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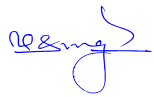
From the Chief Editor's Desk

Forestry, in a holistic view, is an integration of various disciplines relying on scientific principles and traditional wisdom. Managing the forests not only includes management of trees and stands, but also other flora and fauna in varied ecosystems and human beings either living inside the forest ecosystem or on forest fringe areas. Thus a multi-pronged approach is inevitable in the integrated management of forest ecosystem. The December 2016 issue of Field Forester, like previous volumes, is a window that offers an excellent view of various approaches towards achieving the objectives of forest and wildlife conservation in India.

The mission of greening India is impossible without production of planting materials of the highest quality. Article regarding methods adopted in Mizoram for quality seedling production makes a good reading and enhances the knowledge especially for those readers who are entrusted with nursery management in the field. Articles on Wildlife management include man-crocodile conflict management, anti-poaching initiatives, habitat management and success story regarding conservation of the endangered Sangai in Manipur. The smaller sized fauna also play an important role in maintaining the ecosystem processes as much as the larger wild animals. An article on the butterflies of Jaisamand Wildlife Sanctuary in Rajasthan has rightly named the butterflies as "Living Jewels." An exclusive narration on reviving degraded grassland surrounding a lake called Deoriatal in Kedarnath Wildlife Division exemplifies the need to manage anthropogenic pressures to revive the sensitive high altitude lake and grassland ecosystem. In India, conservation has its roots in its culture and traditions. The article on "Sanskritik Van" reflects this unique feature of Indian culture. People and Biodiversity are inseparable from one another. Socio-economic status of the Kanikkar Tribe of Southern India - one of ethnobotanicall rich tribes - is very informative and interesting while eco-friendly approach for tribal development in Chinnar Wildlife Sanctuary, Kerala presents innovative ideas in implementing eco-development programmes. Lesser known indigenous edible fruits and plants of Nagaland have been discussed in details in one of the articles while another article throws light on different biotechnological opportunities available for propagation and conservation of medicinal plants.

The present issue of Field Forester is a good mix of various topics encompassed by forest and biodiversity conservation as practiced across length and breadth of the country. These articles reflect practices and experiences from Western Himalayas, Eastern Himalayas, Western India and Aravallis and the Western Ghats. I am sure that readers will enjoy the articles in this issue of Field Forester and also think of adopting the best practices as narrated in the articles.



(R.P. Singh, IFS)

Producing quality seedlings in Mizoram

Use of traditional techniques and benefit of staff experience has enabled the nursery in Leitan Kawnchung to successfully grow rare trees

Lalthafamkima

As per satellite imaging, Mizoram has a large forest cover—this data includes green herb and shrubs. But, in reality, the actual tree cover is not as much. So, the Department of Environment and Forest planned to plant trees in different parts of the State. For this, nurseries have been set up in different parts of the State. Nursery is a pre-requisite for producing quality seedlings with lesser input and nursery management is a potential tool to successfully execute the activity. This study is an attempt to narrate nursery management and its techniques which lead to their success.

This nursery is located at Leitan Kawnchung in the northern part of Darlawn town (5 km from main town). This Hi-tech Nursery, established in 2014, is a centralised nursery in public sector under NBM. Its area is around 2 ha. Since it is located in a hilly area, standard bed size could not be maintained throughout. In some places, the bed is longer than standard size while in some places it is shorter. The size of the bed is adjusted as per the topography. There are more than 300 beds in the nursery and the approximate annual production is around 40,000 seedlings. Despite being established recently, the nursery has grown tremendously because of the dedication of the staff.

Input Management

Water

Water is taken from the nearby river with the help of an electric pump. The water is stored in a water tank on the top of the hill, from where water is distributed to different parts of the nursery. As there is no water sprinkler, water is given to the plants by a plastic pipe. For newly sown seeds, water is given regularly, but for the older germinated seeds, it is given once every two days. In rainy season, rainwater is collected and stored in the tank; this saves power and money.

Bed

As Mizoram receives enough rainfall, all nursery beds are level beds. The bed is well ploughed before sowing seeds. Bricks are placed at the edge to prevent the beds from crumbling in dry season. As mentioned earlier, the beds cannot have a standard size due to topography. Before sowing, dry leaves are burnt on the bed to control weed. There is open and shade bed according to the need of the seedling. Small and lightweight

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seed are covered with sacks so as to prevent from being wind blown.

Fertiliser

DAP (Di-ammonium phosphate), Neemkasto (from seed of neem plant, good source of NPK) and cow dung are the main fertilisers used in this nursery. The fertilisers are given in liquid form with less concentration at the initial stage. Raw fertilisers are given after they are transferred to the polypot. Other than fertilisers, as the soil in Mizoram is mostly acidic in nature, lime is added to the soil to make it alkaline and neutral.

Weeding

Weeding is done five times a year on a largescale. But, whenever weed germinates in the bed or nearby, they are taken out immediately. The nursery bed and surroundings are kept clean and *khurpi* is the tool commonly used for weeding.

Fencing

The nursery is fenced with barbed wireto protect it from grazing by animals and biotic pressure.

Labour

Labourers are mainly used during sowing, transferring from bed to polypot, filling of polypot and weeding and collection of seeds. Around 10 labourers carry out different activities while one permanent labourer is used in the nursery the whole year round.

Shade House

The main structure of Shade House is made of galvanised iron, which is covered by a nylon. It is used for acclimatisation of seedlings before planting them in the field.

Sowing

Sowing is mostly done in line, dippling and broadcasting. The soil is thoroughly dug and seedlings are covered with a thin layer of soil. The sowing techniques are different from species to species.

Collection of fruit/seeds

Collection is done in a season when fruits are available. The fruits are collected from the nearby forest area. Available fruits are collected from the tree; the branch is chopped off from where fruits are difficult to collect; and, in some areas, fruits falling on the ground are too collected.

Seed extraction

Extraction is conducted carefully to avoid damaging the seed. Only mature and healthy fruits are processed for seed extraction. Normally, 2-3 days of drying is done. Rubbing and crushing of fruits is done with care. Some common tools used during extraction include axe, pruning knife, sacks, trays, buckets and other abrasive material. Species which have wings pod/seeds, are detached by crushing or rubbing of the seed. Large, firmly attached wings are removed by hand and discarded.

Achievement

The great achievement of the nursery is that it can successfully germinate those trees that are hardly grown in

other places of Mizoram. The Forest Guard, who is the man in-charge of this nursery, has done a wonderful job in successful germination of the tree. In the nursery, the staff mainly uses traditional techniques. These, coupled with staff experience, is working very well. The trees which are successfully grown include, *Thingdawl* (*Tetrameles nudiflora*), *Banphar* (*Anthocephalus cadamba*), *Zuang* (*Duabanga grandiflora*) and *Sal* (*Shorea robusta*).

Nursery techniques for different trees are as follows:

Thingdawl (*Tetrameles nudiflora****)***

Time for seed collection: The collection of seed can be started from the middle of April.

How to collect the seed: Mostly collected by chopping off fruit-laden branches. If the fruits are dark green, it has seed content

Processing of the seed: The seeds collected are dried under sun for 3-4 days. The fruits then break up and seeds have to be taken out.

Method of sowing: The nursery bed has to be ploughed and seed has to be sown directly. For better results, dry leaves are burned on the nursery bed as this removes some of the weeds present on the bed and also in better seed germination.

The seeds should be sown right away as they are viable for a few days only.

Banphar (*Anthocephallus cadamba****)***

Time for collection of fruits: August and September are the time for collection of seeds, but, if possible, collection in August is preferable.

How to collect the fruits: The fruits falling on the ground are collected.

Processing of seed: The fruit collected should be covered up 3-4 days for softening the fruits' cover. Then the fruits are put in a water bucket where the seed can easily be separated from the fruit. The seeds are dried in shade.

Method of sowing: The seed has to be sown in a shaded bed. It should be covered with a thin layer of soil. The seed collected in August can be sown on the nursery bed on February. Usually it germinates three weeks after sowing.

Zuang (*Duabanga grandiflora****)***

Time for collection of fruits: In April and May, the fruits become dark, which means the seed is ready for collection.

How to collect the fruits: The seeds are very small; they should be taken out from the fruits.

Processing of seed: The fruits should be dried under the sun for about 2- 3 days. The fruits then break and seeds are taken out from the fruits.

Method of sowing: The bed should be made in such a way that the soil is loose enough. The seed should be covered by sacks to prevent them from being blown away in wind. Water should be given regularly.

If the seedling is good, it should be transferred to the polypot in August. It is a fast growing tree and doesn't require that much fertiliser. If the roots cross the polypot, it will be difficult to plant the next year. If the polypots are to be kept in the nursery for a longer

Materials used in nursery

Nursery beds

Successfully planted Duabanga trees

Awards for outstanding service 2016

time, the root must be taken care otherwise the plant will be die.

***Sal* (*Shorea robusta*)**

Time for collection of seed: The seed is collected in June.

How to collect the seed: The fruit cover is removed and the seed is taken out.

Processing of the seed: The seed is viable for a short period only, so it has to be sown with 1-2 weeks.

Method of sowing: Before the seed is sown, the nursery bed should be well ploughed. After sowing, the seed bed should be covered with sacks and water should be given regularly. The seed germinates after 15 days.

After germination, the seedling is shifted to the polypot.

Discussion

The forest guard's efforts and dedication have brought changes to this nursery to even made it compatible with some of the central nurseries established in Mizoram such as Tuirial Central Nursery and Sairang Central Nursery which had been established long back.

Biodiversity conservation through 'Sanskritik Vans'

The main objective of Van Mahotsavs is to create mass awareness about important trees and green cover

Patel SK[1], Verma YL[2]

Van Mahotsav is an annual tree-planting movement in India, which began in 1950. It has gained significant national importance and every year millions of saplings are planted across India during celebration of Van Mahotsav week. Gujarat government had started a trend and associated the celebrations of Van Mahotsav with cultural heritage instead of only promises of saving the environment and preventing deforestation. The initiative of celebrating Van Mahotsav with people and planting trees according to the various Indian traditions have collectively came to be known as 'Sanskritik Van', with the main objective of creating mass awareness about important trees and green cover.

Department of Forest, Gujarat State, has been organising and executing this new concept of Van Mahotasavs in State, districts and taluka level since 2004. Van Mahotasavs have been held at Gandhinagar (2004), Ambaji (2005), Taranga (2006), Somnath (2007), Chotila (2008), Shamlaji (2009), Palitana (2010), Pavagadh (2011), Mangadh (2012), Dwarka (2013), Kagwad (2014), Navsari (2015) Anand, Valsad, Surat and Jamnagar collectively in 2016. As per the description given in the *Puranas*, each *Graha* (Planet), *Nakshtra* (constellation) and *Rashi* (Zodiacs) has its own favourite tree or trees and protection of such trees gives positive effect and power to individual; keeping this in mind, each and every *van* viz, Punitvan, Mangalyavan, Tirthankarvan, Hariharvan, Bhaktivan, Shyamalvan, Pavakvan, Virasatvan, Smrutivan, Nageshvan, Shaktivan, Jankivan, Mahisagarvan, Amravan, Ektavan, and Shahidvan is constituted by *Grah* Vatika, Nakshtravan, Rashivan, Panchvati, Navgrahvan, Dashavatar-van, Devvan, Heritage corner, Dhan-vantaryvan, Arogyavan, Nirog Balvan etc. The State government has thus changed the concept and given a new shape to Van Mahotsav programme keeping in mind that once faith is developed for conservation, people unintentionally preserve nature.

'Tirlhankar Van''at Taranga

Taranga is a Jain pilgrimage centre

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named after Boudhh Devi Tara, 120 km from Ahmedabad, in Mehsana district of Gujarat. It has a beautiful temple of Lord Ajitnathaji, built by the Solanki dynasty king Kumarpal in 1121 AD. Due to rush of thousands of pilgrims, Taranga assumes special importance as a pilgrimage as well as a tourist centre. Keeping in view the significance of the centre for the followers of Jainism, a Tirthankar Van was set up on July 13, 2006. This 'Van' has been planned in the typical design of Kalpa Vruksha Yantra. The Tirthankar Van also has Nakshatra Van, Navgraha Van, Rashi Van and SriparniVan.

Material and method

The major sources of secondary data for this case study come from reports and publications published by the Gujarat Forest department. Information about area, plant species, number of trees, nurseries, distribution of saplings regarding Tirthankar Van were taken from the booklet for Van Mahotsav-2006, provided by the Gujarat Forest Department. These booklets also had information about trees planted in Rashivan, Nakshtravan, Grah Vatika and Shreeparnivan, so that the people can see and identify the trees with respect to their *Rashi, Grah* and *Nakshtra*. Several field visits have been made and through direct sighting, tree identification and counting has been done. With respect to these information and data, the result is given in original form.

