

A STUDY ON CONSERVATION OF RED GOLDS OF ANDHRA PRADESH: ISSUES AND OPTIONS

BIJENDRA BASNYAT, REKHA SHARMA, SAMIR STEPHEN KUJUR, SANJAY BALA,
SHIKHA KALRA AND A. K. BHATTACHARYA
Indian Institute of Forest Management, Bhopal (Madhya Pradesh)

ABSTRACT

The paper deals with various aspects related to the conservation of Red Golds (Sanders) in Andhra Pradesh. The importance of the species, its distribution, production, utilisation, management issues etc have been described. The conservation problems and possible remedies have been analysed and recommendations made.

Introduction

Red Sanders locally known as "Yerrachandanam" and "Raktachandanam", and scientifically as *Pterocarpus santalinus* is found in tropical dry deciduous forests of Andhra Pradesh mostly in Cuddapah District. This species is also found in small pockets in the adjoining Tamil Nadu State. It is conspicuously predominant in a subtype of this main group, which carries a name "Red Sanders Forests". There it is either pure forest or is associated with a comparatively small number of other top storey species such as *Anogeissus latifolia*, *Kingiodendron pinnatum*, *Chloroxylon swietenia*, *Terminalia alata*, *Terminalia chebula*. In the middle storey, *Chloroxylon swietenia* and *Erythroxylum monogynum* are typically present. The species is also found in another sub type, southern mixed dry deciduous forest in this group, along with a large number of associates where its own proportion is somewhat lower. Here its top storey associates are *Anogeissus latifolia*, *Kingiodendron pinnatum*, *Terminalia alata*, *Cleistanthus collinus*, *Tectona grandis* etc. Red Sanders (RS) also occurs as one of the components of *Hardwickia* forests, an edaphic sub type of dry deciduous forests as recognized by Champion and Seth.

The RS forests are apparently climatic climax, though it disappears in the adjoining areas, where the rock changes from slate to quartzite to gneiss, but with little change of climate. Its value in the international market is very high thereby making it vulnerable to activities like smuggling, illicit felling etc. There is a ban on its felling in the State. The climatic condition as well as biotic interference is reducing the RS forests in Andhra Pradesh (AP). Hence, this report attempts to analyze the status of RS forests in Andhra Pradesh, examine the management interventions made for promoting its regeneration and the problems faced by Forest Department in protection, draw conclusion and finally make recommendations for conservation of Red Gold of AP.

This report has followed "**Systematic Information Collection and Analysis Approach**" (SISCA) and **consultative approach** in collecting information. Available reports, studies and documents were collected, reviewed and analyzed in a coherent manner and documented in a systematic manner, given particular attention to avoid duplication, avoiding potential problems and to harness good lessons. Consultation with the Forest Department staff and local people were carried out to know about the problems faced by them in conservation of RS in the area. For assessing the impacts of management interventions, 5 quadrants of 10m * 10 m was laid down in forests of SV National Park, Talakona reserve forests and Manmadur reserve forests. In order to assess the regeneration condition 15 nested plots of 9 sq. m were laid down and regenerating plants were counted. The information was compiled from the review, analysed and interpreted from secondary sources of information only.

This report has been organized into five sections. First section is the introductory section. Section two presents distribution and general characteristics of RS. Section three deals with different management interventions made by the AP Forest Department for conservation of RS and its implication of stand density and regeneration. Section four deals with the problems of conservation, mainly from biotic factors. Finally section five deals with the conclusions and recommendations.

DISTRIBUTION AND CHARACTERISTICS OF RED SANDERS

Distribution

Red Sanders is endemic to Seshachalam and Velugonda hill ranges of Cuddapah, Chittoor, and parts of Nellore and Kurnool districts of Andhra Pradesh. Naturally, it occurs over 1.47 lakh hectares in Cuddapah, 34,500 hectares in Chittoor, 13,500 ha in Nellore and 5,000 ha in Kurnool districts. Geographically this species occurs in the natural forests ranging from the southern tip of Nallamalla hills to whole of Lankamala, Palakonda and Seshachalam hill ranges. The main associates of RS are *Hardwickia binata*, *Pterocarpus marsupium*, *Acacia leucocopholea*, *Terminalia chebula*, *Chloroxylon swietenia*.

Red Sanders forests are confined to the eastern part of Chittoor district. Red Sanders occur in various proportions in 26 beats covering an area of 35,000 ha. Distribution of the Red Sanders forests in Chittoor East division by administrative unit is given in table 1. The total area is approximately equal to 15 percent of the RS bearing forests in the State.

