department. Later on, due to its popularity amongst the bird fraternity the area was notified as Wildlife Sanctuary through notification GVN-53-88-WLP-1386-162-V.2 dated November 18, 1988. Thol Wildlife Sanctuary is among the eight national wetland sites which have been identified for conservation.

The sanctuary is home to a rich variety of wild fowl, flamingos, grey pelicans, black ibis, gulls, terns, kingfishers, wagtails, pipits, spoonbills, coots, cormorants and other wetland birds (approximately 144 species reported). The tallest flying bird of the world, Sarus crane, inhabits this area and is found in good numbers. The wetland is predominated by an open water habitat, surrounded by cropland, fallow and scrub land. Thol wetlands is positioned in the eco-tonal or transitional zones between terrestrial and aquatic ecosystems where the water table is usually at or near the surface of the land, which is covered by shallow water. Due to

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these characteristics, the Thol wetlands provide opportunities for adaptation to different plant and animal species, leading to high diversity of life forms.

## Potential of eco-tourism

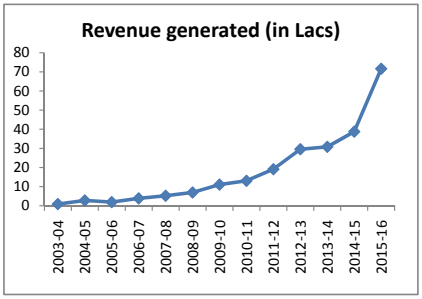
Thol Sanctuary is providing significant ecosystem services in terms of groundwater recharge, erosion control, recreational values, educational value and aesthetic values. It performs important functions of a wetland amidst metropolitan cities with the presence of more than 92 species. Some of these are globally threatened bird species. It is recognised as an important bird area and a centre for conservation education and recreation. The sanctuary serves as the educational centre for nearby schools and colleges. It can serve as one of the important sites for bird watching, especially during migratory season. Because of its location in the urban landscape, it attracts tourists with a wide range of interests. Thol, owing to its proximity to highly populated city like Ahmedabad, can be important tourist destination.

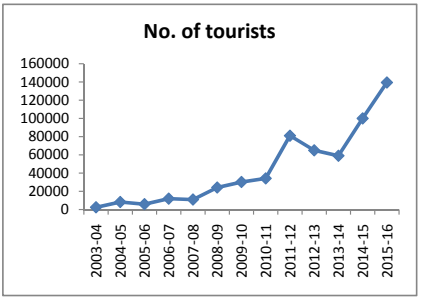
## Identified problems

i. There is low popularity of the place among the tourists.
ii. There is lack of tourist facilities like parking place, rest huts, benches, toilets, drinking water, etc.
iii. No lodging and boarding facilities.
iv. No information kiosk for tourists.
v. There is a high degree of disturbance in the sanctuary from overcrowding during holidays.
vi. There is no proper parking space available for vehicles, rickshaws and waiting space for nature guides at the entrance.
vii. There is no proper receptionist available in the sanctuary to provide assistance to tourists.
viii. The sanctuary is still in a developing stage and there are not much tourist facilities available.

## Strategies to develop eco-tourism

i. In 2003, check post for tourism was started.
ii. The main gate and associated facilities, like ticketing counter, re-designed to avoid crowding and enable easy and quick passage of tourists.
iii. Entry in the sanctuary permitted with fees and details of the number of tourists is recorded.
iv. Measures taken to popularise the place by publishing tourist information brochures, both in Gujarati and English.
v. Tourist facilities, like parking place, rest huts, benches, toilets, drinking water, etc., were developed.
vi. Along the nature trails, signages, benches and dustbins have been put that blend with the surroundings.
vii. Some viewing platforms and watchtowers have been constructed at suitable points to provide a bird's eye view of various blocks.
viii. Interpretation centre has been developed having all the details with coloured illustration of birds along with the information of their migration route, food habit, behaviour, etc.




ix. Motor vehicles other than that of the Forest Department are not allowed to enter beyond the tourist zone.

x. Strict vigil is maintained by the staff against vandalism by tourists. Dos and don'ts and provision of punitive action displayed at appropriate places.

xi. Tourists not allowed to move in the grassland areas during summer.

xii. Visitors not allowed to enter the waters or to get down from the road to get closer to the animals and birds.

## Effectiveness of measures

Effectiveness of measures taken towards development of eco-tourism is reflected in the number of tourists and revenue generated. Number of tourists received in the sanctuary from the year 2003-04 to 2015-16 is shown in the table. It is to be noted that the tourist flow to Thol is more in last five years than Nalsarovar, a well-known birding place, and Ramsar site near Ahmedabad, which reflects the impact of strategies undertaken to cater to eco-tourism.

| S.No. | Year | No. of Tourists | Total Revenue (In Lakh) |
|---|---|---|---|
| 1 | 2003-04 | 2399 | 0.84 |
| 2 | 2004-05 | 8258 | 2.76 |
| 3 | 2005-06 | 5848 | 1.87 |
| 4 | 2006-07 | 11926 | 3.82 |
| 5 | 2007-08 | 10928 | 5.20 |
| 6 | 2008-09 | 24162 | 6.92 |
| 7 | 2009-10 | 30188 | 11.03 |
| 8 | 2010-11 | 34167 | 13.02 |
| 9 | 2011-12 | 81035 | 19.07 |
| 10 | 2012-13 | 64941 | 29.53 |
| 11 | 2013-14 | 59012 | 30.80 |
| 12 | 2014-15 | 100001 | 38.74 |
| 13 | 2015-16 | 139463 | 71.63 |

## Acknowledgements

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- Mr PB Dave, RFO, Nalsarovar
- Forest staff of Thol Wildlife Sanctuary

# Conservation of *Boswellia serrata* in Banaskantha district

*It provides raw material for preparation of Ayurvedic medicines and substantially supplements incomes without adverse impact on biodiversity*

**Hitendrasinh N Chavada**

Socio-economic development linked with bio-diversity conservation, based on the concept of sustainable forest management, is the only effective tool for ecological conservation. India has a rich tradition of folk practices and a heritage of knowledge of biodiversity evident in its thriving system of healthcare such as Ayurveda, which co-exist with modern system of medicines. Thus, Ayurvedic species like *Boswellia serrata* play an important role in providing raw material for preparation of medicines and it substantially supplements the economic returns without adverse impact on biodiversity. They also play a vital role in socio-economic development linked with bio-diversity conservation.

## Introduction

Banaskantha district lies between 24.00 to 24.50 degrees latitude and 71.02 to 72.55 degrees of longitude. It is situated in the northern part of Gujarat along Gujarat–Rajasthan border. The geographical area of district is 10,757 sq km. It comprises of 14 talukas with a total forest area of 1107.22 sq km.

The study was carried out near and around Ambaji village in Ambaji north range, Gujarat. An area known as belt of Salai (*Boswellia serrata*) of Ambaji, Khokhrbili, Amlimal, Goratekra, Jarivav, Koteswar, Chikhla, Kumbhariya, Jetwas, Rinchhdidhar and Panchha was selected and study was conducted to collect the information.

Data was collected through survey in the study area by visual observation and by the help of forest personnel and people residing in the areaa of Ambaji, Khokhrbili, Amlimal, Goratekra, Jarivav, Koteswar, Chikhla, Kumbhariya, Jetwas, Rinchhdidhar and Panchha. Information was also collected from different government offices such as DFO Normal division and Forest Office, Banaskantha.