2.1 Establishment of Tirthankar Van

Taranga hill is located in the western end of the Aravallis; it is to the south-west of Sabarmati. The rocky hills covered by *Anogeissus* forest, form a hilly landscape.

Figure 1: **Design of Tirthankar Van based on Kalpvriksha Yantra**

The 24 Tirthankars of Jainism were enlightened with eternal knowledge under various trees. These trees are known as 'Kevali Vriksha'. It is believed that planting of these trees brings blessings of the Tirthankaras. The design of

Table 1: **Detail of trees planted in Tirthankar Van**

S. No.	Name of Tirthankar	Name of "Kevali Vriksha" planted	No. of sapling planted	No. sapling survived
1	Shri Rishabhdeva Swami	*Ficus benghalensis*	1	1
2	Shri Ajitnath Swami	*Alstonia schularis*	1	1
3	Shri Sambhavnath Swami	*Shorea robusta*	1	1
4	Shri Abhinandan Swami	*Buchanania lanzan*	1	1
5	Shri Sumatinath Swami	*Callicarpa macrophylla*	1	-
6	Shri Padmaprabha Swami	*Ficus benghalensis*	1	1
7	Shri Suparsvanath Swami	*Albizia lebbeck*	1	1
8	Shri Chandraprabha Swami	*Calophyllum inophyllum*	1	1
9	Shri Suvidhinath Swami	*Aegle marmelos*	1	1
10	Shri Shitalnath Swami	*Ficus lacor*	1	1
11	Shri Sreyanshnath Swami	*Saraca indica*	1	1
12	Shri Vasupujya Swami	*Symplocos racemosa*	1	1
13	Shri Vimalnath Swami	*Syzygium cumini*	1	1
14	Shri Anantnath Swami	*Saraca indica*	1	-
15	Shri Dharamnath Swami	*Butea monosperma*	1	1
16	Shri Shantinath Swami	*Cedrus deodara*	1	-
17	Shri Kanthunath Swami	*Symplocos racemosa*	1	1
18	Shri Arnath Swami	*Mangifera indica*	1	1
19	Shri Mallinath Swami	*Saraca indica*	1	1
20	Shri Suvrat Swami	*Michelia champaca*	1	1
21	Shri Naminath Swami	*Mimusops elengi*	1	1
22	Shri Neminath Swami	*Salix caprea*	1	1
23	Shri Parsvanath Swami	*Woodfordia fruticosa*	1	1
24	Shri Mahavir Swami	*Shorea robusta*	1	-
		Total	24	20

this *Van* is based on the 'Kalpa Vriksha' yantra, where the trees associated with the Tirthankars are planted.

For establishing Tirthankar Van, survey no. 718 and 719 of total area covering 14,872 sq m from Timba gram panchayat has been transformed from grazing land to forest land as well as survey no. 717 of total area covering 5,969 sq m from Timba gram panchayat has been transformed from government wasteland to forest land and given to the Forest Department, Social Forestry Range, Kheralu. Similarly, total area of 33,159 sq m from forest land has been transformed for the purpose of

Tirthankar Van. Thus total area of 54,000 sq m (5.4 ha) has been utilised for establishment of Tirthankar Van.

2.2 Establishment of Navgraha Van

Indian astrology strongly believes in definite correlation between plants and planets (*Navagrahas*). These planets are supposed to influence different organs in the body, either in positive or negative manner, and may result in diseases due to evil effects. Different plants have been prescribed for usage to overcome the ailments. Such plants are thus associated with planets and are believed to have medicinal properties for treating the diseases. A Navgraha Van would thus typically include plants associated with each of the *Navgrahas*.

2.3 Establishment of Nakshatra Van

Constellations are groups of stars which appear to be fixed in the sky. The Hindu *panchanga* assigns a separate tree for each of the 27 constellations (*Nakshatras*) through which the sun passes. It is believed that celestial bodies like the sun and the moon exert different influences on human beings when they are transiting through these 27 constellations. It is also believed that such effects can be moderated or enhanced by planting and worshiping trees assigned to each constellation. This collection of trees planted in the correct order constitutes a Nakshatra Van.

Figure 2: **Design of Navgrah Van**

Table 2: **Detail of trees planted in Navgrah Van**

S. No.	Name of planet	Name of trees planted	No. of sapling planted	No. sapling survived
1	Budh(Mercury)	*Achyranthes Aspera*	5	5
2	Shukra(Venus)	*Ficus glumerata*	5	3
3	Chandra(Moon)	*Butea monosperma*	5	3
4	Guru(Jupiter)	*Ficus religiosa*	5	3
5	Surya(Sun)	*Calotropis Procera*	5	3
6	Mangal(Mars)	*Acacia Catechu*	5	3
7	Ketu(Ketu)	*Saccharum Spontaneum*	5	4
8	Shani(Seturn)	*Acacia Ferruginea*	5	4
9	Rahu(Rahu)	*Cynodon Dactyon*	5	5
		Total	45	33

Table 3: **Detail of Trees planted in Nakshatra Van.**

S. No.	Name of constellation	Name of trees planted	No. of sapling planted	No. sapling survived
1	Ashwini	*Strychnos nuxvomica*	3	2
2	Bharni	*Emblica officinal*	3	3
3	Kritika	*Ficus glomerata*	3	3
4	Rohini	*Syzygium cumini*	3	3
5	Mrigshira	*Acacia catechu*	3	3
6	Ardra	*Awuilaria agalocha*	3	3
7	Punarvasu	*Dendrocalamus strictus*	3	3
8	Pushya	*Ficus religiosa*	3	3
9	Ashlesha	*Mesua ferrea*	3	-
10	Magha	*Ficus benghalensis*	3	3
11	Purva Falguni	*Butea monosperma*	3	3
12	Uttara Falguni	*Ficus rumphii*	3	3
13	Hasta	*Jasminium auriculatum*	3	3
14	Chitra	*Aegle marmelos*	3	3
15	Swati	*Terminalia arjuna*	3	3
16	Vishakha	*Mesus ferrea*	3	3
17	Anuradha	*Mesua ferrea*	3	3
18	Jyestha	*Bombax ceiba*	3	3
19	Moola	*Vateria indica*	3	3
20	Poorvashada	*Calamus spp.*	3	3
21	Uttarashada	*Artocarpus heterophyllus*	3	3
22	Shravana	*Calotropis gigantean*	3	3
23	Dhanishtha	*Prosopis spicigera*	3	3
24	Saiabhisha	*Anthocephalus cadamba*	3	3
25	Poorva Bhadrapada	*Mangifera indica*	3	3
26	Uttara Bhadrapada	*Azadirachta indica*	3	3
27	Revati	*Madhuca latifolia*	3	3
		Total	81	77

2.4 Establishment of Rashi Van

The 27 constellations are further grouped into 12 zodiac signs. Astrology groups human beings into these zodiacs. The zodiacs play a vital role in the lives of human beings and any astrological prediction starts from the zodiac sign of a person. Indian astrology has assigned specific trees for specific zodiac signs.

2.5 Establishment of Shriparni Van

As per Hindu mythology, the goddess Laxmi resides in Shriparni (*Gmelina*

Figure 3: **Design of Nakshatra Van**

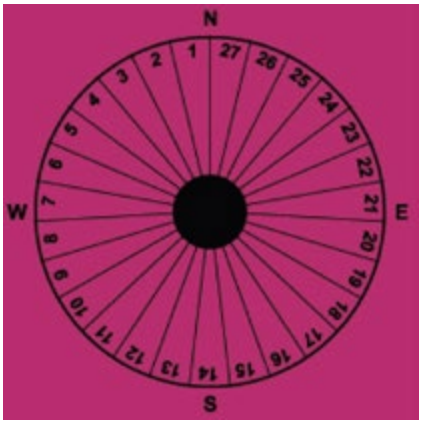

Figure 4: **Design of Rashi Van**

arborea) and brings peace, happiness and prosperity for worshippers and people who raise such trees. Keeping this in mind, 100 trees of *Gmelina arborea* have been planted at this place as per the design given here.

Including all those *Vans*, plantation of more than 40,000 trees at Smriti Van, Bilva Van, viewpoint, Main gate, Kid garden, Camp sight, Between Timba-Taranga and boundaries has been made.

Figure 5: **Design of Shiparni Van**

Results

Each Sanskrutik Van (during Van Mahotasav) covers on an average 6.5 hectare involving 30 to 40 plants species with more than 10,000 plant saplings. If we consider 16 Sanskrutik Van; each from 55th to 66th Van Mahotasav and 4 from 67th Van Mahotsav in Gujarat, the final figure goes to 104.54 hectare of land and more than 160,000 plant saplings. While considering the Tirthankar Van, it covers 5.4 hectare of land involving more than 43,000 plant saplings of more than 30 plants species. The land on which Tirthankar Van has been established has been transformed from wasteland, revenue land and patch of brushy forest land. Instead of initial brushy surroundings, with association of Rashi Van, Navgrah Van, Nakshatra Van, Shreeparni Van and Bilva Van, the 'Tirthankar Van' has more than 40,000 plant saplings today. Due to the change in environment, increase in avifauna, butterfly population as well as frequent visits of python has been noted here (direct sighting by forest guards). Instead of initial brushy surroundings, now per year around 6,500 visitors are getting rich vegetation, greenery around them and fresh air at Taranga Hill. Frequent visits of students and

Table 4: **Detail of Trees planted in Rashi Van**

S. No.	Name of zodiac	Name of trees planted	No. of sapling planted	No. sapling survived
1	Aries	*Ficus recemosa*	5	2
		Emblica officinalis	-	-
		Strychnos nuxvomica	-	-
2	Taurus	*Syzygium cumini*	5	3
		Ficus recemosa	-	-
		Acacia chundra	-	-
3	Gemini	*Acacia chundra,*	5	2
		Aquilaria agalocha	-	-
		Dendrocalamus strictus	-	-
4	Cancer	*Ficus religiosa*	5	5
		Musua ferrea	-	-
		Dendrocalamus strictus	-	-
5	Leo	*Ficus benghalensis*	5	3
		Ficus religiosa	-	-
		Butea monosperma	-	-
6	Virgo	*Aegle marmelos*	5	3
		Jasminum auriculatum	-	-
		Butea monosperma	-	-
7	Libra	*Terminalia arjuna*	5	5
		Aegle marmelos	-	-
		Mesua ferrea	-	-
8	Scorpio	*Bombax ceiba*	5	1
		Mesua ferrea	-	-
		Shorea robusta	-	-
9	Sagittarius	*Calamus rotung*	3	1
		Shorea robusta	-	-
		Astocarpus heterophyllus	-	-
10	Capricorn	*Calotropis gigantaia*	5	4
		Astocarpus heterophyllus	-	-
		Prosopis spicejera	-	-
11	Aquarius	*Anthocephallus chinesis*	5	3
		Prosopis spicejera	-	-
		Mangifera indica	-	-
12	Pisces	*Azadirachta indica*	5	5
		Mangifera indica	-	-
		Madhuca indica	-	-
		Total	60	37

scholars to this place has resulted in the State government organising annual Nature Education camps here.

Under Social Forestry through a scheme like Van Mahotasav, people have been motivated and roped in tree planting activity. This is not only helpful in Social Forestry, but also helps in greening Gujarat as well as India.

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Photo plate-2: **Recent condition of Tirthankar Van**

Photo plate 3: **Recent condition of Tirthankar Van**

Photo plate 4: **Recent condition of Tirthankar Van**

Photo plate 1: **Site plan and converted land map of Tirthankar Van**

Photo plate 5: **Recent condition of Navgrah Van at Taranga**

Photo plate 6: **Recent condition of Nakshatra Van at Taranga**

Photo plate 7: **Recent condition of Shreeparni Van at Tirthankar Van**

Photo plate 8: **Recent condition of Rashi Van at Tirthankar Van, Taranga**

Man-crocodile conflict in Vadodara

Crocodile attacks on humans are largely preventable; the primary cause being a lack of awareness of the danger humans put themselves in

Patel Rahulkumar Keshavlal

The human population growth rate in close vicinity to nature reserves, increasing demand for resources and growing demand for access to land seems to pose unique challenges in wildlife management. The species, Mugger, is recovering across the part of its range in Viswamitri river in Vadodara. The loss of habitat, combined with human expansion into previously wild areas, is causing increasing reports of conflict. Here we look at the extent and causes of man-crocodile conflicts, how it is dealt with in the area and efforts taken by the Forest Department and other government agencies to mitigate these issues amicably and also help to conserve the population of crocodiles in Vadodara region.