Table 1: Distribution of forests by Administrative units

| SN | Administrative Unit | Extent of area | Condition of crop |
|----|----------------------------|----------------|--|
| 1 | S.V. National Park | 35% | Mature crop occurring in patches |
| 2 | Sri Venkateswara Sanctuary | 35% | Mature crop occurring in patches |
| 3 | Chittoor East Division | 30% | Scattered, pole crop, young regeneration |

Source: DFO Office, Chittoor East Division, Chittoor

General characteristics

Classification

Family : Leguminosae
Sub family : Papilionoidea
Genus : *Pterocarpus*
Species : *santalinus*
Local name : Lal Chandan, Rakta Chandanam, Yerachandanam,
Common name : Red Sanders, Red Sanders wood

Morphology

Red Sanders is a deciduous medium sized tree with glossy, semi ever green foliage usually found at an elevation of 250 to 900 m in hilly and undulating topography. In nature, it attains a girth of 1.9 to 2.5 meters and height of 15 to 18 meters.

Stem: Clean bole, erect

Bark: Blackish brown, deep cleft into rectangular plates by deep vertical and horizontal cracks.

Leaves: Imparipinnate, 10-18 cm long, leaflets three, rarely four or five.

Flower: Yellow, axillary in simple or sparingly branched racemes

Seed: One or two, 1-1.5 cm long, reddish brown

Two varieties of trees are locally recognized. One has a comparatively smooth bark and lighter colored heartwood, while the other has rough bark and dark red colored heartwood. Local people distinguish these trees as male and female but no botanical difference exists between these two.

Characteristics

Climate: In its natural habitat typified by Cuddapah climate is dry and hot. Mean daily temperature for summer varies from 37.8 to 48.9°C and winter temperature varies from 9 to 14° C. Mean annual rainfall is 768 mm and relative humidity is 58%. It is a drought resistant species usually found on an elevation of 259 to 900m.

Geology and Soil: It grows on rocky hill consisting of quartzite soil, limestone and laterite. It is not exacting in its soil requirement and is found in poor shallow soil. But the timber quality/grains formation greatly depends on soil quality. It requires perfect drainage and is found mainly found on stony or gravel soil.

Silviculture: Red Sanders is a light demander and requires abundant growing space for crown development. So thinning is required for proper growth of this tree. It is more resistant to fire than many of its associates. Sometimes even seedlings and saplings escape serious damage by wild fires. It shows a dying back mechanism and is a very good coppicer. This characteristic is very evident from the fact that all the mature trees that have been chopped off have mostly regenerated through coppicing. Stumps up to 1.2 m girth produce numerous coppice shoots. The growth of the coppice shoot is fast and it attains a height of 4.5 m and girth of 15 to 20 cm in a period of three years. It also produces root suckers freely.

Natural regeneration occurs from seeds. Artificial propagation can be achieved with seeds and cuttings. Saplings are field planted when one year old at spacing of 3.5 to 4.5 meter. It avoids both water logged sites and over shading by other trees

Physical and mechanical properties of wood

The wood is very heavy. It weighs 900 to 1265 kgs/ cubic meter at 12% moisture content. It has a specific gravity of 0.87 to 1.2 air dry. Heartwood and sapwood are sharply demarcated. It is very strong and extremely hard. If compared to teak taken as 100, its comparative strength coefficient is 125 to 165. The timber contains red dye 'Santalol' soluble in alcohol. Timber from some trees exhibits wavy grains. It is extremely difficult to saw wood when dry. It has interlocked grains and requires are to be brought to a good finish. It polishes well. It is a very steady timber and shrinkage is very less.

Utilization

Red sanders wood was employed in the past for dyeing wool, cotton and leather and for wood standing. Today, the usage of RS appears restricted to foods since it imparts a sweet spicy

flavor and orange red shade. For food industries, RS have been traditionally used with fish products in Europe and more recent application includes coloring of seafood sauces, meat products, snack foods, breadcrumbs and alcoholic drinks. Dosage levels ranges from 0.1 to 1 percent.

Despite the attractive color of the wood, its weight and hardness go against it for making furniture. Two main varieties of its timber are recognized for trade. The first is known as quality wood or Japan quality wood, which contains wavy and ripple grains. It is highly valued and is almost entirely exported to Japan to be used in the manufacture of a particular instrument known as “Shamisen”. The second variety, which constitutes a bulk of the available supplies, has no ripple or wavy grain and is known as non-quality wood. It is also used for carving into idols, which are in great demand for pilgrims and other people visiting Tirupathi and other centers. The wood is also used for turnery, toys, ornamental house posts, agriculture implements, poles, shafts, picture frames, cart wheels, etc. A small quantity of this variety is also exported to Japan for making of dolls there.