## Current Status

The forest areas of Danta-Ambaji are inhabited by around 20 tribes. These forests are inhabited by a variety of ethnic groups, including tribes like Bubadiya, Parghi, Taral, Bhemiyat, Dhrangi, Khair, Laur, Makwana, Dabhi, Solanki, Chauhan, Gamar, Parmar, Rohisa, Rathod, Mansi,

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**Table 1:** Shows the detail about specific girth sized trees, total number of trees, No. of trees per hectare, growing stock per hectare, basal area per hectare

| Species | Common name | Girth 61-90 cm | Total | No. of tree / ha | GS / ha (cm) | Basal area / ha |
|---|---|---|---|---|---|---|
| *Boswelliaserrata* | Salai | 301483 | 481764 | 15.603 | 2.03598 | 0.41446 |

Damor, Khermal, Kodarvi, etc. These tribes comprise 48 per cent of the total population. The *adivasi* (local people) dwelling in the forest have good knowledge of herbal medicine and directly depend upon forest resources for their daily needs

*Boswellia serrata*—known as *Salai, Dhupelio* and *Gugal*—and it's gum is sold in local market of Ambaji by local people. They prefer folk medicine because it is more proximate, convenient and cheaper than any modern medicine systems. It is a vulnerable species of Banaskantha division.

Local people today mostly depend on forest produce for their livelihood. *Boswellia serrata* in this forest area needs conservation for survival because of various threats.

## Tapping for harvesting and collection of gum

Gum tapping in Salai leads to killing of trees as traditional practice of gum tapping in *Boswellia serrata* is very crude and destructive. Normally a blaze is lit at the middle of the stem with the help of sharp knife/axes. The oozing of gum starts and continues till exhausted. The dried gum-resin extract is then collected.

Tapping directly affects flowering and seed production. So it affects the natural regeneration. Tapping in immature tree and trees of lower girth classes may adversely affect their growth or they may even die. Due to a cut across the stem, the tree gets infected and gradually dies. Thus the traditional system of gum tapping leads to mass killing of Salai trees. Hence, proper

**Table 2** shows the types of forest area considered under the plantation project:

| Area availability under *Boswellia serrata*(Salai) Project | | | | | |
|---|---|---|---|---|---|
| **Name of Range** | Forest Area (Ha.) | | | Total Area (Ha.) | Proposed Area under Project |
| | Sec-4 | Sec-20 | Sec-29 | | |
| **Ambaji North** | 11898 | 2501.6 | – | 14400 | 100.0 a. |

technique of gum tapping needs to be evolved so that periodical extraction can be done and such trees can survive for their total life span.

## Need for conservation

Due to adverse effect of tapping and other factors like soil erosion, heavy rainfall and high speed wind, many trees fall down or are destroyed. There is a growing demand of the *Boswellia serrata* plant for medicines; pharmaceuticals, health and bodycare products and cosmetics, etc., both in the national and international market.

## Departmental efforts

The Forest Department is undertaking afforestation in forest areas, non-forest areas, wastelands annually. It is taking up various plantations in the forest areas available as per the working plans prescribed under the medicinal plants scheme. The department has been successfully raising various plants, including *Boswellia serrata*. Besides, under the social forestry project also, *Boswellia serrata* is raised and distributed to people. The department going to implement a plantation project of *Boswellia serrata*, which includes plantation of 1 lakh seedlings in the area of Ambaji.

The department is also doing soil and moisture conservation work, like building of contour trench, contour bunding, check dam, etc., and by regular patrolling protecting it from grazing and browsing by fencing, lopping and cutting. The department also identifies research priorities for *salai guggal* and to standardise propagation and nursery techniques, silvicultural aspects, promote biotechnology:,tissue culture, disease control measures, standardise harvesting stage / size / age / season / value addition etc., and to recognise and promote innovative and locally available techniques

## Conclusion

*Boswellia serrata* plantations provide raw material and better returns to the local population. An improved tapping method with skilful incision can lead to sustainable and high yield of gum resin. The plantation project of the department provides employment to local people and will enhance the availability of medicinal gum in the district. It will also act as a tool for dissemination of information and conservation of vulnerable species, which are fast depleting.

*Boswellia serrata* plays a vital role in socio-economic development linked with bio-diversity conservation.

# Preservation of Community Forest in Mizoram

*By the initiatives taken up by Forest Department, a project for preservation of community forest was formulated under the Lunglei Forest Division*

**C Laldanmawia**

Lunglei District is situated in the southern area of Mizoram, located in between $92^0 35''$ E and $93^0 35''$ E longitude and between $22^0$ 30'' N and $23^0 05''$ N latitude.

## Community forest

This can be defined as a forest protected, managed and utilised by local forest user groups. A forest user group is a group of people having the right to manage, protect and use a forest area. The objective of community forestry is to develop and manage forest resources through active participation of individuals and communities to meet their basic needs.

## Community forest in Mizoram and local importance

Forest in Mizoram is the property of the State. Since the introduction of the National Forest Policy in 1988, India has been experiencing a major shift in forest management and with the Government of India resolution of 1990, various aspects of participatory management favouring communal management and exclusive rights to forest used have been covered. This has been further strengthened during the tenth plan with the launch of National Afforestation Programme (NAP) having a decentralised set up of forest development agencies (FDAs) at the forest division level and the resultant Joint Forest Management Committee (JFMCs) at the village level.

In most places in Mizoram, villages near the forests have been directly or indirectly depending on the nearby forest, from which the villagers usually meet their livelihood in obtaining their household requirement such as firewood, Non-Timber Forest Produce (NTFP), etc. However, the non-judicious use of these community forests by villagers in different parts of the State needs attention and management intervention otherwise it will lead to depletion of forest resources.

## Profile of study areas

1) **Chengpui village: A**bout 20 km from Haulawng village with 40 household and 160 persons. The area under this community forest is 130 hectares.
2) **Zotuitlang Village:** About 10 km from Haulawng with 120

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households and 520 persons. The area under this community forest is only 15 hectares.

3) **Mausen village:** About 15 km from Haulawng and towards the southern side with 62 households and 280 persons. The area under this community forest is 120 hectares.

By the initiatives taken up by the Forest Department, a project for preservation of community forests was formulated under Lunglei Forest Division so as to maintain healthy and sustainable resources. The objectives of the project are:

1) Preservation of forest areas for protection of important watersheds as well as forests around natural water sources of the village.
2) Protection of community/ village forests from fire, and other biotic pressure; eg, felling of tress for collection of timber and fuelwood.
3) Preservation of biodiversity rich community forest reserve

***Why preservation of this community forest is necessary?***

- The degradation of village forests started immediately after the political disturbance in the State in 1966 when group of villages were brought under a single administration unit and the forests and jungles were cleared in the name of 'security clearance' to mitigate attacks by insurgents.
- Fencing of villages was done by bamboo and poles of suitable species. For this a chunk of forest was indiscriminately cleared. This resulted in degradation of the community forests.
- The degradation further continued owing to anthropogenic and other biotic factors. In the process, village forests over the years deteriorated and in many places are bereft of any vegetal cover.
- This is particularly true of the village supply forests. A concerted afford with proper management intervention is, therefore, urgently required for the restoration of such forests.

Management steps taken up by the Forest Department for preservation of community forest:

1) **Resource assessment, inventory and survey:** The first and foremost requirement was resource assessment by way of vegetal inventory, including survey and demarcation of areas. That was taken up for each of the community reserves by the community through Young Mizo Association (YMA), one of the biggest NGOs in Mizoram. The Forest Department facilitated the process by way of technical inputs—chain and compass survey, scientific classification of plants and animals.

2) **Identification of community needs:** The needs of the villagers were first identified through the process of Participatory Rural Appraisal (PRA) exercises. While doing so, the need for increase in species diversity to provide long-term forest stability were always be borne in mind. At the same time, the need for increasing public awareness could not be overemphasised. Only through an enlightened public would

such ventures for conservation and sustainable resource utilisation succeed.