Introduction

Vadodara district of Gujarat is the location of the Vishwamitri-Dhadhar river system and basin. The Vishwamitri river originates from the western and southern slopes of Pavagadh hills, passes through the heart of Vadodara city; further downstream it is linked with two other tributaries, Dhadhar and Jambuva, and finally culminates in the Gulf of Kambhat.

Of paramount importance in its ecology is the presence of highly protected species, the Indian crocodile. The crocodiles have been inhabiting and breeding in the stretch of the Vishwamitri River for thousands of years.

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The census carried out in 2015 shows that the river is now home to over 260 crocodiles. The figure was 204 in the last census of 2011. (*ToI 6.3.15*)

Why crocodile population has increased

1. The crocodile is included in Appendix-I of the Convention of International Trade in Endangered Species (CITES) and brought under Schedule-I of The Wild Life (Protection) Act, 1972, meaning that any activity which is against the survival of the highly protected species cannot be done without being approved by the State Wildlife Board/ National Wildlife Board.
2. Moreover, unlike in other parts of the country, they are not killed in Gujarat because the mugger crocodile is the mount of Khodiyar Maa, a form of the Mother Goddess worshipped widely in State.
3. Crocodile is a tough species. It has evolved to survive in a drought-prone region and is very adaptable.
4. The Vishwamitri and its tributaries are flush with fish stock and help the crocodile population thrive.
5. The populace has increased as urban areas don't have many predators that consume crocodile eggs.
6. Also, many restaurants and slaughterhouses dump their waste in the river that makes food availability easy for crocodiles.
7. Forest officers said awareness among citizens has led to increase in the population.

Threats and reason of conflict

1. Human population growth and close vicinity

Demographic and social changes place more people in close proximity with crocodiles as human populations grow, settlements expand into and around protected areas as well as in urban and sub-urban areas.

The urban population growth was 25.12 per cent and rural population growth was 5.12 per cent during 2001-11 (censusindia.gov.in/2011). People use the river, its tributaries and connected water bodies for bathing, washing clothes, fishing and relieving themselves.

2. Species habitat loss, degradation and land use transformation

Over the years of its course within the city of Vadodara, the river has been subject to abuse as a consequence of rapid urbanisation and neglect towards water systems within the city and its outskirts. It has also suffered from ecological damage by way of sewage, contaminated storm water outfalls, industrial effluents drained in the river and several other point and non-point sources of pollution.

On certain occasions, river water has reached flood alert level. Flood waters inundating low-lying parts of city have resulted not only in despair for people living in these areas, but also created situations of human-crocodile conflict as they endanger the habitats for crocodiles within the river as well.

3. Increasing wildlife population as a result of conservation programmes

Strict enforcement of the Wildlife Protection Act, 1972, and the species adaptable nature have caused it to flourish.

Human-crocodile conflict incidents

Muggers attacking people were observed while the victims were crossing the river,washing clothes and operating a motor for pumping water. Mainly the conflicts were observed during June–September. (www.thretenedtaxa.org)

Human-crocodile conflict mitigation

The majority of crocodilian species do not pose a serious danger to people, although like any other wild animal, they will bite when provoked or surprised. If we objectively analyse the reasons behind these attacks, we may be able to minimise them and hopefully convince people that crocodiles are worth keeping around.

1. Spreading awareness among people

Crocodilian attacks on humans are largely preventable, the primary cause being a lack of awareness of the danger they put themselves in. This is why education and awareness are critical. Safety measures, when practiced, can prevent many attacks.

The State Forest Department has swung into action, spreading awareness about safe practices on the banks of the rivers. Attacks on humans intensify during the April to July period. Mother crocodiles, nesting and hatching young ones, are insecure about their safety and, consequently, on high-alert and nervous. Any movement near the river banks, where the nests are usually located, aggravates the crocodiles.

But for people using the banks, it is difficult to entirely cut-off access to the river. Some wash clothes, others attempt to cross the river. Many take a plunge for fun. However, according to forest officials, crocodiles have not attacked unless they have been provoked or disturbed.

2. Compensation

Crocodiles are one of protected species under Schedule I (Part II) of the Wildlife (Protection) Act, 1972. Any violation of the Act can result in up to seven years of imprisonment. Victims of these reptilian attacks are

given compensation from the State government—kin of the deceased get Rs 4 lakh, and disability get anything between Rs 59,100 and Rs 200,000, depending on the extent of disability.

3. Signboards regarding habitat of crocodile

In Vadodara, as part of the safety measures, numerous signboards carrying warnings about crocodilian dangers have cropped up over bridges and in streets. The only way to mitigate the risk of crocodile attacks is to make people aware of their behaviour.

4. Awareness campaign

In villages, crocodile awareness programmes are being introduced in schools and safety tips shared through group meetings. "*Magar thi sachavie, magar ne sachavie* (Keep safe from crocodiles, keep crocodiles safe)" is the mission slogan. It has found a connect with the people.

The city is also seeing a rise in migrant population, which is mostly unaware of such dangers. Coupled with the fact that the Vishwamitri riverbed has been shrinking, reducing the nesting space for the crocodiles, the number of incidents has only increased.

Photos by Mr. Nilesh shah (Motivator)

Photos by Mr. Nilesh shah (Motivator)

(Fencing around crocodile affected water bodies by the Forest Department) (Warning Boards by the Forest Department regarding habitat of crocodile in river)

The Forest Department is conducting awareness programmes in this area.

5. Effective management by the Forest Department

The Vishwamitri has been divided into seven zones by the Forest Department. Two volunteers, two guards and one forester have been assigned to each zone. Their job is to make locals aware of their reptilian neighbours and to ensure that all safety measures are in place. The department has also identified the needs for which people turn to the rivers—toilets, washing and crossing. The Forest Department has apparently asked civic bodies to make these facilities away from the riverbed.

6. Wildlife rescue centre

The Forest Department has a wildlife rescue centre and a toll free number 18002332636. Forest officers immediately respond to the call of any rescue of wildlife, including crocodiles, and rescue the animals in Vadodara.

7. Protected area for crocodiles, Crocodile park

City planners are thinking a proposal to declare a certain stretch of the Vishwamitri, passing through the city, a protected zone for crocodiles and beautify it. This will prevent attacks. It will not be a protected zone as defined under the Wildlife Protection Act. But, it will ensure that animals are not disturbed.

The initiative has been proposed under the Vishwamitri River Front Development Project. A feasibility study has been done and the report has been sent to the State Government for approval.

The corporation is also planning to build a crocodile park for awareness among people and to provide crocodiles an ideal environment.

8. Community engagement, safety guideline and training in safe capture

This covers community engagement, safety measures, capacity building of rescuers and Forest Department officials and also standardising of efforts. Such mitigation measures can effectively bring down the negative interaction and ultimately provide opportunities to promote crocodile conservation.

Conclusion

Use of properly implemented and monitored crocodile exclusion enclosures and crocodile fences and awareness programme among citizens, proper supervision, continuous rescue operations and management plan incorporating socio-economic realities help to gain community support and effectiveness in the area to reduce man-crocodile conflict and conservation of this unique species.

Acknowledgement

Vadodara Social Forestry Division, Gujarat

Forest fires and the way forward

A first person account of dealing with forest fire

Shivendra

I was working as Range Officer (mobile squad) when on April 26, 2009, at about 12.30 pm, I received a call about a forest fire in the Keratapuram area. The field staff, which was on patrolling, was immediately called back to the headquarters.

At 2.30 pm, with four executive staff members and nine labourers, I reached the spot. After conducting a survey of the area, it was found that a mangrove patch of about 500 sq m was burning. The force was devoted to cut a fire line on the demarcated point.

The Territorial Range Officer, police and fire brigade were also informed as fire was adjacent to human habitation.

All about 4 pm, the fire brigade came. But, as there was no proper road, it was not possible for the fire truck to reach the spot. The Arial Bay Territorial Range Officer was requested to bring 10-15 regular labourers. As they reached the spot, the force was engaged to prepare a road for the fire tender.

Meanwhile, the fire was spreading and now covered about 800 sq m due to the 3-tier canopy of the rainforest. Somehow, a 50-metre *kutcha* road was made for the fire truck. The truck was engaged at about 9.30 pm. Unfortunately, due to its weight the truck got stuck in loose soil. I requested the Territorial Range Officer to bring an elephant to pull the fire brigade truck out. At around 5.30 am the next day, three elephants reached the spot. But, they were reluctant to go close to the truck as the ground had heated up due to the fire.

Again, 12 labourers were engaged to create a carpet area with soil and water from the truck; in two hours the area cooled down. The elephants then pulled out the truck, but by that time, due to the heat, the front right tyre of the truck was completely damaged. The fire brigade staff told that us that till the tyre is not repaired, it won't be possible to use the truck.

The situation was discussed with the Arial Bay Range Officer and it was decided to hire 2-3 tractors to cut the fire line. The Assistant Director, Agriculture, was contacted at about 8 am for the tractors. He told us that while one tractor at the headquarter was not working, the other two were about 40 km away.

We then called the Pramukh of the Panchayat Samiti and the Pradhan and requested them to provide the tractors.

The tractors with ploughing blades reached the spot at around 9.30 am and were engaged in cutting a 1-km long fire line. The fire was then contained.

Range Officer, Department of Environment & Forest, Andaman & Nicobar Islands

Anti-poaching operations in Maharashtra's Sholapur district

On World Forestry Day, brave forest officials send black buck poachers behind bars

VR Shinde

On 21st March, 2009, the World Forestry Day was celebrated all over the world with the "Oath" to protect environment and wildlife. On the same day, one black buck was shot dead by poachers at Boramani village, near Sholapur city in Maharashtra. The officers of the Forest Department swung into action and caught six poachers and sent them behind bars in a very short time.

It all began on 21st March when the forest officials Sholapur, Maharashtra, got the information that some poachers from Mumbai had entered Sholapur's grass lands to hunt and had killed a black buck near Boramani village, in Sholapur District.

Acting on this information, the forest officials – the Range Officer along with his team – moved to verify this piece of information. On the way to the site at 9:30 PM, where the act of poaching had taken place, the Range Officer also informed the local police station. On the way, they searched each and every vehicle on the National Highway 13 (Solapur – Hyderabad National Highway) but to no avail.

When they reached Boramani village it was late in the night and most of the villagers were asleep. The team then fanned out and started searching for the probable location in the fields and open lands. Despite searching for two hours, they were no closer to catching the poachers.

They continued their search operations and at 1:30 AM, while searching in the open lands or *malrans* they saw a light in the field at about half a kilometer from their location. Moving quietly through the rocky area, they reached a hut where the light was shining. Alighting from their vehicle, they were shocked by what they saw. On the ground, there were *thalis* or plates in which food had been consumed. On all the *thalis* there were pieces of mutton and bones.

One of the members of the team kicked the door open. There were six men sleeping inside the hut and there were also weapons which included two imported rifles and pistols and a huge quantity of ammunition. The poachers had been caught red handed. The forest officials seized all the weapons and ammunition along with the meat of the black buck which had been killed. Two vehicles which were used for poaching were also seized.

Range Forest Officer, Radhanagari

All the six offenders were arrested and produced before the Hon'ble Court which remanded the accused to custody for seven days for further investigations. At the end of seven days of investigation a charge sheet was filled in the Hon'ble Court of Law. During the trial, evidence collected by the Range Officer (Mr. Shinde) who was the investigation officer, was placed before the Court. The Hon'ble Court sentenced all the six accused to rigorous imprisonment for 3 years and imposed a fine of Rs. 25,000 under Wildlife Protection Act and Rs. 10,000 under the Arms Act on each of the accused.

Nature lover's as well common public from Sholapur, lauded the quick action taken by the forest officials particularly the Range Officer, Mr. Shinde in bringing the poachers to book.

Solving a panther kill case

An account of dealing with wildlife traffickers

Vishwas B Bhadale

The story began with the arrest of some persons by Pune police at Katraj. The police had caught these persons who had a panther skin in their possession. They had come to Katraj with the intention of selling the skin. All the accused were college students and were now in the custody of the Crime Bramch of Pune police. News of this arrest reached the Forest Department and we contacted the Pune police for more details. The accused were then handed over the Forest Department for further investigation through the Court procedure.

During the interrogation of the accused, we tried to get the correct information about where the killing of the panther had taken place. Based on the information provided by the accused, we travelled to Kolhapur, Gargote and Budargad forest area. There we were able to arrest other persons who were connected to this act of poaching. The arrested persons were placed under our custody by the Hon'ble Court for two days. We were however unable to get the correct information about the spot where the kill had taken place. The accused were then released on bail after two days.