The principal red pigments in Red Sanders heartwood are Santalin A and B. These are soluble in organic solvent and alkalis but insoluble in water. The Santalin is used for making medicines in Japan to recover from the atomic effects of Second World War. The use of the Red Sanders for this purpose is still to be verified.

World Demand and Supply trend

Export of Red Sanders wood from India to Europe commenced in the seventeenth century, primarily for textile dyeing although there was some demand for the timber also. Around 1880, exports averaged 3000 tonnes per annum with the UK as the major importers. By 1900, exports and usage of RS as a textile dye had virtually stopped owing to the competition from synthetic cloth.

In 1930, Japan started importing Indian Red Sanders wood for manufacturing the traditional “Shamisen” musical instrument and this market remains important today at a level of several hundred of tonnes per annum. Demand by Japan for wavy grain quality timber resulted in significant illegal and destructive exploitation of the wild resources in the 1950s and hence, controls were imposed on trading.

The AP Forest Development Corporation has been appointed as an agent to Government of Andhra Pradesh for the disposal of Red Sanders Wood available with AP Forest Department. There is a stock of about 1830 metric tonnes of various grades of Red Sanders Wood available in different the depots of AP Forest Department as detailed below in Table 2. The government floats global tenders for the sale of Red Sanders wood. The main buyers are the Japanese. The average price of wood is Rs 200 per kg. The sale of Red Sanders wood is permissible for internal consumption i.e. inside India. Export of Red Sanders Wood in a value-added form is also permissible under the Indian Laws.

Upon seizing a cache of RS the concerned range office dresses it, numbers it and measures it. The timber collected is dressed up to heartwood. The log length is kept above 75 cm while the top girth is kept 36 cm and above. The logs stored are straight or nearly straight. The wood is either concerted into logs or rippers (a log vertically cut into half).

The logs after dressing are graded into four types – A, B, C, D and N (non-grade). **Grade A** is characterized by excellent wavy grains. The grains are short and deep while being prominently visible. The surface of this grade wood gives a ripple reflection. These logs are round or nearly

round and smooth with few or no defects. These have a less than 10% bend. **Grade B** wood has a medium deep wavy grain which is clearly visible. They are round or semi-round with few or no defects. B grade wood has a more than 10% bend. **Grade C** Red Sanders wood has long, shallow and almost straight grains and are round or semi-round with few defects. **N or non-grade wood** is unutilisable and defective. Even this wood is sold to parties in Kerala for a very high price. The price of non-grade wood is Rs 80,000 per tone and is mainly used in doll factories and for making color pigments used in coke.

Table 2: Red Sanders Wood available in the Depots of AP Forest Department

| | Characteristics | Amount in MT |
|-----|---|----------------------|
| I | Dressed & graded | |
| | 1. A-Grade | 7.5434 |
| | 2. B-Grade | 113.9431 |
| | 3. C-Grade | 634.0257 |
| | 4. D-Grade | 13.7900 |
| | 5. Non-Graded | 721.4119 |
| | Total | 1490.720 |
| II | Dressed & Non-graded | 9.1670 |
| III | Un-dressed | 305.1487 |
| IV | Product & By-Product | 136.6515 |
| V | Patta land product of Sri B.B. Reddy vide GO Ms. No.502, dt.5.11.1999 | 25.5650 MTs |
| | TOTAL: | 1967.2523 MTs |

MANAGEMENT PRACTICES

Present status of Red Sanders bearing forests:

These are dry deciduous forests and annual fires during summer are a common affair. This affects the natural regeneration and its further growth. Ground fires are common in these forests and are attributed to the excess growth of Boda grass (*Cymbopogon coloratus*), which becomes highly inflammable during summer. In the ground fires, not only the young regeneration of Red Sanders but also the humus layer on topsoil floor and its micro flora get destroyed. This ultimately affects the growth of Red Sanders. In addition to the fire hazard the Boda grass (high light demander) suppresses the growth of young regeneration of Red Sanders seedlings. The elimination of Boda grass in Red Sanders bearing areas increases regeneration by 18 to 20 %.

Management interventions

With a view to rejuvenate and regenerate degraded Red Sanders bearing forests and improvement of water regime through soil and moisture conservation works and gap planting, the following treatments are being carried out in Red Sanders forest:

Removal of Boda Grass: The dried Boda grass is highly inflammable and susceptible to fire. The uprooting of Boda grass helps in the natural regeneration of the Red Sanders and other timber species. It further helps in building the humus layer and supports the organic manure to the natural regeneration and also to the standing crop including the Red Sanders.