3) **Established goals—prioritised because of limited resources:**

a) Establish maximum tree cover through plantation programmes, both for village supply and safety.
b) Soil and water conservation measures in the catchment areas.
c) Identity entry point activities; create public education programmes; eco-tourism sites, etc.

4) **Awareness on Rights and privilege:** Three classes of Village Forest Reserve constituted under Section 12 of Mizoram Forest Act, 1955, have been followed

a) **Village Safety Reserve:** For protection against fire, constituted in the interest of health and water supply. No one shall utilise for any purpose any portion of land inside the Reserve and no tree shall be cut in this except with the permission of the State government.
**b) Village Supply Reserve:** For supply to fulfil the needs of the village. Any person in the village may cut trees and bamboos from this reserve for his household needs.
**c) Protected Forest Reserve:** For protection of valuable forest from destruction. No one shall utilise for any purpose any portion of land inside this Protected Forest Reserve and no tree shall be cut except with the permission of the State government.

5) **Implementing Agency:** Initially the implementation plan was such that for every community sanctuary, respective existing agencies, namely the concerned branch of Young Mizo Association (YMA), would be the implementing agency. Funds were made available to such societies from the Forest Department, which would be the nodal agency. However, at the time of actual implementation, not only the YMA was given priority to carry out the works for implementation but also representatives from the Village Council, YMA, Church and locality of the village, out of which 50 per cent of the members or one-fifth of the members should be women. The role of the department was limited to that of a facilitator, rendering necessary technical advice, wherever and whenever required.

6) **Monitoring, Evaluation and Revision**: Monitoring of the progress of the project was accorded very high priority and was carried out in a systematic manner through:

a) Periodic progress reports obtained from the nodal agency (Forest Department) and programme implementing agency (PIAs). (Village Community).
b) Field visits by programme officers (DFO) of the Department of Environment and Forests.

7) **Expected returns:** With mounting pressure on various classes of forest in the State, the project is expected to rejuvenate forest-based resources, while at the same time creating

employment opportunities. Once involved, both during the planning and implementation stages, the village community would have a sense of ownership over the area and would undertake sustainable utilisation of the resource without compromising. Thus, in addition to immediate returns in the form of wage employment, the project will take care of biodiversity conservation aspects as well.

To prevent these reserves from fire as well as encroachments, and to make people aware of their importance, management measures are taken up by the department. These are:

a) Demarcation of the area and erection of boundary pillars.
b) Construction of inspection path and patrolling path inside the forest.
c) Fire line cutting all along the boundary and contour fireline inside the reserve.
d) Fixing of signboards at prominent places about conservation reserve.
e) Organising awareness programmes for benefit of forest conservation amongst schools and local public.
f) Construction of watchtowers with RCC bases and beam.
g) Gap filling works by planting of seedlings in the conservation reserve area, etc.

***Result of preservation of community forest within the respective study areas:***

1) The condition of community forest improved through the process of preservation and management by the department as well as local users. This was achieved by management measures taken up inside the community forest by the department, which include demarcation of the boundary and subsequent erection of boundary pillars for community forest reserves. Likewise, protection measures were undertaken, such as creation of firelines and inspection paths inside the area for preventing it from fire and other biotic interference. Apart from this, artificial regeneration by planting suitable species and their subsequent gap filling was also done. All these measures improved the quality and health of the forest and increased the growing stock of the area.
2) The preservation of community forests also directly protects watershed of the nearby village, which increases the water reservoir in the area and acts as a good source of water for village water tanks, springs and wells that had decreased due to depletion of forest cover.
3) The villagers could meet their requirements of fuelwood, small timber, bamboo as well as other NTFPs after taking permission from the committee specially constituted for that with permissible limit of quantity.
4) Through the entry point activities, the villagers were benefitted in various ways, which include construction of community halls, public urinals, construction of link roads, churches, waiting sheds, culverts and other water tanks depending upon the requirements. Apart from this, the department

also distributed LPG gas stove to villagers. This significantly reduced pressure on forest from firewood collection.

5) Women participation to the society was increased by forming VFDC to carry out the departmental works through this committee. For this the criteria was to include women into the committee—at least 50 per cent of the committee members or one-fifth have to be women.

## Conclusion

The study on community forests in the selected three villages is helpful in perceiving the departmental goal towards maintenance of community forests in its present form and composition to achieve sustainable utilisation of such forests by local users. Previously, local users depended heavily on the forest for their needs. However, the existence of the community forest near the village to act as a reserve for security as well as to supply village requirements was not enough for sustainable use. The identification of such problems through village survey, the management measures through different means of technical inputs and people's participation brought positive changes to these community forests.

At the same time, scientific and technical inputs given by the department augmented the stronghold of community forests as there were some provisions under Mizoram Forest Act 1955. From this, the uses of community forests were regulated with certain rules and guidelines.

The four years project—from 2011 to 2014—to preserve community forests at these three villages—Chengpui, Zotuitlang and Mausen—had a good outcome for rejuvenating the forest, improving the growing stock and benefitting the local users.

# Link between avian density and habitat

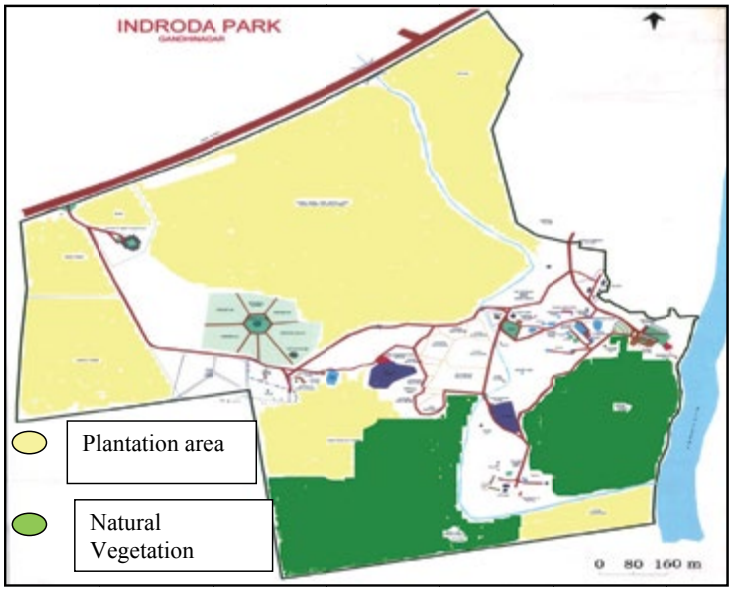
*Study of Bird Nesting Preferences in Indroda Nature Park, Gandhinagar*

**Brahmbhatt Bhargavkumar Chinubhai**

The Indroda Nature Park (INP), Gandhinagar, is situated at the bank of Sabarmati River.It can broadly be categorised in two vegetation types—natural and plantation—covering around 164 ha area of the INP. The present work, carried out during January 2017, explores the relation between nesting preference of birds in these two vegetation types. In a study done in 2014, a total of 173 plant species, belonging to 139 genera and 48 families, were recorded collectively from the two zones. Further, the two zones were found to have heterogeneous vegetation. The plantation area has less floristic diversity as compared to the natural vegetation area.

In addition to its floristic diversity, the park supports a rich avian diversity. So far, about 201 species of birds have been recorded from the park. This is about 38 per cent of the 526 bird species found in the State. Hence, the present study aims to look at the reasons for

## Study Area

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such augmentation of bird species by correlating nesting preferences with different habitats of the plants in the Indroda Nature Park.

## Objective

- To find out the relationship between floristic diversity and nesting of birds in the study area.

## Methodology

To fulfill the objective following methods were adopted:

- Data compilation of previous floristic studies.
- Data collection of bird nesting in INP.
- Counting of nests and species of plants on which the nests occurred.