During our investigations, we came across a person who had a connection with the actual poacher. This person however would not reveal the truth but would give us misleading answers. Since we could not use physical force to get the information we devised a plan to get the correct information.

We had four people who were being interrogated. We divided them in two groups, three of these people who were less connected with the case were kept in one group and the person who was the real culprit was kept alone. They were kept in two different neighboring rooms. The three persons were told that we will not beat you, but we will make the sound as if we are beating you and you have cry and shout as if we are beating you. The real culprit was in the room and I was there with him. I told him "tell me the truth or else I will beat you". At that point, in the other room, the forest officers started making the sound as if they were beating the people in the room. Hearing this, the real culprit got frightened and started telling the true story as to who had really killed the panther.

According to the information provided by him, the kill had taken place in the Ratnagiri (Konkan) District. The name of the village was Vadgaon in Kudai Tehsil. This place was about

Range Forest Officer

600 km from Pune. We quickly rushed to the Vadgaon village the same night so as to grab the real poacher. The next day morning at 6:00 AM we reached Vadgoan village and searched the house of the offender. We were able to get hold of the person who had actually killed the panther. The accused was a very poor villager staying with his family in the house. During interrogation he revealed that the panther had killed his cow. So, he then put poison in the cow's carcass. The panther came to feed on the kill the next night and after eating the poisoned flesh fell sick and died. The accused then removed the skin and the nails of the panther with a knife and cutter and then buried the body.

On being led to the site, we exhumed the body of the panther. We were only able to find the bones and the skull of the animal, as the kill had been done a year before. We removed the bones, skull and other body parts, did a *panchanama* (the *panchanama* accounts state, to things which were found at particular place at particular time, in criminal law the *panchnama* has corroborative value) and sealed the remains of the panther.

We then searched for the knife and cutter which was used in the case. Further, we questioned the culprit about the poison which he used for the killing. It was thrown in bushes 100 to 200 m away from the spot. We found the box of poison, did a *panchanama* and sealed it and took it into our possession. We then questioned the culprit from where he had purchased the poison. After searching his house we were able to find the purchase receipt for the poison. We did the *panchanama* and took it our custody. Thus, concluded the search of the panther kill. We arrested the culprits and took all the sealed material with us and came back to Pune. All the evidence was then placed before the Court of Law.

Analysis of habitat management practices in Parambikulam Tiger Reserve

Habitat management plans at Parambikulam Tiger Reserve address the immediate and long term threats and problems for sustainable management of habitats

Mito Rumi

Parambikulam Tiger Reserve (PTR) is located in the Nelliampathy – Anamalai landscape of the southern Western Ghats in Palakkad District of Kerala. It is one of the biodiversity hot spots of the world supporting a rich flora and fauna and habitat types. It has 1835 plant species with domination of herbaceous flora, evergreen and deciduous tree species. Important faunal species found here include among other the tiger, elephant, gaur, sloth bear, sambar deer, mouse deer, barking deer, spotted deer, nilgiri langur, lion tailed macaque, bonnet macaque, Indian porcupine, wild dog and wild boar.

Parambilkulam Tiger Reserve was declared as Tiger Reserve in 2009 and is spread over an area of 643.66 km^2. The tiger population at PTR here has been recorded as 34 in number. PTR has six tribal settlements of indigenous tribes namely Kadar, Malasar, Muduvar and Mala Malasar. The tribals are engaged as guides for treks, safaris and employed in various ecotourism activities. All these activities are managed under the aegis of the Parambikulam Tiger Conservation Foundation. The Phase IV tiger monitoring in PTR started in 2011-12 and 26 tigers were identified by using camera traps. The habitat management

CASFOS, Burnihat, SFS 2015-17 Batch

of PTR forms the primary components of management plan of PTR.

Description of PTR

PTR with total area of 653.66 km^2 falls under the jurisdiction of Parambikulam Wildlife Sanctuary, Nemmara, Chalakkudy and Vazhachal Forest Divisions of Kerala.

Habitat Management

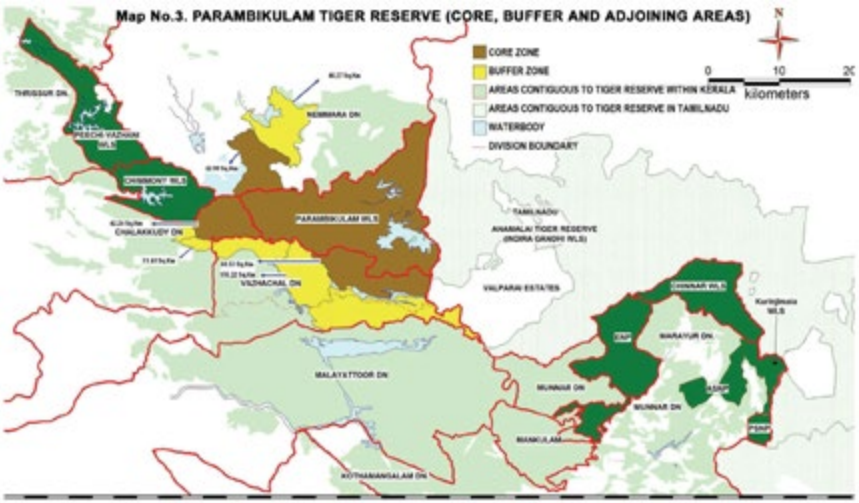
The major habitat management practices undertaken in PTR include the following:

i. Maintenance of *vayals*
ii. Soil and moisture conservation activities
iii. Development of water sources such as check dams and water holes
iv. Conversion of monoculture of teak, eucalyptus plantations into natural forests of indigenous species
v. Fire lines for preventing forest fires

PTR comprises of a mosaic forest vegetation type. Major components of habitat of PTR are discussed in the following sections:

Vayals: These are low altitude marshy grasslands with perennial availability of water and grass. They thus form the most important niche for herbivore population in the sanctuary. *Vayals* are a unique habitat supporting a specific biodiversity. They are a sustainable source of palatable grasses for animals. These are also prime habitats for the prey species like the tiger. There are 113 *vayals* in PTR. The management of all the *vayals* can sometimes be a problem due to lack of funds.

Threats to the vayals include invasion by coarse and unpalatable sedge species in the recent years. *Rhyncospora corymbosa* is the most hazardous sedge. Exotic weed *Eupatorium* is seen in most of the vayals. *Mikania micrantha* is also observed in vayals in Karimala and Orukomban Ranges. Bamboo, *Glycosmis pentaphylla, Lantana camara* are other examples.



Management strategy

i. The *vayals* has been categorized into very good, good and moderate based on parameters such as availability of water during summer, forage quality, type of adjoining cover (ambush/escape cover), wildlife utilization and natural salt.

ii. Removal of Invasive species:
   - Uprooted pits of *Lantana*/ *Rhyncospora* and *Mikania* will be seeded with seeds of palatable grasses.
   - Mechanical Methods of weed removal and grass cutting in open area will be adopted and their cost-benefit analysis will be done for future.
   - Eco-restoration camps will be involved to remove weeds.

Water Sources

PTR region is criss-crossed run by three rivers (basin) – P eriyar, Chalakkudipuzha and Bharathapuzha. Together form 8 sub-basins. Parambikulam is the single major river system present within the sanctuary. There are 61 streams, 58 waterholes and 32 check dams in PTR. The moist deciduous and dry deciduous vegetation types in the Tiger Reserve necessitate steps to conserve moisture.

Threats to the water sources include – drying up of streams and water bodies during the dry season. Also several streams and rivers flowing through the Tiger Reserve are causing soil erosion.

Management strategy

i. Ridge area treatment activities required to restore the health of the catchment areas by reducing the volume and velocity of surface run off are as follows:
   - Protection and regeneration of

vegetative cover from fire
- Afforestation
- Staggered trenching, contour and graded bunding

ii. Drainage line treatment: This will be carried out using a combination of vegetative and engineering structures such as earthen checks, brushwood checks, gully plugs, loose bolder checks, gabion structures, underground dykes etc.
iii. Development of water harvesting structures such as low cost ponds, *nallah bunds*, check dams etc.

Soil and moisture conservation measures

Data on soil and the seasonality and quantity of flow in these streams were collected and compiled. Gully plugging using dry rubble packing is the primary method for soil and moisture conservation adopted. Other methods also adopted include brushwood check dams, vegetative gully plugging and contour *bunding*.

Mosaic Forest Type Habitat

PTR forms a mosaic of west coast tropical evergreen forests, tropical semi-evergreen forests, southern moist mixed deciduous forest, southern dry mixed deciduous forests, southern montane wet temperate forests (sholas) and bamboo brakes. The Gaur and Sambar prefer evergreen and semi-evergreen habitats, the Chital prefers the moist and dry deciduous type of habitats. The Nilgiri Tahr prefers the grasslands on hilltops.

Threat to the forest type is an almost continuous stretch of poorly raised teak plantations. These plantations continue downstream towards south and west beyond Orukumbankutty along the Chalakkudy River Valley to the very foothills in Thrissur District. This teak belt extends over more than 150 km^2. Industrial plantations of eucalyptus have also been raised all along the south-western fringes of Parambikulam in the Vazhachal Forest Division areas in past. During the 1960s all the river valley forests along Chalakkudy River downstream of Athirappilly were clear felled and converted to rubber plantations through the Plantation Corporation of Kerala. The destructive extraction of the giant evergreen canopy trees and the subsequent damage by fire inflicted upon these forests degraded the areas and created areas with bamboo and rocky blanks.

Management strategy

i. Geographical distribution of selected species in PTR was studied. Spatial patterns of abundance of the different scheduled species were compared in order to appraise their relative habitat selectivity and their tolerance to human disturbance.
ii. Indigenous species of the region have been identified and recorded. Their growth, stock health, regeneration are recorded and studied over period of time all over the. Gap filling plantations are done with indigenous species selected based on Importance Value Index (IVI) of species.

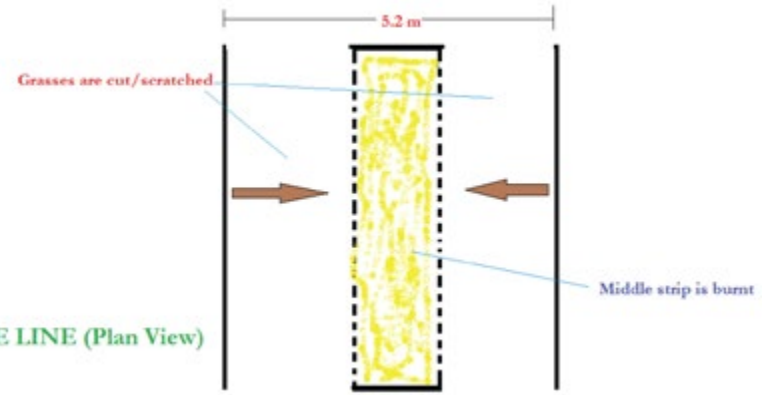


Fig: FIRE LINE (Plan View)

Forest Fires

Forest fires can cause devastating damage to wildlife and habitat over thousands of hectares at an instance. Forest fires caused naturally by lightning are very rare. They are mostly anthropogenic in nature. They are mostly caused by accidental fires set off by villagers or tourists while cooking or smoking cigarette on roadside or in forest areas. They can sometimes be directly caused by miscreants.

Management strategy

i. Fire line of 5.2 metres width are created alongside roadways used by the villagers and tourists during safari rides. Grasses are cut / scratched across the entire width and the middle portion is burnt. This creates firebreaks during forest fires.
ii. Patrolling is increased during dry season to prevent forest fires.

Conclusion

To protect and conserve wildlife, the natural habitat must be protected and conserved. Habitat management forms the basis of wildlife management plans of protected areas. Habitat management strategies must be formulated after carrying out elaborate

scientific studies of a habitat, making use of existing technology in studying biodiversity and ecosystems of the area. Habitat management plans must address immediate and long term threats and problems for sustainable management of habitats in protected areas and forests in general.

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I extend my gratitude to Shri K Manoj, Assistant Wildlife Warden, Parambikulam Tiger Reserve and forest staff of Parambikulam WLS Division, for the valuable information, support and guidance to impart us knowledge of the tiger reserve. Visit to the forest and adjoining village settlements provided us opportunities to critically analyse the habitat management and monitoring of the animals. I would like to thank the whole fraternity of Kerala Forest Department for assistance and support throughout the South India tour to make it a very successful learning programme.