## Results and discussion

***Floristic Diversity:***

A study carried out in 2014 reported 173 plant species belonging to 48 families and 139 genera. Out of these, 23 were climbers, 40 trees, 26 shrubs and 84 herb species (Figure 1). Also, 39 species were armed and majority of the vegetation in both the plantation and natural vegetation areas was found to

Figure 1: **Habitat distribution among plant species recorded.**


be of armed species. Though the area with natural vegetation was smaller compared to that of the plantation area, but the floristic diversity was higher in the natural vegetation area with 110 species.

## The avian diversity and nesting preference

A total of 149 nests of 57 bird species were recorded in the two vegetation types collectively. Out of which, 74 nests of 42 species were recorded in the plantation area and 75 nests of 44 species were observed in the natural vegetation area. Out of the 57 species found in the Park, 15 and 13 species were exclusively found in natural and plantation areas, respectively, and the remaining 29 species were found in both the areas (Figure2).

Figure 2: **Nest distribution in different Habitats**

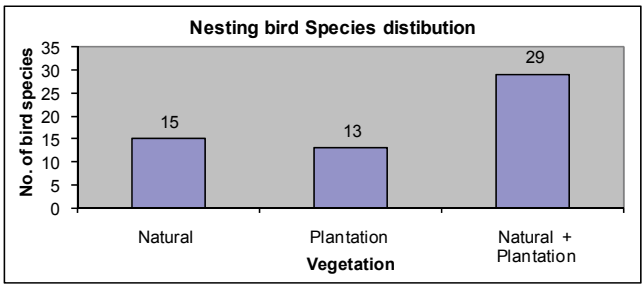
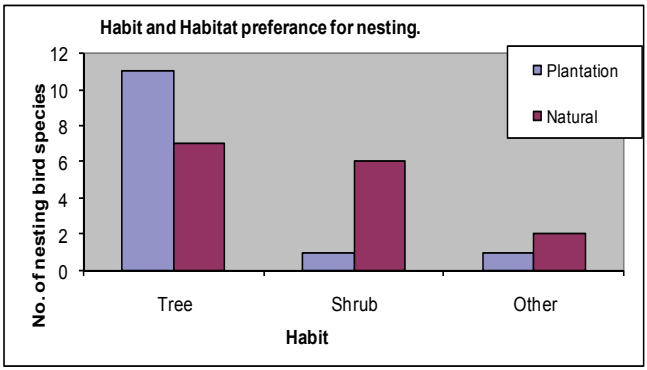


Figure 3: **Habit and Habitat preference in birds**




Further, in the natural vegetation area 7, 6 and 2 species nested on trees, shrubs and other habits of plants, respectively. In the plantation area, the numbers were 11, 1 and 1 species, respectively. In total 66.44 per cent nests were on trees, 27.51 per cent on shrubs, 5.3 per cent on ground and about 1 per cent on climbers (Figure 3).

## Conclusion

The study reveals that in INP, birds for nesting mostly prefer spiny vegetation (62.41 per cent) as it provides them protection as compared to the non-spiny vegetation (36.91 per cent).

The study also indicates that out of the 14 bird species which nest on shrubs (and one climber), 13 species prefer natural forests and only 8 species prefer plantation areas. Whereas six species exclusively nest in natural areas, there is only one species that exclusively nests in the plantation area.

- Most of the bird species prefer nesting sites based on availability of protection and food.
- The birds prefer armed as well as non-palatable species for nesting.
- In presence of bushes, trees are least preferred and absence of bushes may lead to the reduction of avian diversity in the habitat.
- To augment the avian diversity, bushes should be maintained along with trees in the habitat.

## Acknowledgements

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# Man-animal conflict in Wayanad wildlife division

*Competition for food and water in the fringes and habitat fragmentation are the two main causes of man-animal conflict in the region*

**Shrinivas lakhmawad**

Human beings and animals have been living in co-existence since ages, but today there is increasing incidents of man-animal conflict. This case study was conducted in the forest areas of Wayanad Wildlife Division, Wayanad district, Kerala. The forest areas of this division are contiguous to the Bandipur National Park of Karnataka and Mudumalai Wildlife Sanctuary of Tamil Nadu. Hence, they support all animals found in the sanctuary, including tigers. In almost all the portions of this division, man-animal conflict is on the higher side.

Tribals and other forest dwellers have been traditionally living in co-existence with wild animals since ages. However, the man-animal conflict has increased alarmingly in recent years. The study reveals that the competition between man and wild animals for food and water in the fringes and habitat fragmentation are the two main causes of man-animal conflict in the region

## Kinds of man-animal conflicts

The incidents of man-animal conflicts can be categorised into following major types:

- Human beings get killed or injured by wild animals in human-wild animal conflicts.
- Livestock/cattle reared by man gets killed/injured or lifted in human-wild animal conflicts.
- Crop is damaged in human-wild animal conflicts.
- House or other property is damaged in human-wild animal conflicts.
- Wild animals get killed or injured in human-wild animal conflicts.

## Causes of man-animal conflicts

***Habitat Loss:*** Due to varying degree of anthropic pressures, like shifting cultivation, extensive grazing, heavy forest exploitation, conversion of forest into teak plantation, large scale settlements of people, etc., leads to formation of mosaic of forest patches. This further leads to fragmentation and degradation of habitat of wild animals. Due to this habitat loss, the large mammals get affected in particular. Wild elephants used to move in corridors—a narrow strip of forests linking two major habitats of elephants. But due to the various anthropic activities, these corridors got

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degraded, which imposed restriction on the movement of large mammals.

***Population Pressure:*** As mentioned earlier, principal tribes living in the forest plateau are Mullukurumbas, Paniyans, Kattu Naikans, Uralis and a few Kurichiars. Wayanad is one of the major districts in respect of tribal population in the State. It constitutes 17 per cent of the total population in the district. There are 16 tribal colonies inside the forest area of the Division. Chetti, Gowdas and Christians are also residing in forest.

***Cattle grazing and fuelwood:*** Increased disturbance due to collection of fuel-wood, fodder, NTFPs, water, grazing etc., from the forests has also increased the incidences of man-animal conflict. Tendency to graze cattle deep in the forest and not adopting the practice of stall grazing has increased the number of man-animal conflict incidents.

***Change in crop pattern:*** Changes in cropping pattern have also contributed to increased man-animal conflict. People have started growing commercial crops like sugarcane, coffee, banana, coconut, arecanut, orange, etc., which provide food and good hiding place for wild animals like elephant, bison, monkeys, etc.

## Mitigation measures for man-animal conflict

Man-animal conflict has become a big issue now-a-days for society, wild animals as well as the Forest Department. The very first reason for this is that tolerance level of the people has reduced; they are treating wild animals as member of some other planet. Also, due to shrinkage of forest areas and some other reasons, incidence of conflict has increased by a significant number. There is no permanent solution for this, but by adopting proper mitigation methods, we can reduce the number of incidence. Some of the recommended mitigation measures are as follows:

- Measures may be taken for resettling interior enclosures to ensure free movement of wildlife.
- Measures may be taken to protect the existing browse species (like bamboo) and enhance their availability in the habitat.
- Existing *vayals* (marshy areas) should be maintained to ensure growth of palatable grass.
- Number of livestock within the forest should be reduced. Stall feeding should be encouraged.
- Eco-development programmes may be taken up as alternate source for the people depending on the forest that would reduce their impact on the habitat to a great extent.
- Electric fencing was found to be the most economic and effective control measures if maintained properly.
- Trenches, though effective, would cost more in maintenance.
- Compensation for damage due to wildlife is not a permanent solution to the problem. However, timely action for compensating the loss due to crop raiding would help in building up a good rapport with the people.