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Eco-friendly tribal development in Chinnar Wildlife Sanctuary

From eco-tourism activities to education and health programmes for the tribal population in the sanctuary, the Forest Department has initiated a number of development projects in the area

Rohit Chaudhari

Chinnar Wildlife Sanctuary, with an area of 90.442 sq km, was constituted in 1984.This is the only sanctuary in Kerala located in the rain shadow region, representing a unique thorny vegetation. It is situated in Devikulam Taluk of Idukki District. The sanctuary is contiguous with Anamalai Tiger Reserve in the north and east, Eravikulam National Park along with Marayoor Range in the west and Kanthalloor Range along with Kurinjimala Sanctuary in the south.

The complex terrain system has resulted in diversity of vegetation types, which harbor a large array of plants and animals. The sanctuary is a repository of endemic, endangered and rare species—965 species of plants were collected from the sanctuary. The area harbors 27 species of mammals, which include albino gaurs (probably the only record in the world). A recent bird survey conducted in the Protected Area (PA) reported 172 species of birds, majority of them breeding here. After Srivilliputhur, the sanctuary has the second viable population of Grizzled Giant Squirrel. About 5 sq km area has valuable sandal trees.

A panoramic view of Chinnar Wildlife Sanctuary

Officer Trainee SFS 2016-18 Course, CASFOS Dehradun

Eco-friendly tribal development activity in Chinnar

Eco-development is an important activity as the sanctuary is inhabited by considerable tribal population, spread out in 11 settlements. Providing adequate livelihood options to the tribes forms an important part of PA management. All the 11 tribal settlements within the sanctuary were brought under the Eco-Development Project under the Kerala Forestry Project. Community support programmes are run with the Community Development Fund received from the Anaimudi Forest Development Agency, to which the Eco-Development Committees (EDCs) in Chinnar Wildlife Sanctuary are affiliatedto.

Eco-tourism activities and initiatives

The eco-tourism activities were initiated in the PA during 2002-03. Trekking and night halt programmes are offered as part of eco-tourism. These programmes are operated by professional EDC groups, which were formed from the tribal EDCs exclusively for eco-tourism operations. Presently three professional EDC groups are functioning in the sanctuary—Champakkad Tribal Trackers EDC, Eachampetty TTEDC and Alampetty TTEDC. Eco-tourism activities are operated from two points, at Chinnar which is the entry point to the sanctuary from the Tamil Nadu side, and Alampetty, about 8 km from Marayoor Town.

The programmes offered at Chinnar include visit to watch tower, river side trekking along Chinnar river and night halt at tree top *machans* and log houses. At Alampetty, trekking to Thoovanam waterfall and stay at log houses are offered as part of eco-tourism activities.

The programme is functioning in a benefit sharing manner. The salaries to the guides are based on the income generated through various activities. A part of the income is set aside for community development activities.

Development activities at the sanctuary

Some of the development activities that are undertaken at Chinnar Wildlife Sanctuary are as follows:

- Permanent water supply arrangements.
- Electrification of settlements by PICO Turbine Hydro-Electric project

PICO Turbine Hydro Electric Project

Solar panels for lighting

Tribal Women making paper bags

Products prepared and marketed by Tribal EDCs

Library at Vatmeekam coaching Centre

in Tayannankudi and solar light systems in Palappetty, Echampetty and Iruttalakkudy tribal settlement.

With the help of other government bodies, various programmes for employment generation for local people have also been started. These include various production units like Agarbathi making units, Paper bag making units, Soap making units, Amla product making units, Flavoured honey making units, Minivet sweets and confectonaries.

An education empowerment activity is also carried out for the well being of tribal students and people. A PSC coaching centre, named 'Vatmeekam', has been set up at Karimutty to train tribal people for PSC exams. There are also an establishment of Bodhi Library.

Many activities are carried out for improving the health of the people. A free medical camp is conducted at each tribal hamlet of the Chinnar Wildlife Sanctuary by Kottayam Nature Society and Wildlife Division, Chinnar. The Wildlife Division also started 'Punarjeevan' project, aimed at improving the health of tribal people.

Health of the communities can be rejuvenated only by reviving the diverse cropping patterns with diverse traditional varieties, which provide them with nutritional and food security. This agri-project has also become a part of income source for the tribal people.

Acknowledgements

Shri Prasad G., Wildlife Warden, Munnar Wildlife Division, Kerala

Shri Prabhu, Assistant Wildlife Warden, Chinnar Wildlife Sanctuary

Imparting new life to Deoriatal

It is important to explain the stand of the department regarding conservation on sustainable basis through firm measures by means of continuous interaction with local people to make any project successful

Neethulakshmi M.

Deoriatal is a natural lake situated in the Kedarnath Wildlife Sanctuary, Rudraprayag District of Uttarakhand. Located at an altitude of 2438 mts above mean sea level, to reach the lake one has to trek for 3 kms from a village named Sari, near Ukhimath.

Mythology and importance

According to Hindu mythology, *devas* used to take a holy dip in the lake, hence its name. It is believed to be made by Pandava brother Bheema, to quench his thirst on the advice of Yudhisther. The lake is also called 'Indra Sarovar' by *sadhus.*

The lake is surrounded by lush green forests of oak (*Quercus leucotrichophora*), burans (*Rhododemdron arboreum*), etc. It is crowned by a majestic view of Himalayan peaks Chaukamba, Nilkanth, Kedarnath, Bandarpunch, Kalanag, etc. Their reflection on the lake is a breathtaking view, especially on a clear sunny day in the morning. One can enjoy the forest by walking on the nature trail encircling the lake.

The lake is a water source for many herbivores like Sambar, Barking deer, etc., and carnivores like leopard. It is also frequently visited by Yellow-throated Marten. One wakes up in the morning to the natural orchestra of birds like Khalij Pheasant, Koklass Pheasant, Himalayan Partridge, Blue

Reflection of Himalayan peaks on Deoriatal

IFS, DFO Kedarnath Wildlife Sanctuary

Nature trail around the lake

Burans *(Rhododendron arboreum)* in full bloom around the lake

Whistling Thrush, Black-headed Jay, Eurasian Jay, Rufous Sibia etc. In winter, especially in snow, the view of Himalayan Monal, the State bird of Uttarakhand, perching on tree top is an unforgettable experience.

Both Indian and foreign tourists visit the site to enjoy the reflection of the Himalayan mountains on the lake, to enjoy snow during winters and the Burans bloom in spring. Some camp in tents in the meadows surrounding the lake. There is also a 14 km long trek from Deoriatal to Chopta, traversing thick lush green forests.

Eco-tourism initiative in the past

An Eco-development Committee (EDC) was formed in the past with villagers

Camps at Deoriatal

Snow at Deoriatal

of Sari as members to manage eco-tourism activities in Deoriatal. Under the initiative, a 3 km long bridle path was made from Sari to Deoriatal with basic amenities like shelters, waste bins, signages, etc., developed on the trek route. However, the villagers wanted to erect shops near the lake to cater to the needs of the tourists, which was opposed by the department. Moreover, an entry gate, which was built by the department so as to demarcate the boundary of Deoriatal, was destroyed by the villagers, who were of the opinion that the lake was located outside the sanctuary area and that they wanted direct control of the management of tourism without the EDC model. As a result, eventually, the EDC stopped functioning and

further talks with the villagers to revive it also failed. However, the villagers continued erecting shops on the trek route to Deoriatal in the civil land and catered to the mules for transportation of tourists and the camping materials.

Degradation of the lake and meadow

The camps at Deoriatal as well as Rohini Bugyal, a meadow, situated halfway on the trek to Chopta, are run by travel agents who employ mules for transporting the camping materials to both places. After unloading the luggage, the mules are set free on the meadows to graze and venture into the lake to quench their thirst. The scarcity of staff made it difficult to control the mules and convince their owners every time. Moreover, a check on the camp been run at Rohini Bugyal was difficult too. The travel agents were of the opinion that the trekkers need to halt at Rohini bugyal at night before they proceed towards Chopta, though the trek is not very tough and can be done easily in a day by an average trekker. Also, the Himalayan treks are never chosen by weak trekkers.

Trying to solve the problem

Since the area is visited only by trekking enthusiasts and the trek route to Chopta does not fall under any pilgrim route, use of mules can be restricted. Moreover, there is a high chance of transmission of communicable diseases to the wildlife from the mules, the dogs accompanying the camp assistants and the cattle in the surrounding villagers.

As a first step, the mules were restricted beyond the boundary of the sanctuary and the travel agents were asked to employ porters to carry the camping materials to Rohini bugyal. It led to unrest among the villagers who owned mules, sometimes instigated by the travel agents who had to pay more porters instead of one or two mules. The travel agents, the mule owners' onion and local representatives approached the staff and division office several times with a request to reconsider the decision. They also used to approach in large group whenever I made a visit to the area. During various meetings, attempts were made to convince them regarding the importance of the area in terms of scenic beauty as well as a potential habitat for wildlife and the reasons for the failure of EDC initiatives and motivated the villagers to think beyond the scope of just porters or mule operators. Every time, the stand of the department on restoration of the site was emphasised. It took several rounds of talks with the local people to make the stand of the department clear.

Present scenario

The water in the lake has become cleaner than before when the mules used to be set free to pollute it. Fresh blades of native grasses started appearing in the meadows, which were about to be replaced by sturdy unpalatable ones soon after the restriction was imposed. The entire surrounding of the lake as well as the meadow is becoming cleaner with the absence of dung of mules which used to spread foul smell all over, making it inconvenient for the tourists to camp or enjoy the view

while resting at various spots. Further, with strictly demarcating the sites for camping, the rest of the meadow is now free to regenerate.

Inference

Eco-tourism and EDC initiatives cannot be successful always, especially as it depends on the aspirations of the local people to a great extent. In such difficult cases, it is important to ascertain the stand of the department regarding conservation on sustainable basis through some firm measures by means of continuous interaction with local people. Eventually, the local people have started respecting the decision of the department and the site is being managed well.

Conservation of Sangai, a success story

Though the population of Sangai has risen from 14 in 1975 o 204 in 2013, the population is still non-viable. Further measures need to be taken to conserve this endangered deer species

Mahamuda Begum

The Sangai (*Rucervus eldii eldii*) is an endangered deer whose last single population in its natural habitat is found only at Keibul Lamjao National Park, Manipur, over the floating biomass locally called *phumdi* in the south eastern part of the Loktak Lake. Sangai, also known as Manipur Brow Antlered Deer, is the State animal of Manipur.

There are three species of *Rucervus eldii* in the world, the other two *Eldii* sub-spp are *Rucervus eldii thamin* of Myanmar and *Rucervus eldii siamensis* of Thailand. Recently, there was news of yet another *Rucervus eldii* in South China. Of the three *Eldii* species, Sangai—*Rucervus eldii eldii*—has the least population in the wild and thus the most endangered.

Sangai is a medium sized deer. The size of a fully grown Sangai stag is about 110 cm to 125 cm high at the shoulder and about 105 cm at the hind. The length of an adult buck ranges between 145cm-155cm. A mature Sangai stag weighs about 110 kg.

History of Keibul Lamjao National Park

Sangai was once reported extinct in 1951 and was re-discovered and counted six heads in 1953 by Eldii Percy Gee, the then Honorary Secretary, Indian Board for Wildlife, Eastern Region, in a survey conducted under the auspices of the IUCN. It was the first turning point for Sangai conservation.

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Following this, the Manipur Wildlife Advisory Board declared Keibul area as Protected Sanctuary and Sangai as Protected Animal in its meeting held on December 10, 1954 (Manipur Gazette, February 2, 1955).

Further conservation measures were taken up and Keibul Lamjao area was declared as Protected Forest vide notification No. 55/10/65-M(Pt) dated November 25, 1965. Keibul Lamjao was declared a Reserved Forest in 1974 under the Indian Forest Act, 1927.

The second turning point for Sangai conservation was the initiative of the Government of India in 1975. A team led by Dr M.K. Ranjit Singh, the then Deputy Secretary, Ministry of Agriculture, the Government of India, was instructed to go to Manipur and to assess the population. The team counted 14 heads of Sangai in 1975.

Finally, Keibul Lamjao, covering an area of 40 sq km, was declared a National Park, called Keibul Lamjao National Park, by the State Government of Manipur in 1977 for protection of its flagship species Sangai and other associated wildlife under the provisions of Wild Life (Protection) Act, 1972.

Sangai Population in the wild

Sangai was reported extinct in 1951 at Keibul area, but counted 14 heads in 1975. With relentless protection, conservation works and local support, the Forest Department of Manipur could manage successfully the population of Sangai to 204 in 2013.

Threats

There is a significant change in the vegetation composition of the *phumdis* in terms of shelter and food plants for animals. There is a change in *phumdi* thickness due to change in hydrology, pollution and *phumdi* proliferation. There is encroachment along the Park boundary due to non-delineation. Moreover, there is dependence of the local population on the Park for collection of food and fodder biomass due to their poor socio-economic condition.

Increasing trend of Sangai Population

Year	Census type	Number of Sangai			Total
		stag	Hind	Fawn	
1975	Aerial	-	-	-	14
1977	Aerial	6	8	4	18
1978	Aerial	9	10	14	23
1979	Aerial	9	13	8	30
1984	Ground	20	25	6	57
1986	Ground	44	45	6	95
1991	Ground	37	51	16	104
1995	Ground	58	69	25	152
1996	Ground	57	65	21	143
1999	Ground	63	61	25	149
2000	Ground	54	76	32	162
2003	Ground	65	74	41	180
2013	Ground (Point Transect Method)	90	86	28	204

Major issues

The major issues of concern are: Single isolated population with non-viable population, lack of connectivity for re-colonisation and further loss of genetic diversity. As per studies, the viable population should be more than 500 individuals of Sangai. Also, there is shortage of staff and inadequate infrastructures for protection of wildlife and its habitat.

Proposed measures

- Extension of the Park area by inclusion of habitable adjoining areas and habitat consolidation by compacting isolated *phumdi* patches.
- Delineation of the Park boundary by constructing ring bunds.
- Establishment of anti-poaching camps along the boundary of the Park.
- Establishment of alternative home of Sangai within the traditional bio-geographic range of the sub-species.
- Research on Sangai, its associated species and *phumdi* habitat.

Acknowledgement

Sri Arun R. S., IFS, DFO Keibul Lamjao National Park, Manipur

Socio-economic status of Kani tribe in Kanyakumari Wildlife Sanctuary

Kani tribals are natural foresters and their main source of income mainly is cultivation of cash crops like rubber, cardamom and cinnamon

Mukta V. Tekale

Kanyakumari is the southern-most district of Tamil Nadu. It is the geographical end of the Indian mainland. The confluence of three seas— Indian Ocean, Arabian Sea and Bay of Bengal—makes Cape Comorin very special in terms of religious, cultural and tourism values. Kanyakumari takes its name from the deity of Kumari Amman temple—Kanya Devi, an avatar of Godess Parvati. On November 1, 1956, according to the State Reorganisation Act, Kanyakumari was merged with Tamil Nadu. Previously it was a part of Travancore State.

The forest in Kanyakumari is verdant and virgin and said to be 75 million years old. Of the total district area of 167,130 hectares, forest occupies an area of 50,486 hectares, which comes to about 30.2 per cent of the total district geographic area. Nearly 52 per cent of the forest is dense forest.

The Kanyakumari Wildlife Sanctuary, with adjacent areas of Kalakkad Mundathurai Tiger Reserve and Neyyar Wildlife Sanctuary of Kerala State, constitutes the southern-most tip of Western Ghats. It is the culminating point of both Western Ghats and Eastern Ghats. The natural vegetation of the region represents biomes ranging from southern thorn forests, dry deciduous, moist deciduous, semi evergreen forests to evergreen hill shoals with grassy downs. The tract is exceedingly rich in wildlife harbouring a variety of animals. The avifauna, the reptilian fauna and amphibian fauna of this region is also rich and diverse. In recognition of the tremendous biological potential, Kanyakumari forest divison was declared as the Kanyakumari Wildlife Sanctuary in 2002.

Kanyakumari Wildlife Sanctuary forms the part of southern-most end of Southern Western Ghats and is recognised as one of the three mega centres of endemism in India and one of the two global hotspots of biodiversity in India. It also forms the part of Agasthimalai Biosphere Reserve.

About Kani tribe

Kani tribals have been residing within the sanctuary area since time immemorial. During 1911, the Travancore Government allotted certain forest areas, named as Kani settlements, within the reserved forest of Kanyakumari district. The Kani tribe is permitted to grow food crops and cash crops. Although they are allowed in the settlement area, but as the ownership rests with the For-

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est Department, they are not able to sell it. There are 47 Kani settlements in the area.

The 47 Kani settlements are situated within the catchment areas of Pechiparai, Perunchani and Citthar reservoir. During 1988-89, there were 864 families with a total population of 3,560. As per the record in 2011, there are 1,578 families with a total population of 5,342.

The life of the Kani tribal people of Kanyakumari is unique. They follow different customs and ceremonies that are suitable to their environment. They are a strong and well-built race fit for the wilds they inhabit. Their value systems, spirituality, capabilities and culture have a huge untapped potential for sustainable development. They play a crucial role in the stewardship of natural resources and biodiversity and provide environmental services at local, regional and international levels. Indigenous people have rich, varied and locally rooted knowledge systems and their immense culture diversity is extremely valuable in a world threatened by the homogenising trend of globalisation. They have developed a remarkable power of scenting different kinds of wild animals at a great distance and can elude them successfully in the thickest of the forests.

Social structure of Kani tribe

Each 'Kanikudi' (Kani settlement) has a 'Moothukani'. The eldest son-in-law of Moothukani usually becomes the next Moothukani, or another deserving person is selected. Moothukani is the custodian of all social affairs and he delivers the justice. He takes care of all the problems pertaining to his people and presides over meetings where solutions to the problems are found.

There is a 'Pilathi' in each settlement. He finds out whether evil spirit or bad weather is due to harm done to god. When a Pilathi wants to select a new Pilathi due to his old age, the belief is that god will come in his dream and inform who will be the next Pilathi. He teaches the Pilathi *mantra* to the new person whom god has selected. The new Pilathi goes to forest for meditation for 41 days by chanting Pilathi *mantra* taught to him. When he returns, it is believed that he has got a super power from god and acquired knowledge about herbs of the forest.

Pilathi

Kani

There is a 'Vilikani' to assist Muthukani. 'Vili' means 'to call'. It is the duty of Vilikani to make the Kani people assemble in one place and inform about the orders of Moothukani.

Appearance

Tribals of Kanyakumari District are very attractive to look at with black body, circular head, curled hair and broad nose. The tribal women are generally small in size and dark-skinned. Men show much respect to women. They are good trackers and fond of sport, and, in clearing forest paths, they hardly have any equals.

Language

They speak Malaipashai, which is a South Dravidian language of the Malayalam-Tamil sub-group. They use Tamil script.

Costume

The men wear dhoti and towel and women have a long cloth wound round their waist and wear a small cloth over their body. The women also use coloured saris and blouses. The women wear a long cloth, called *charm*, around their waists and wear a loose blouse called *raveeka*. They say that their ancestors wore a garment made of jungle fibre. The women are not used to wearing jewellery in their ears and nose, but they use a number of brass rings on fingers. They also wear chains made up of beads and shells around their neck. Today, however, some women wear modern dresses and jewelllery.

Food

Previously Kani were dependent on wild edible plants and animals for food. Recently, there has been a change in their food habits. Wild as well as cultivated tubers form their staple food. They cook tubers in many ways, such as Kallukachi, frying and boiling. Kallukachi method is followed when they go in the forest. In this method, they firstly collect oval or medium sized stones and heat them red hot by burning large pieces of wood. Then half of the stones are spread closely. Tubers are placed on this layer of red-hot stones. Another layer of stones is placed above the tubers and then the whole structure is covered with *Ochlandra* leaves. After 20 minutes tubers are taken out and eaten with chillies and salt. Their staple food is rice and millets. They also consume

pulses, vegetables and fruits. They use groundnut and coconut oil for cooking. They consume milk and milk products and drink coffee and tea.

Occupation

The chief occupations of the tribals are honey collection, agricultural works, hunting and fishing. They also do plantation of coconut, black pepper, tapioca, cardamom, cinnamon. Nowadays they also get much income from rubber planting and working under ARSU Rubber Corporation.

House

The Kani live in small huts. The huts are constructed with wood, mud, and grass. But, nowadays the government has provided them with many facilities.

Educational Development

The Department of Elementary Education and Literacy and of Higher Education in States have provided special incentives to ST students which include textbooks, uniform, tuition fee, and so on. Special focus is also accorded to ST students under the District Primary Education Programme, Kasturba Gandhi Balika Vidyalaya. Midday Meals Programme, Navodaya Vidyalaya, National Talent Search Scheme and the like. The Post-Metric Scholarship Scheme is open to all ST students whose parents' annual income is up to Rs 1 lakh to facilitate students to pursue professional courses.

Schools

Earlier, tribals had only two schools at Pechipparai and Pathukani. Now the government has taken steps to improve the education of tribes in Kanyakumari District. Now there are eight tribal schools in Kanyakumari District. Among them are two higher secondary schools and one high School, two middle schools and three primary schools in Kanyakumari District. In all these schools, 70 per cent of the students are tribals. Except for the high school, all other schools have hostel facilities. The students are provided with free boarding and lodging, woollen blankets, textbooks, writing materials and uniforms.

Health facilities

Kani people get government medical facilities free of cost. But there is no Primary Health Centre in any of the Kani settlements. Medical mobile van visits each settlement every week.

Puberty ceremony

Puberty rites are observed when a girl attains maturity. The girl is kept in seclusion (*Gudisai Kuthirudu*—siting in her hut) for about one month. The maternal uncle erects the hut and presents gifts to the girl.

Marriage and dowry

Among the Kani, monogamy is the most common. Polygamy is rarely accepted. The age of marriage varies from 16 to 20 years for girls and 20 to 25 years for boys. A gold *thali* and toe-rings are marriage symbols. Cash and clothes are given as dowry. But nowadays jewellery and money too is given alongwith brass vessel, choppers, grain and pulses, land and house.

Economic condition

The development in economy is largely depended on climate, natural resources, infrastructural facilities, entrepreneurial skills, attitude towards investments and availability of skilled labour. Forest is the main source of income to these people. Their economic system is almost self sufficient and confined to their village.

Sources of Income

Daily wages in ARC :

Male	- Rs 500 /day
Female	- Rs 350/day
Rubber sheet	- Rs 200 /sheet
Tapioca	- Rs 30 /kg
Banana	- Rs 70 /kg
Dry coconut	- Rs 30 /kg
Cardamon	- Rs 850 /kg
Black pepper	- Rs 700 /kg
Honey	- Rs 200 /lit

So, the average income of a family is approximately Rs 2-2.5 lakh/year.

Basic facilities provided by the government

The Tamil Nadu State government has provided a lot of basic facilities free of cost to Kani people. These include electricity (100 units free of cost per month per family), television, mixer-grinder, fan, etc. Students in Class 12 get laptops and bicycles from the government.

Tribal festival

Hindu Kanikkars celebrate festivals such as Onam, Deepavali and Karthigai. The Christian Kanikkars are converts to the Roman Catholic faith. They celebrate Christmas and observe Good Friday.

Medicine knowledge of medicine

Almost all the tribal men and women at Pechipparai settlement possess a good knowledge of medicinal plants and their uses. The Muttukani in the settlement has thorough knowledge about herbs. He gives medicines for curing ordinary diseases like stomach ache, fever and common cold. Certain Kanis use medicinal plants independently. If the disease is not cured, they go to Muttukani for better treatment.

Problems faced by Kani people

When I interacted with some Kani people and asked about their problems, they told me that they were happy. Only one demand of Kanis is that they should get cultivated land in their own name in the records. Also they want four hectare land per family according to the Tribal Act 2006. Further, medical facility is not available if any emergency occurs. Wild boars and monkeys destroy the crops of Kani people.

Conclusion

1. The government of Tamil Nadu is taking many welfare measures to look after the well-being of Kani tribal people. Even though the government is coming forward to enlighten them, the benefits of the government schemes have not yet reached the people. The economy of tribals is limited and not self-sufficient.
2. Kani people have forgotten their

traditional agricultural practices i.e cultivation of paddy, because they get ready cash from crops like rubber.

3. There is introduction of invasive alien species, *Mucona bracteata,* a leguminous species planted as a cover crop in rubber plantation for nitrogen fixation. But today it has turned into a weed and spread into adjoining forest areas. It covers the ground completely, climbs on the forest trees and covers them completely. Thus the photosynthetic ability of trees is destroyed and leading to their death.
4. Kani people not ready to approach government services.