## Acknowledgements

I want to say thanks to those who helped in this work directly or indirectly during my case study. They gave me their precious time, guidance and help. I would like to give special thanks to wildlife warden of Waynad Wildlife Sanctuary, Mr Dhanesh Kumar. Thanks to Assistant Wildlife Warden of Kurchiat Range, Mr Ajit Raman, Assistant Wildlife Warden of Muthunga Range, Krishnadas. I also acknowledge Mr Vinod for accompanying with me to the forest.

I also want to say thanks to all staff of Waynad Wildlife Division and Kerala Forest Department for helping me in the case study.

# Convergence for Afforestation

*Utmost care, peoples' involvement and meticulous planning enabled the afforestation drive to become successful in the shortest possible time*

**R. Yesoda Bai**

The Andhra Pradesh Forest Department joined hands with the Panchayati Raj & Rural Development Department along with 13 other departments in the State to implement convergence of MGNREG Scheme funds with other State and Central share funds of these departments in developing and improving rural amenities while providing employment opportunities to the needy in rural areas.

As part of the convergence, the AP Forest Department was entrusted with the goal of greening the rural areas. Greening involved raising of nursery seedlings, taking up avenue plantations, shelter-belt plantations, bund plantations and distribution of seedlings to the public on demand. Other components were institutional planting, raising school nurseries and bio-fencing around those schools not having a permanent compound wall. Soil and moisture conservation works inside forest areas like continuous/staggered contour trenches, mini percolation tanks, check dams, rock filled dams, etc., were also amalgamated with the mandate given to the Forest Department.

The Annual Action Plan for each District / Division (Territorial / Wildlife / Social Forestry) was chalked out giving emphasis on MGNREGS, State Plan and Non-Plan Schemes.

On its part, the Social Forestry Division, Kurnool, achieved the mammoth target of raising 50 lakh seedlings in central nurseries in addition to field and school nurseries during the year 2015-16. These seedlings were extensively utilised for the 2016 planting season in the district by involving all the depart-

**Bio-fencing using *Caesalpinia pulcherima* plants around a school**

*IFS, Divisional Forest Officer, Social Forestry Division, Kurnool, Andhra Pradesh*

**School nursery at ZP HS, Kolimigunta**

ments, institutions like schools, colleges, health centres, farmers and general public. The nursery targets were also achieved through raising of nursery in 59 schools, with each school nursery having 5,000 to 6,000 seedlings. Species of local importance were raised in these nurseries as the students of secondary and senior secondary classes received hands-on experience in nursery techniques through these nurseries.

As an experiment, bio-fencing plantations in schools were carried out. About 21 km of such bio-fencing planting was taken up in 93 schools in the district, using species like *Lawsonia inermis*, *Nerium* sp., *Bougainvilla* sp., Golden Duranta, *Pedilanthus*, *Ceasalpinia pulcherima* for the first time during the 2016-17 planting season. Planting was done in a trench having 0.5 m width and 0.5 m depth with a spacing of 30 cm within and 15 cm between rows (3 such rows) placing approximately 9 to 10 plants per metre length of the trench. In all these schools, regular watering was done by the job card holders under MGNREGs. Thus, biofencing plantation was established in just three to four months.

Roadside avenue plantations were taken up during 2016-17 under a central scheme for backward districts, the SDP (Special Development Package) for backward area development. The district administration allotted Rs 3.5 crore for avenue plantations and the challenging task was given to the Forest Department. R&B roads and PR roads leading to villages were selected in consultation with the line departments and after field verification, avenue plantation was raised in 12 different locations running over a length of 100 km by the Social Forestry Division, Kurnool, with the limited staff available. Territorial and wildlife divisions in the district also collectively raised another 100 km avenue plantation using funds under the SDP. Species like Neem, *Pongamia pinnata*, *Ficus religiosa*, *Ficus benghalensis*, *Peltophorum pterocarpum*, *Samanea saman*, etc., are the major species planted on both sides of the road with a spacing of 5x5 m. Local villagers were engaged for watering the plants in addition to a

**Bio-fencing planting using *Tecoma* sp**

**Avenue plantation along R&B road**

watch and ward for every 5 km stretch of the plantation to ensure better survival and success of the avenue trees.

Utmost care, peoples' involvement and meticulous planning of convergence enabled the afforestation drive to become successful in shortest possible time. Recognising the achievements, the Social Forestry Division, Kurnool received the State Award for its work on the occasion of 'National Panchayathi Raj Diwas' on April 24, 2017 arranged by the Panchayathi Raj & Rural Development Department of Andhra Pradesh with special emphasis on the works taken up in rural areas and making an effort to bring change in the face of rural India.

# Tribal participation in conservation efforts in Andhra Pradesh

*Ecotourism programmes are aimed to sensitise visitors on nature conservation and to empower the local community by improving livelihood options*

**Sonam Dhole, Vikas Bhosale, Priyanka Sawant, Chaitali Wagh & Ashutosh Medhe**

The tribal people of Andhra Pradesh are economically and technologically better equipped than the tribes of other regions. Most of them have youth organisations. The government has been making efforts for the all-round development of the tribal people, including educational improvement, employment opportunities and socio-economic development. For their economical development, the government has included them in community-based ecotourism schemes. The primitive tribes of this area, viz Yanadi (Talkona) and Chenchus (Nallamala), were engaged in collection of honey, bamboo and other non-timber forest produce. The lifestyle of these communities mainly depended upon finding a living from the surrounding forest area. It is noted that they collect NTFP for their survival but maintained the balance and sustainability of environment.

The concept of participation originally grew out of radical criticism of mainstream development projects in the 1960s and 1970s. Critics who asked why development projects often failed to meet their objectives came to the conclusion that a lack of participation was the reason. Too many projects, they argued, were designed and implemented without consultation or cooperation with the people whose lives they affected. Since then, participation has become one of the buzzwords of development. It now seems that every project description or plan adopts a 'participatory approach', often because this is required by donor organisations for political reasons. Unfortunately, project planners and implementers frequently use the word 'participation' while continuing a traditional style of management that does not involve local people . Nevertheless, true participation may lead to more effective conservation of forest resources.

## Importance of people participation in conservation

Participation by local people is essential to conservation efforts like conservation of forest, wildlife, cultural, social aspects and so on. It is expected that humans can maintain better coordination with nature. Due to participation of local people, there is minimum disturbance to the forest so the whole ecosystem can be protected.

While conserving forests, local people get employment, food, charcoal,

*F.R.O. Trainees 2016-2018 batch UFTA Haldwani*

medicinal plants, non-timber forest produce, etc. Alternatives are provided to traditional farming practices like shifting agriculture that lead to deforestation and environmental degradation. Availability of amenities such as medical facilities, transportation facilities, water and sanitation in the remote regions help to improve the quality of life of the tribal community. The Forest Department also benefits as the local people help in protection of forests, minimising illegal activities like poaching, felling, encroachment, etc. Through NTFP and community-based ecotourism, the Forest Department also gets higher revenue.

## Peoples' participation in eco-tourism

**Talkona waterfall:** Yanadi is the second major tribe in the state and constitute one-eighth of the total tribal population of the state. Yanadi tribals are found more in Nellore, Chitoor and Prakasham district of AP. Considering their population and area of residence (i.e. forest land) the Forest Department decided to include these people in forest conservation efforts. At Talkona waterfall, they started community based eco-tourism.

The Forest Department constructed cottages, canteen, dormitory, bamboo huts and children park. From these resources, Rs 3-4 lakh per year revenue is generated. Out of these 80 per cent revenue is given to community development activity. Through such work, the Forest Department tries to conserve the tribe and their culture in the forest area. In return, the tribal people provide protection to the forest. The success of the initiative is evident from the fact that in future they want to increase accommodation and canteen capacity.