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Living jewels of Jaisamand Wildlife Sanctuary

The sanctuary has a large number of butterfly diversity, indicating pollution free and ecologically healthy atmosphere—a result of rich floral diversity

Priya R. Mhaiskar

Jaisamand Wildlife sanctuary is situated in the most fragile ecosystem of Aravalis, around 50 kms from the city of Udaipur in the State of Rajasthan. Encompassing a geographical area of 52.342 sq km, this sanctuary forms an ideal habitat to support variety of terrestrial as well as aquatic fauna. Jaisamand Wildlife sanctuary is quite rich in biodiversity, organised into geometric composition of ground flora to the top canopy designed naturally to harvest maximum sunlight and maximise the biodiversity. The floral diversity is dominated by mixed miscellaneous forest. The sanctuary is also rich in faunal diversity, including big carnivores like Leopards, Hyenas; herbivores such as Chital, Blackbuck, etc., alongwith significant number of butterflies species.

Butterflies have lived on Earth for at least 150 million years and have a great aesthetic value. The most important part of the butterfly is its wings, which enables it to move for food, find shelter and mate, blending in with its surroundings, to warn its enemies that it is poisonous and should be avoided and all the other things it needs. Almost every colour of rainbow is displayed in the wings of butterflies and every butterfly is different from other. The appearance of wings is just like a leaf which is supported by a network of veins. The shape of the wings varies with the species, which make flying pattern of each butterfly different from other. Butterflies play a vital role in pollination of various flowering plants besides being a key component of food chain. In the world, 16,823 species of butterflies have been recorded out of which 1,501 species of butterflies are recorded from India (*Ali and Basistha, 2008*).

Butterflies are found all over the world and in all types of environments: hot and cold, dry and moist, at sea level and high in the mountains. Most butterfly species, however, are found in tropical areas. The average life span of a butterfly is at most two months although some tropical butterflies can live up to one year. Butterflies are amazing fliers and some can migrate over 3,000 miles (4,800 kilometres) to spend the winter in a warmer place. To avoid adverse environmental conditions like cold weather, many butterflies migrate from hotter region to cooler areas.

The survival of these beautiful creatures has become very critical due to increase in corrosive pollutants in the atmosphere. The reaction of corrosive pollutants with moist oxygen

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and water forms inorganic and organic acids. The oxides of carbon, oxides of nitrogen, oxides of sulphur, oxides of halogens and hydride of sulphur form carbonic acid, nitric acid, nitrous acid and sulphuric acid. Organic acids are formic acid, acetic acid and benzoic acid. Butterflies come in contact with these corrosive acids to develop micro-bio-electro-chemical corrosion cell. Oxidation and reduction reactions start on the body of the butterfly. It disturbs catabolic and anabolic process of butterflies (*Rajesh Kumar, 2013*). Such corrosive pollutants destroy the life of butterflies and hence there is reduction in their population growth. The greenhouse gases, along with global warming, are also causing negative impact on the life of butterflies. The acid rain accelerates corrosion reaction with butterflies. Due to urbanisation and deforestation, the concentration of carbon dioxide and methane gases are increasing in the atmosphere by the day. These gases are increasing surrounding temperature of the earth and global warming is becoming a threat to their survival. The particulates easily adhere to the butterflies and they react with moisture to produce acid and base. It is a major cause of corrosion in their body parts.

Jaisamand Wildlife Sanctuary has a large number of butterfly diversity, indicating pollution free and ecologically healthy atmosphere—a result of rich floral diversity. Various butterfly species contributing to biodiversity of the sanctuary are:

Plain Tiger (*Danaus chrysippus*)

White Orange tip (*Ixias marianne*)

Tiny Grass Blue (*Zizula hylax*)

Danaid Eggfly (*Hypolimnas misippus*)

Indian cupid (*Everes lacturnus*)

Peacock Pancy (*Junonia almana*)

Common Bush Brown (*Mycalesis perseus*)

Stripped tiger (*Danaus genutia*)

Dark Evening Brown (*Melanitis phedima*)

Common Bush Brown (*Mycalesis perseus*)

Common Emigrant (*Catopsilia pomona*)

Pale Grass Blue (*Pseudozizeeria maha)*

Common Silverline (*Spindasis vulcanus*)

Blue Pancy (*Junonia orithiya*)

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Forestry and contemporary challenges

Contemporary forestry-linked challenges vary from local to global levels and thus need efforts from all the sections of the society to mitigate adverse impacts

Rameshwari Bongale

Forests form the heart of biodiversity and base of all the living entities on the earth. The changes that are occurring in our surroundings are with a speed far higher than any time before in history. The changes that are occurring today are long-term and about to affect the environmental balance for years to come.

The Mother Nature stays at equilibrium, taking care of all living and non-living things. This slight change at delicate areas of this balance leads to an overall cascading impact on environment that forms the part of chain at forward and backward linkages. Unfortunately, the changes that are taking place are on large scale and taking place in one of the most delicate areas of environmental linkages, such as Himalayan eco-system and ocean current network. Right from urban areas to small tiny villages and from local to global, the changing aspects of environment is well noticed and largely discussed at various platforms. This very change is the major prime indication of contemporary challenges in the field of forestry. Forestry as an academic discipline has long history wherein people have given all their life for purpose of forest research. The mention of German scientists is simply unavoidable. In today's context, the forestry is an important subject at the national and international levels.

The main challenges in forest conservation are the huge pressure that forest suffers from various economic processes. The unaccounted illegal trade of medicinal plant is one such example. The commercialisation of forest produce has led to the plunder of forest wealth and it is still continuing. While on the one hand, the forest policy of 1988 specifically denies the use of forest for revenue purposes, on the other hand, there is a high demand for timber and non-timber forest produce in the market. This leads to illegal trade of forest produce, resulting in the huge parallel black economy that is beyond calculation. This is directly linked with the economics of ecological services that are provided by the forest.

The challenge of social pressure on available forest resources is immense. Population growth and changes in demographic attributes (rural/urban balance, agricultural dependency, incomes and prosperity, changes in aspirations and expectations) has further led to many changes in socio economic setup of country. In India—it being still a developing country—the number of people who are directly dependent on the forest for their daily

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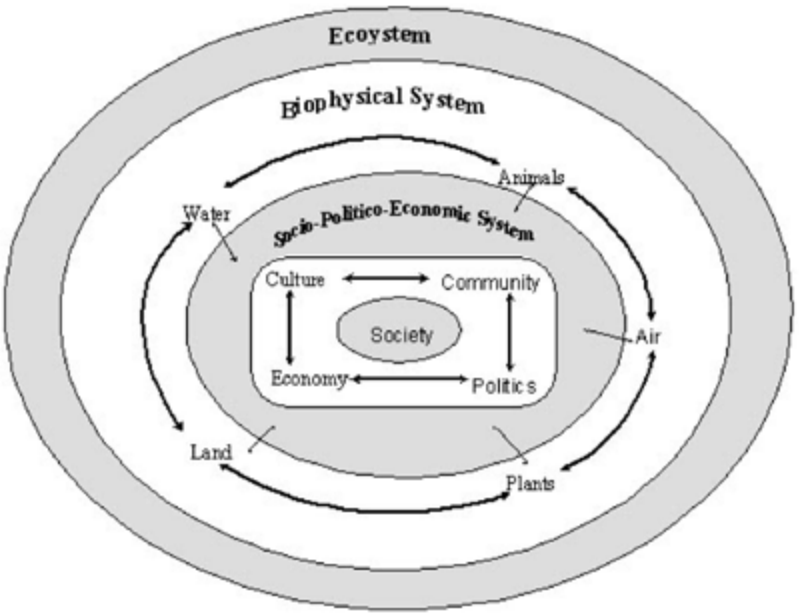
livelihoods is remarkably high. People living on forest fringes and backward areas of the country are the main section that extracts many products from the forest. This extraction has turned unsustainable due to commercialisation of forest products at a large scale.

If we see the map of India, the distinct nature of mineral wealth can be observed. One of the dominant forest areas is holding a huge mineral wealth beneath it. This leads to a conflict between conservation and economic development. The State of Bihar, Jharkhand and Odisha are rich in forests, loaded with minerals and home to a large tribal population of the country. Forestry activities in such areas are very tough and create a problem for the foresters.

The next main challenge in the field of forestry is the level of research in India. The dominant role played by forest bureaucracy and non-linkages that exist between officials and research needs to be solved on war footing. The 'lab to land' concept needs to be implemented on practical lines across various parts of the country. The social and farm forestry field has been stagnant for a long time and there is a dire need for fresh inputs to revitalise the overall farm forestry sector. The forest productivity in India is one of the lowest in the world. Along with social pressure and policy priorities, low level of contemporary forest research is one reason.

Another contemporary challenge for forestry comes from climate change. This challenge is local as well as global in nature. Some of the changes in some areas of the world are leading to massive imbalance in other areas. Tropical areas are more prone to the impact of climate



change that may lead to rise in the temperature, erratic nature of rainfall, rise in sea level, shifting of snowline to higher altitudes and resulting in migration of animals to higher ranges of mountains. These affect forestry more than human life due to the very close connection forests has with other components of the eco-system.

The responsibility to deal with these changes mainly lies in the field of forestry. The old age activity of afforestation has returned to contemporary life with the sophisticated name of carbon trapping and green bond. The clean development mechanism of Kyoto protocol provides the option wherein a developed country can invest in developing countries through window of joint implementation and clean development mechanism. One cannot ignore the evolution of political orientations and policies (within and outside the sector) and institutional/policy adaptations (such as economic liberalisation and deregulation, decentralisation, adherence to trading blocks, becoming parties to international agreements and associated obligations).

The energy sector is also closely linked to forestry. Wood fuels and farm residues are important elements in national energy budgets. The rate at which they are being displaced by "modern" conventional fuels, or the rate at which they enter the commercial mainstream themselves, will affect the forestry sector. Transport infrastructure, particularly roads, can also have a major impact on forestry. By improving access to forests, roads offer greater ease of settlement, encroachment and deforestation. On the positive side, roads open up opportunities for viable commercialisation of forest resources.

The contemporary challenge is also linked with the accounting of ecological services. Greater interest in non-production forest functions may develop with greater incomes. Many of these will be environmental and recreation services. Concern for the environment and for the ecological services provided by forests are not yet perceived as priorities in the greater part of Asia and the Pacific, as many countries are more preoccupied with the role of forests in producing economically or socially useful physical goods. As the region's people become richer, they are, however, likely to put additional pressures on forests in the Asia-Pacific region through increased demand for goods. They will also shift the balance of their demands toward greater prominence of services.

The next area in forestry is about intellectual property rights. As many of the forest products are indigenous in nature and connected with the ethno-botanical history of an area, it needs efforts to give equal share for tribal people in profits earned by usage of traditional knowledge. The convention on biological diversity and Cartagena protocol under UNFCCC take special care for the protection of the rights of indigenous people and equal benefits sharing from ecological resources. The contemporary forestry-linked challenges vary from local to global levels and thus need efforts from all the sections of the society to mitigate the impacts of climate change.

Usage of indigenous edible fruit and plants in Mokokchung district of Nagaland

Due to lack of proper documentation and conservation, wild edible fruit and plants are getting lost at an alarming rate

Alemwapang Imchen

Let me take you on a journey through one of the north-eastern states of India, a land of hills and forests where folklore has passed down the generations through word of mouth. By whatever name people have called this realm, Nagaland has always evoked a sense of mysticism and awe, intensified by the remoteness of its geographical location. One may consider it not so huge in area, however, the exuberance and diversity of the place, be it biologically or culturally, is something to be reckoned. Nagaland has 16 major tribes and other minor ethnic communities as well, each having their distinct dialect. The Ao Naga is one of the major tribes in the state inhabiting the district of Mokokchung. The Aos are well known for their multiple harvest festivals held each year such as Moatsu and Tsungremong. A substantial proportion of the people are hardworking farmers whose major part of their daily diet consists of local indigenous wild fruits and plants. These are either collected from the wild or purchased from local markets and are consumed fresh.

The north-eastern states of India are a natural reservoir of an umpteen diversity of wild edible fruits and plants In spite of their potential use, they are unattended both at scientific and farmers level. Due to lack of proper documentation and conservation they are getting lost at an alarming rate. Many of these plants although used traditionally for the treatment of diverse local ailments are undocumented and lack any scientific research. These fruit trees are used in the socio-economic life of the rural people as constructional timber, firewood, fodder, charcoal, dyes, oil, etc. Although, these plants play an important role in the social and cultural life of rural people, most of them are threatened. Therefore, there is an urgent need to conserve these genetic resources for livelihood security of rural people and for the benefit of the nation as a whole.

As a young child, I recollect the wild days where we used to climb the trees and wade through the thickets unafraid of what lay ahead just to savour some tasty fruits. Sadly, many species are disappearing due to various reasons which are as diverse as the diversity among the people here. Although the wild edible indigenous fruits and plants that I personally relish run in hundreds, very few have been scientifically studied or documented. Let me mention some of the ethno-botanical uses of wild edible fruits and plants of Mokokchung district of Nagaland from where I belong.

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Houttuynia cordata **(Saururaceae)**
This species is a herbaceous perennial plant. Both leaves and roots are used for culinary purposes. Leaves possess a typical aroma. One may not like the taste at first instant. It is said to cure diabetes, encourage weight loss, used as a diuretic, for pneumonia, etc.

Allium hookeri **(Liliaceae)**
Also known as the hooker's chives, it is an evergreen, herbaceous plant producing a cluster of leaves. The plant grows from a cluster of thin bulbs with thick, fleshy roots. Leaves are used as a garnish and flavouring on foods. One can make tasty *pakodas* of it too.

Averrhoa carambola **(Oxalidaceae)**
Also known as star fruit. It is a rich source of dietary fibre, vitamins C, B2, B6 and B9 and minerals such as phosphorus, potassium, zinc and iron. 100g of the fruit contains only 31 calories. You may have it if you want to lose some weight.

Elaegnus latifolia **(Elaeagnaceae)**
It is a shrubby plant reaching height up to 3m. The plant is gathered from the wild for local use as a food, medicine and fuel. The fruit is sour in taste when unripe and becomes sweet on ripening. You may even dry the fruit in the sun and have it later. However this species is rare to find these days.

***Gynura nepalensis* (Asteraceae)** This is a creeper or climbing plant. The leaves are collected from the wild for consumption and also for local medicinal use. It has been found to keep the digestive system healthy. Juice of the leaves is applied on wounds and bruises as well.	
***Allium chinense* (Liliaceae)** It is an evergreen herb that grows to 0.3 m. Its bulbs are edible and are one of the well-known favored condiments used in many traditional Naga dishes. Chutneys made out of it taste superb.	
***Baccaurea sapida* (Phyllanthaceae)** Also called Burmese grape tree. The genus comprises over 100 species, distributed from SE Asia to the West Pacific. The fruit of this tree is edibe and is sweet in taste.	
***Diplazium esculentum* (Athyraceae)** The 'vegetable fern', is an edible fern found throughout Asia and Oceania. It is probably the most commonly consumed fern. The top ends of the young ferns are gathered for culinary purpose. This fern is usually found growing wild along river banks.	

Clerodendrum colebrookianum **(Lamiaceae)** Also known as East Indian Glory Bower. This is a perennial shrub whose leaves are used traditionally as vegetable. The leaves are also utilised for treatment of diabetes, hypertension, cough and rheumatism.	
Zanthoxylum oxyphyllum **(Rutaceae)** It is a spiny shrub. The plant is harvested from the wild for local use as a medicine and food. All parts of the plant are useful. Generally the leaves of this plant are consumed by the locals.	
Myrica rubra **(Myricaceae)** It is a dioecious medium sized tree, with separate male and female individuals. Being a dioecious species, both male and female forms need to be grown if you want to taste its fruit. The sugar added preserved fruit would certainly arouse one's taste buds.	
Citrus indica **(Rutaceae)** Wild mandarins are found in the hill regions of north-east India which is a natural gene bank of several citrus varieties. However due to faulty agricultural practices and lack of sensitisation, these precious genetic resources are gradually getting eroded.	

Rhus semialata **(Anacardiaceae)** The matured fruit of the plant is used as a condiment for flavoring food and also for several medicinal purposes. The dried fruit is ground and stored in closed containers which can then be used when needed. This is one of the main local medicinal plants utilised by the Ao Nagas.	
Musa **spp. (Musaceae)** The fruit of these wild banana varieties are not consumed as they are unpalatable for humans. Instead the inflorescence (spadix) is consumed for food by the local people. One will certainly find it being sold in the local markets.	
Castanopsis indica **(Fagaceae)** The edible part is the fleshy portion of the seed inside the matured spiny fruit. This species is not so tasty as one might expect. However it can act as a dietary supplement. It is seldom harvested in the wild for consumption.	
Calamus erectus **(Arecaceae)** Unlike most cane species it does not climb and grows only to about 3m. The fruit is edible and sour in taste. Due to shorter internodes, the cane is not useful for making furniture. The fruit bunch is even kept as a show piece due to its unique appearance.	

Phyllanthus acidus **(phyllanthaceae)**
Star gooseberry is a medium-sized deciduous tree. The flowers can be male, female or hermaphrodite. Unlike the common gooseberry which is sour in taste, this is less sour. It is a good source of Vitamin C and can be eaten raw, made into pickle or juice.

Parkia timoriana **(Leguminosae).**
It is a large evergreen tree. The flowers of this tree are pollinated by bats, especially *Eonycteris spelaea*, which feed on the nectar. The fruit is a local delicacy. A bunch of the fruit may cost around Rs 50 to Rs 100 in the local market.

Elsholtzia blanda **(Lamiaceae)**
It is a small herbaceous plant. The matured, dried leaves and inflorescence of the plant is utilised as an aromatic spice for flavoring in local cuisine. It provides the food with a unique aroma and taste.

***Docynia indica* (Rosaceae)** Knows as Wild apple or Sour apple, this tree is found in wild tropical rainforest regions of Nagaland. The fruit contains multi-medicinal value *viz.* for high blood pressure, diabetes, heavy body weight, fatigue, general weakness, etc. The processed dry fruit of this species is very tasty and is sold in the local market.	

Use of biotechnological tools in conservation of medicinal plants

The most widely accepted scientific technologies of biodiversity conservation are in-situ and ex-situ methods

Ganesh N Patole

Medicinal plants occupy an important position in the socio-cultural, spiritual and medicinal arena of rural people of India. Their sustainable management and harvesting can conserve biodiversity, sustain human and environmental health, generate employment and enhance export earnings.

Exploration of forest-based plant products for new pharmaceuticals and the demand for medicinal plants are increasing. India is ranked second amongst the exporting countries, after China, with an annual export of 50,000 tonnes with a value of more than Rs 100 billion. In addition to the international trade, there is a substantial volume of internal trade in medicinal plants. It has been estimated that in total over 8,000 species of plants are used by several ethnic communities. The expanding trade in medicinal plants has serious implications on the survival of several plant species, many of which are under threat of becoming extinct. Further, the rich biodiversity of medicinal plants is facing a serious threat because of the rapid loss of natural habitats and over-exploitation of plants from the wild. A strong strategy in terms of conservation through biotechnology and legal matters has to be developed. Biotechnological tools are important as they help to select, multiply and conserve the critical genotypes of medicinal plants. In-vitro regeneration, plant tissue culture, mycorrhization, regeneration through somatic embryogenesis and callus-mediated organogenesis hold tremendous potential for the production of high-quality plant-based medicine. Cryo-preservation is long-term conservation method in liquid nitrogen and provides an opportunity for conservation of endangered medicinal plants. In-vitro production of secondary metabolites in plant cell suspension cultures has been reported from various medicinal plants.

Conservation Strategies

The conservation and sustainable utilisation of medicinal plants must necessarily involve a long term, integrated, scientifically oriented action programme. This should involve the pertinent aspects of protection, preservation, maintenance, exploitation, conservation and sustainable utilisation. The most widely accepted scientific technologies of biodiversity conservation are in-situ and ex-situ methods.

In-Situ Conservation: The best and

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most cost-effective way of protecting the existing biological and genetic diversity is 'in-situ' or on the site conservation wherein a wild species or stock of a biological community is protected and preserved in its natural habitat. In-situ conservation of medicinal plants in India can be accomplished through the active support and participation of people who dwell in or near and around protected forest areas.

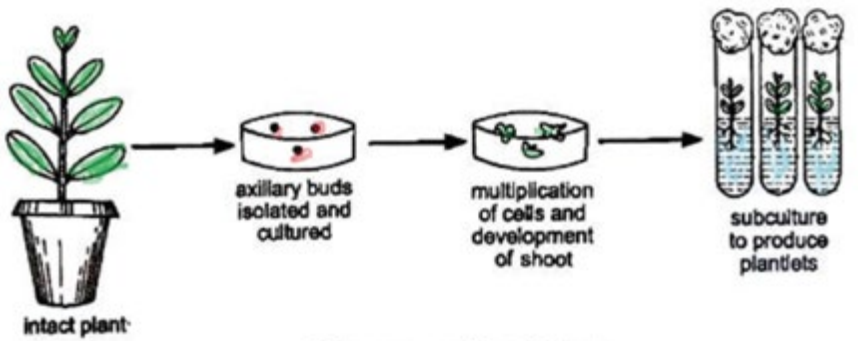
Ex-Situ Conservation: Conservation of medicinal plants can also be accomplished ex-situ, i.e. outside the natural habitat by cultivating and maintaining plants in botanical gardens, parks, other suitable sites, and through long-term preservation of plant propagules in gene banks (seed bank, pollen bank, DNA libraries, etc.) and in plant tissue culture repositories and by cryopreservation.

Biotechnological Tools

The sustainable utilisation of plant diversity can be greatly assisted by the application of direct and indirect biotechnological procedures.

In-vitro Regeneration: The in-vitro regeneration of medicinal plants is done from various explants and enhanced production of secondary metabolites. In-vitro propagation of plants holds tremendous potential for the production of high-quality plant-based medicines. Micropropagation of various plant species, including many medicinal plants, has been reported. Plant regeneration from shoot and stem meristems has yielded encouraging results in medicinal plants like *Catharanthus roseus, Cinchona ledgeriana, Digitalis spp, Rehmannia glutinosa, Rauvolfia serpentina and Isoplexis canariensis.*

Regeneration through somatic embryogenesis: Somatic embryogenesis is a process where groups of somatic cells/tissues lead to the formation of somatic embryos which resemble the zygotic embryos of intact seeds and can grow into seedlings on suitable medium. Plant regeneration via somatic embryogenesis from single cells, that can be induced to produce an embryo and then a complete plant, has been demonstrated in many medicinal plant



Micropropagation of plants.

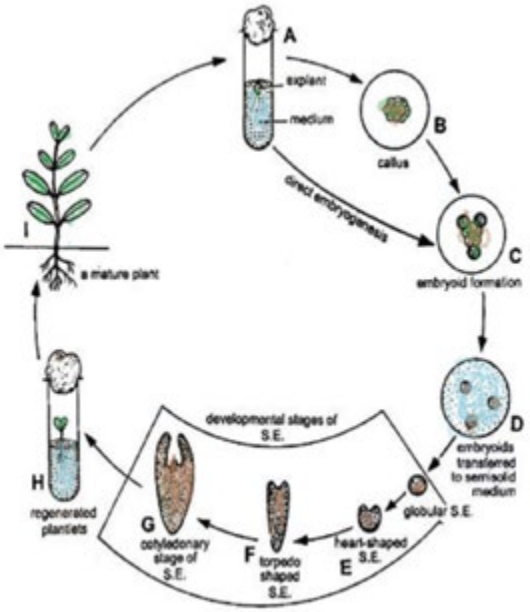


Fig. 5. Somatic Embryo (S.E.) Differentiation

species, for example *Cayratia japonica*.

Conservation through cryopreservation: The cryopreservation of in-vitro cultures of medicinal plants is a useful technique. Cryopreservation is long-term conservation method in liquid nitrogen (–196 °C) in which cell division and metabolic and biochemical processes are arrested. A large number of cultured materials can be stored in liquid nitrogen. Since whole plants can regenerate from frozen culture, cryopreservation provides an opportunity for conservation of endangered medicinal plants (e.g. *Rauvollfia serpentina*, *Digitalis lanata*, *Atropa belladonna)*.

Genetic transformation: Medicinal plants are one of the most important sources of drugs, as plants contain many secondary metabolites which are responsible for their medicinal properties. Genetic transformation improves the yield and quality of medicinal plants and involves the alteration or introduction of genes which improves secondary metabolite synthesis. Genetic transformation technology has become a versatile platform not only for trait improvement but also for studying gene function in plants. Genome manipulation is the general aim of genetic transformation with medicinal plants by developing techniques for desired gene transfer into the plant genome in order to improve the biosynthetic rate of the compounds of interest. Genetic transformation facilitates the growth of medicinal plants with multiple durable resistances to pests and diseases. Likewise, transgenes or marker-assisted se-

lection may assist in the development of insect-, pest-, drought- and salinity-resistant plants, which are needed to fulfill the world's need and save land for the conservation of plant biodiversity in natural habitats. There are more than 120 species belonging to 35 families in which transformation has been carried out successfully by using *Agrobacterium* and other transformations techniques.

Conclusion and future prospects

Biotechnology is now integrated in all aspects of plant germplasm characterisation, acquisition, conservation, exchange and genetic resource management. Future prospects are highly encouraging in terms of the development and application of new techniques and protocols within the context of germplasm conservation.

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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.

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