**Nallamala Jungle Camp:** The landscape of Nallamala is unique with deep valleys, grassland and forests. It is the best place for promoting conservation education to the general

public, tourists and students. Nestled in the Nallamala ranges of the Eastern Ghats is a repository of biodiversity and an abode for endangered flora and fauna. To elicit local support for wildlife and to impart conservation education to the visitors, ecotourism programmes with the involvement of local communities have been initiated in Nallamala Jungle Camp, Pacherla.

The Forest Department constructed four modern cottages, four tent houses, 1 restaurant, children park, children adventure game, jungle safari, etc. Theyalso helped to start the Girijan Cooperative Corporation (GCC) for collection and sale of honey.

The tribe provided labour for daily work, which helped in inclusion of tribes in economic development. In future, they want to develop boating for children, rock climbing and Nakshatra Vana, etc.

## Conclusion

Ecotourism programmes like jungle safari, jungle camp, nature trails, trekking, bird and butterfly watching, tribal archery and heritage walk are aimed to sensitise visitors on nature conservation and to empower the local community by improving livelihood options.

# *Vayals* and life in Wayanad

*The changing pattern of agriculture driven by policies has led to the destruction of the existing balance of vayal ecology.*

**Rameshwari Bongale Ashok**

Nature has its own way of expressing things. I got this experience when I was on my South India case study tour in Wayanad Wildlife Division of Kerala. The *vayal* is the cradle of synergy between wildlife and human life. It is a topographic site which depicts how mother earth takes care of all its children, including humans. *Vayal* is the topographical unit of land which is a low lying area between two high lands. Being so, it supports the flow of streams which are generally perennial in nature. It is a small basin-like structure having a substantially larger longitudinal dimension than horizontal. The very name of the Wayanad region comes from the *vayal*. *Nad* literally means land. Thus, the Wayanad is the land of *vayals*.

As one travels along the wavy yet well maintained roads of Kerala, one can see the repeated interruption created by small and large *vayals* in the overall landscape. This topography is peculiar in its form and expression, unparalleled to any other landscape I have seen yet. The topographical understanding of the *vayal* landscape was a humble beginning of a big experience for me. As I stepped out every morning for data collection regarding tribal resettlement and rehabilitation in Wayanad Wildlife Division, each moment seemed to offer a new experience, much beyond my own capabilities to understand it completely. Here, in Wayanad, everything is well knitted together by nature; a small wrong intervention can have devastating effects on the overall ecosystem.

The Kabini landscape of Northern Kerala is peculiar in its ecological and anthropological concept. Kerala, generally referred to as God's Own Country has lot to learn, feel and experience. Kabini is one crucial part of it. The composition of forest varies from the dry deciduous forest to mesmerising *shola* forests. The range is big and covers a variety of forest types and related niches.

*Vayals* adds to the functionality of the overall landscape not by just being a topographical component but also creating huge impact on ecological and livelihood conditions of the people. First, the *vayals* act as an excellent site for escape as well as attack by wildlife for its survival and food purpose, respectively. This dual nature of *vayals* makes it a hotspot for wildlife. The source of water in the *vayals* attracts a large number of herbivores, which are then followed by carnivore animals. The water availability helps in growth of tall grasses which creates an ambush atmosphere for the animals to attack.

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**Trees adjoining a *Vayal* in Tholpetty Range of Wayanad Wildlife Sanctuary**

Apart from wildlife, *vayals* are the rejuvenating grounds for ground water resource. Areas having *vayals* generally holds a handsome level of groundwater in comparison to other areas. *Vayals* have been the traditional grounds for paddy cultivation by tribal people. Tribals hinder the flow of water by creating a temporary barrier that stores the water. These created wetlands are used for paddy cultivation. Even today, the main livelihood source for people living in Wayanad is agriculture. The transition from food crop to commercialised non-food crop exists on parallel lines. Tribes such as Katunayakas categorised as a primitive tribal group live around the *vayals* and sustain on it. The lush green grass grown on both sides of the *vayals* is accompanied by small beautiful huts of tribal people in the middle of the dense forest. Though unique in itself, it is a commonly seen beautiful sight here.

Yet, all is not beautiful here. The story of *vayals* follows an unfortunate trajectory. The changing pattern of agriculture driven by policies has led to the destruction of the existing balance of *vayal* ecology. The post-independence policy to grow more food on all possible and available land led to intensive rice cultivation in *vayal* areas. The ready availability of water was a boon in the initial years. Intensive cultivation further brought chemical fertilisers and pesticide. The obvious result was water and soil pollution in this sensitive zone. Prosperity in agriculture brought in commercialised animal husbandry. A single tribal family holds the rights of 2-3 mulch animals but on the ground they hold at least 10 to 12 and the number may go high as 50 to 60 sometimes. One can imagine the huge

**A *Vayal* in Muthanga Range of Wayanad Wildlife Sanctuary**

grazing pressure of these animals in the middle of the forest. These animals are dominating the whole landscape, and number more than the wildlife. The changing nature of the life of tribals who continues to live in their original settlements is exponentially harmful as they bring changes directly to the core area of the forest. The change in the overall lifestyle of the primitive tribal groups of country itself is a big issue for discussion. Is it desirable? Is it sustainable? The culture of tribal people encompasses the traditions of ages. The damage, both in terms of tribal culture and ecological degeneration, is beyond correction.

A well-planned and managed scheme for resettlement and rehabilitation of tribal people is going in Wayanad. One can surely say that it is one of the best resettlement schemes in the country. The multi-stakeholder approach and interdepartmental cooperation is a case study that should be brought to other areas as well. Yet the question still persists about the very validity of resettlement and changes that government is bringing about in tribal life. Changes are clearly happening at two levels. On one level, the changes in tribal lifestyle in the middle of the forest is affecting *vayal* ecology. At another level, the people who are migrated from the forest to outer areas are suffering. The minds of these resettled people are as parched as the *vayals* nowadays. Psychological distress and the pain of moving move out of one's own land is immense. I talked to one such young man with the help of an intermediary translator, and his feelings of despair were very transparent.

Though the case study tour soon

came to an end, the issue still lingers in my mind. The beautifully woven lives of mother nature and human beings are getting disturbed every single day. It is high time that right steps are taken towards small positive interventions that should start correcting the course of human actions. At the end, nature is far beyond our understanding and holds immense potential to restore itself. Let's not come to such a point where there will be no option to return. It is time to show the humane side of our race. Let's be the children of mother earth again; let's get the warmth of her kind arms again.

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Sri. Dhanesh Kumar, Wildlife Warden, Wayanad Wildlife Sanctuary, Kerala

# Status of elephant barriers in Nagarahole Tiger Reserve

*With rising human-elephant conflict around the Nagarahole Tiger Reserve, it is all the more important today to increase the number of elephant barriers. While Elephant Proof Trenches and Solar Power Fences that have been constructed are in the need of maintenance, railway barricade is an innovative way to add to the barriers.*

**Chaudhari Brijeshkumar Devsingbhai**

Nagarahole Tiger Reserve (NTP), earlier known as Rajiv Gandhi (Nagarahole) National Park, was named after the river 'Nagarahole', which literally means the 'Serpent River' (Nagara = Serpent; Hole = River) in Kannada language. Nagarahole Tiger Reserve is spread over Mysore (Hunsur and HD Kote taluk) and Kodagu (Virajapet taluk) districts of Karnataka. It is located at the junction where the table land of Deccan plateau climbs up on to the Western Ghats, about 90 km west of Mysore city. It is situated at the foothills of Brahmagiri hill range (eastern range) of Western Ghats.

The area was declared a timber reserve as early as in 1870. In 1955, an area of 285 sq km was declared as a game reserve. In 1975, it was declared as Nagarahole National Park and the area expanded to 571.55 sq km. Strict wildlife protection measured were enforced thereafter. In 1988, the area was further increased to 643.39 sq km and in 1992 it was rechristened as Rajiv Gandhi National Park. Under Section 38 V (4) of the Wildlife Protection Act 1972, as amended in 2006, the Government of Karnataka declared an area of 562.41 sq km as 'Buffer zone' of Nagarahole Tiger Reserve (200.57 sq km as 'Ecological Buffer' and 361.84 sq km as 'Social Buffer'). During 1870-1980, monoculture plantation of teak was raised which currently occupies about 14 per cent area of the National Park. The elevation of the National Park is 700-960 m and it has a tropical climate with an annual rainfall of 1000-1500 mm.

Administratively, the entire 643.39 sq km core, or the Critical Tiger Habitat, of the Nagarahole Tiger Reserve (Hunsur Wildlife Division) is divided into seven wildlife ranges. For management purposes, these seven ranges have been further divided into 19 sections and 63 beats.

## Reasons for man-animal conflict in NTP

Nagarahole is one of the important tiger reserves of our country, sharing a border of 226 km with the outside world. Of this, 155.9 km is along the eastern, southern and western side of the Reserve. Along the eastern side, it shares 84.9 km boundary with local

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villages and agricultural land. Along the western side, it shares 71.1 km border with coffee estates. Further, it shares 15 km inter-State boundary with Kerala, which is mainly forest area, and 10 km boundary with the forests areas of Virajpet and Hunsur territorial divisions, which have now become part of the Buffer Zone of NTP. Around, 45 km long border is surrounded by Kabini and Taraka backwaters. Within 5 km periphery of the 84.9 km long boundary on the eastern side, there are more than100 villages with population more than 1 lakh. In the recent past, there has been an increase in the movement of wild animals to the neighbouring fields and villages. Most of the land around the tiger reserve, which was fallow earlier, has been put under cultivation in recent days. Moreover, the cropping pattern around the tiger reserve has changed drastically—from low value crops to high value commercial crops like sugarcane, banana, etc. This has contributed to largescale human-elephant conflict around the eastern border of NTP as elephants are attracted more towards these high energy crops. Further, the presence of jackfruit trees in the coffee estates along the 71.1 km border in the western side of NTP, also lure elephants to this area.

The factors responsible for the human-elephant conflict in and around NTP may be attributed to the following facts:

- Habitat degradation.
- Vegetation type and change in its composition (reduction of palatable grass including bamboo and fodder species). The proportion of bamboo has reduced from 70 per cent to30 per cent within the last 40-50 years.
- Spread of Alien Invasive Species (AIS) like *Lantana, Parthenium, Eupatorium, Heliotropium indicus, Xanthium strumarium* etc. has reduced the fodder quality in most areas of the Tiger Reserve and has thus created temporary scarcity of fodder in places.
- Encroachment of forest land (By coffee estates along the western borders of the Tiger Reserve and by forest villages on the southern end of the Tiger Reserve).
- Change in cropping patterns in the agriculture areas surrounding the Tiger reserve. High value commercial crops, which are more nutritious and very lucrative for the elephants like sugarcane and banana are grown very close to the Reserve.
- The agricultural land around the Tiger Reserve today was forest land earlier and thus part of the elephant home range. This has led to the human-elephant conflict.
- Habitat fragmentation at some places, like at Kutta, have led to elephants frequently coming to this place before crossing from Kerala and Nagarahole to Brahmagiri wildlife sanctuary and vice-versa.
- No proper maintenance of the existing Elephant Proof Trench (EPT) and power fence / solar fence (batteries, fence) have led to the breach of these barriers by elephants.
- Failure to keep watch and ward at some places and failure to provide adequate fire crackers to these watch and ward people have led

to aggravated conflicts between humans and elephants.

## Nature of crop damage by elephant

In case of staple foodgrains, nature of damage by elephants is through eating of panicles. In the case of non-grain food crops, the damage is through eating tender and its shoots, trampling, uprooting of young seedlings. Commercial crops are damaged through trampling, breaking of branches and twigs. The percentage of damage is high in commercial crop areas (25.98 per cent), followed by staple crop (24.49 per cent) and non-grain crop (22.63 per cent).

## Different types of barriers

a) **Elephant Proof Trench (EPT)**: Dimension of 3 m x 3 m x 1 m (top width: depth: bottom width). During 1980s, the department excavated EPTs

**Expenditure on excavation of EPT during 2010-2016**

| Year of working | Total Length of EPT excavated | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | - | - | |
| 2011-2012 | 1.1 km | 2.789 lakh | 253.54 ≅ 254 ₹ |
| 2012-2013 | 7.24 km | 18.940 lakh | 261.60 ≅ 262 ₹ |
| 2013-2014 | 0.39 km | 2.887 lakh | 740.25 ≅ 740 ₹ |
| 2014-2015 | - | - | - |
| 2015-2016 | 17.520 km | 125.435 lakh | 715.95 ≅ 716 ₹ |
| **Total** | **26.26 km** | **150.060 lakh** | **571 ₹ Average** |

**Expenditure on restoration of EPT during 2010-2016**

| Year of working | Total Length of EPT restored | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | 18 km | 12.480 lakh | 69.33 ≅ 69 ₹ |
| 2011-2012 | 37.98 km | 63.495 lakh | 167.18 ≅ 167 ₹ |
| 2012-2013 | 41.82 km | 69.930 lakh | 167.21 ≅ 167 ₹ |
| 2013-2014 | 29.01 km | 71.480 lakh | 246.39 ≅ 246 ₹ |
| 2014-2015 | - | - | - |
| 2015-2016 | - | - | - |
| **Total** | **126.80 km** | **217.385 lakh** | **171 ₹ Average** |

along the boundary of NTP of over 156 km wherever human habitation and agricultural land exist on the periphery.

Practical difficulties, frequent crossing over by NTFP collectors either damage or fill up the elephant proof trench at many points/places. Siltation during rainy season is also a problem in maintaining the EPTs. These points along the EPT from where elephants can easily cross over the trenches lead to conflict between people and the wildlife.

b) **Solar Power Fence (SPF):** For effective working of Solar Power Fence, solar sheds are constructed every 2.5 km along the boundary line to keep solar energizers, solar panels and battery, etc. These solar sheds can also be used as anti-depredation sheds, where staff can stay at night.

There are two different groups of people around the Reserve. One, those who having agricultural land, cultivate crops and demand that wildlife should not cross from NTP, and two, landless individuals have large number of cattle and push the same inside the Tiger Reserve for illegal grazing. They also collect firewood and NTFP from the forest, thus damaging the solar fence. They basically don't want these barriers so as to facilitate their entry into the PA.

A total of 89.80 kms of SPF has been installed since 1980. Today, only 35.5 km of SPF is in working condition. In the photos, we can see that SPF has been damaged by either the elephants or the

**Expenditure on erection of SPF during 2010-2016**

| Year of working | Total Length of SPF erection | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | 4.63 km | 7.560 lakh | 163.28≅ 163 ₹ |
| 2011-2012 | 11.25 km | 22.994 lakh | 204.39≅ 204 ₹ |
| 2012-2013 | 14.50 km | 32.592 lakh | 224.77≅ 225 ₹ |
| 2013-2014 | 1.53 km | 1.249 lakh | 81.63≅ 82 ₹ |
| 2014-2015 | - | - | - |
| 2015-2016 | - | - | - |
| **Total** | **31.91 km** | **64.395 lakh** | **201 ₹ Average** |

**Expenditure on maintenance of SPF during 2010-2016**

| Year of working | Maintenance of total Length of SPF | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | 31 km | 13.460 lakh | 43.41≅ 43 ₹ |
| 2011-2012 | 39 km | 5.879 lakh | 15.07≅ 15₹ |
| 2012-2013 | 11.50 km | 2.403 lakh | 20.89≅ 21 ₹ |
| 2013-2014 | 5.25 km | 1.620 lakh | 30.85≅ 31 ₹ |
| 2014-2015 | - | - | - |
| 2015-2016 | 35.500 km | 7.649 lakh | 21.54≅ 22₹ |
| **Total** | **122.25 km** | **31.011 lakh** | **25 ₹ Average** |

village people.

c) **Masonry walls, RCC pillars, concrete beam pillars and iron spike fabrication:** Stone masonry wall, rubble stone masonry wall and any other special structure to plug any porous point on the boundary line. This should be taken up once EPT and solar power fence have been completed. Since elephants were intelligent animals, they constantly try to break and breach the barrier. On such spots, we have go for SSM wall, RSM wall and any other special civil structure, using discarded railway tracks and iron pillars etc. to plug the weak points.

d) **Barricade using Railway rails:** On the lines of the success story of Addo National Park of South Africa, there should be a pilot project to erect elephant Proof barricade by using used railway sleepers along the boundary of NTP. This should be taken as a pilot project around selected areas along

**SSM WALL**

**Expenditure on construction of RSM wall pitching to ETP during 2010-2016**

| Year of working | Total Length of RSM constructed | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | 172 mt | 5.001 lakh | 2907.55≅ 2908 ₹ |
| 2011-2012 | 1144.70 mt | 37.610 lakh | 3285.57≅ 3286 ₹ |
| 2012-2013 | 837.80 mt | 35.775 lakh | 4270.11≅ 4270 ₹ |
| 2013-2014 | 1077 mt | 47.329 lakh | 4394.52≅ 4395 ₹ |
| 2014-2015 | 705.80 mt | 36.225 lakh | 5136.72≅ 5137 ₹ |
| 2015-2016 | 285.400 mt | 37.487 lakh | 13134.89≅ 13135 ₹ |
| **Total** | **4222.70 mt** | **199.427 lakh** | **4722 ₹ Average** |

**Expenditure on construction of SSM, pillars, iron spike fabricated during 2010-2016**

| Year of working | Total Length of different civil structure constructed | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | - | - | - |
| 2011-2012 | 313.20 mt | 21.073 lakh | 6728.28≅ 6728 ₹ |
| 2012-2013 | 511.40 mt | 53.621 lakh | 10485.13≅ 10485 ₹ |
| 2013-2014 | 1709 mt | 144.356 lakh | 8446.81≅ 8447 ₹ |
| 2014-2015 | 2168.80 mt | 153.839 lakh | 7093.27≅ 7093 ₹ |
| 2015-2016 | 1162.500 mt | 116.445 lakh | 10016.77≅ 10017 ₹ |
| **Total** | **5864.90 mt** | **489.334 lakh** | **8343 ₹ Average** |


**RSM WALL**


**RCC PILLARS**


**IRON SPIKE FABRICATED**

**Concrete beam pillars**

**Expenditure on erection of barricade using rails**

| Year of working | Total Length of railway barricade constructed | Expenditure (in Rs) | Expenditure per metre |
|---|---|---|---|
| 2010-2011 | - | - | - |
| 2011-2012 | - | - | - |
| 2012-2013 | - | - | - |
| 2013-2014 | 73 mt | 42.138 lakh | 57723.28 ₹ |
| 2014-2015 | 285 mt | 1003.968 lakh | 352269.47₹ |
| 2015-2016 | 8989 mt | 1299 lakh | 14450.99 ₹ |
| **Total** | **9347 mt** | **2345 lakh** | **25088 ₹ Average** |

**Abstract**

| Total periphery of NTR | Barriers required | EPT already excavated | SPF in working condition | Construction of SSM, RSM, pillar, iron spike fabricated | Erection of railway barricade (including work under progress) |
|---|---|---|---|---|---|
| **226 km** | **156 km** | **156 km** | **35.5 km** | **10.09 km** | **23.31 km** |

the boundary of the core area of NTP, then, based on its effectiveness, it can be implemented all along the 155 km (84.9 km along the eastern border adjoining revenue villages and 71.1 km along the western border adjoining coffee estates) boundary of the Tiger Reserve.

## Conclusion

Since railway barricades have been constructed, number of cases of crop compensation are decreasing. So, we can definitely say that railway barricade is relatively better than other barriers. Other barriers can be effective if they are kept under continuous observation and properly maintained. It does seem that the cost of constructing railway barricades, compared to the money paid by the department for crop

**Comparison of cost of Elephant barrier with crop compensation cases' expenditure due to elephant**

| Year | Expenditure on erecting elephant barriers (in Rs) | No. of crop compensation cases | Expenditure of crop compensation cases (in Rs) |
|---|---|---|---|
| 2010-2011 | **38.501 lakh** | 1637 | **57.987 lakh** |
| 2011-2012 | **153.849 lakh** | 1308 | **57.707 lakh** |
| 2012-2013 | **213.261 lakh** | 1703 | **73.503 lakh** |
| 2013-2014 | **311.059 lakh** | 1336 | **58.751 lakh** |
| 2014-2015 | **1194.032 lakh** | 1027 | **35.673 lakh** |
| 2015-2016 | **1586.019 lakh** | 858 | **30.639 lakh** |

damage, is much higher. Moreover, erection of 156 km long railway barricade will be expensive. Also, after a short time railway barricades too need maintenance.

We also need to think of methods like promoting community and private solar fences around crop lands, community-based cooperative crop protection effort, control of elephant population, change in cropping pattern, etc.

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**Note:** Articles may be sent at the following email ID:
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## Contributions Invited

The Field Forester invites articles from serving as well as retired forest officers and others working in the forestry sector. The Field Forester offers a unique platform for forestry professionals to share their work and experiences. The article should be interesting and entertaining to read and should be written in a lively and concise style.

## Evaluation and Review System

There will be two layers of review of the contributions; Faculty and the Directorate review. Evaluation and review at the faculty level in the training institutes/academies will be undertaken under the guidance of Director/Principal/Head of the institutions. Even very specialized and technical topics shall be presented in simplified format so that frontline staff and forest community are able to appreciate and understand the topics. Articles shall be written in a popular style, easily understandable and in simple English.

However depending on the response to this programme, arrangements can be made for translation of the magazine into the vernacular. A short note about the contributor and the reviewer shall accompany the article. The note shall contain name, age, postal and e-mail address, course, academic accomplishments, and important assignments held. The evaluation would be done on following criteria:

a. **Style**: The article should be interesting and informative. The introduction should draw the reader in and convince them that the remainder is worth reading. The remaining should be written in a lively and concise style, and should leave the reader convinced of the importance of the topic.
b. **Structure**: The article should be within 1000 words, and formatted in 1.5 line spacing in Times New Roman 12 point font.
c. **Organization**:
    - Instead of an abstract the article will give information on the location, the period when the field work was carried out
    - Integration - the article organized in a coherent form and all ideas are clearly leading to a single main argument.

The review at the Directorate level will be done through an editorial board constituted by the DFE, which will be responsible for the content, design and review of the journal articles. The editorial board shall consist of expert/experts constituted by DFE and reconstituted every year, which would screen contributions and recommend their publication. Articles previously published elsewhere, or simultaneously sent for publication elsewhere, may be accepted with modifications. Article submitted shall carry a declaration that the article is original. The Editor would reserve the right to reject articles without assigning any reason and articles not found suitable will be sent back.

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