Rank growth cutting, cut-back of whippy and mal formed saplings, multiple shoots, cutting, climber cutting and pruning: This helps in the regeneration and formation of healthy

and clean bole Red Sanders and other valuable timber species. This also helps in the removal of unhealthy competition from the unwanted species against the desired species. Cutting back also contributes to vigorous coppice regeneration.

Weeding and soil working for the natural Red Sanders seedlings: This helps in boosting the growth and early establishment of Red Sanders seedlings and other valuable timber species.

Construction of Dry Packed Stone Walls (With locally available stone) : This acts as a physical barrier in preventing the spread of forest fires which further helps in the regeneration and humus layer building.

Soil and Moisture Conservation Works (Check dams and contour trenches) : These are constructed across the gullies and hill slopes and help in arresting the soil and water run-off and prevent the loss of top soil from erosion. It also conserves the moisture, which helps in the regeneration of natural seedlings and their early establishment.

Fire Tracing: 3 m width fire tracing around the treated plot, along the bridle paths, cart-tracks etc. prevents the spread of ground fires from one place to another. This further helps in natural regeneration.

Hamata Seed Broadcast: This helps in enriching the soil and suppresses the unwanted grasses that cause fire hazard in summer. This also improves the soil fertility.

Management implications

Tree Number

The total enumeration of trees more than 10 cm diameter is carried out in Jhalari Plot as listed in Table 3. Number of RS has increased drastically (more than 200 %) from 1971 to 1990, but total number of trees increases by 0.5 percent only during the same period. The tree species of *Shorea species*, *Mangifera indica*, *Tectona grandis*, *Terminalia arjuna* have reduced in population whereas *Adina cordifolia* has totally vanished. There is not much addition of the trees in the plots. This may be due to falling of over mature trees due to high velocity of winds, biotic interference or poor natural regeneration.

Table 3: Comparison of tree numbers in Jhalari plot

| SN | Tree species | 1971 | 1990 | Increase percent |
|----|--------------------------------------|-------------|-------------|------------------|
| 1 | <i>Shorea species</i> | 1996 | 1519 | -23.9 |
| 2 | <i>Mangifera indica</i> | 1794 | 1519 | -15.3 |
| 3 | <i>Eugenia jambolana</i> | 762 | 829 | 8.8 |
| 4 | <i>Pterocarpus marsupium</i> | 587 | 860 | 46.5 |
| 5 | <i>Pterocarpus santalinus</i> | 171 | 517 | 202.3 |
| 6 | <i>Terminalia tomentosa</i> | 369 | 617 | 67.2 |
| 7 | <i>Tectona grandis</i> | 112 | 54 | -51.8 |
| 8 | <i>Terminalia arjuna</i> | 77 | 66 | -14.3 |
| 9 | <i>Adina cordifolia</i> | 111 | - | |
| | Total | 5949 | 5981 | 0.5 |

Source: Chittoor East DFO Office, Chittoor

Regeneration condition

Regeneration conditions were assessed in 15 nested plots of 3m * 3m and were classified as established with dbh from 5 to 10 cm, **woody** with dbh less than 5 cm and height more than 1 m, **whippy** with height between 50 cm to 1 m and **sub-whippy** with height less than 50 cm. Number of regenerated plants falling under the categories as defined in the topic were recorded for each species and number per hectare was calculated and presented in Table 4. The table reveals that the growth of RS is much better as compared to other species. In all the regeneration classes the RS dominated over the other species. The special care and attention provided for the regeneration of RS as discussed in above section, has resulted in the better performance. Hence, the management has had positive impacts on the regeneration of the RS.

Table 4: Regeneration condition of Red Sanders forest,

Unit: per ha

| S No | Species | Established | Woody | Whippy | Sub-whippy | Total |
|-------------|--------------------------------------|--------------------|--------------|---------------|-------------------|--------------|
| 1 | <i>Mangifera indica</i> | 83 | 83 | 83 | 167 | 417 |
| 2 | <i>Eugenia jambolana</i> | 83 | 0 | 0 | 83 | 167 |
| 3 | <i>Pterocarpus marsupium</i> | 167 | 83 | 250 | 333 | 833 |
| 4 | <i>Pterocarpus santalinus</i> | 500 | 750 | 1000 | 1833 | 4083 |
| 5 | <i>Terminalia tomentosa</i> | 83 | 167 | 0 | 83 | 333 |
| 6 | <i>Tectona grandis</i> | 250 | 167 | 250 | 417 | 1083 |
| 7 | <i>Terminalia arjuna</i> | 167 | 0 | 83 | 83 | 333 |
| 8 | <i>Adina cordifolia</i> | 83 | 0 | 0 | 167 | 250 |
| 9 | <i>Tamarandus indica</i> | 250 | 83 | 167 | 500 | 1000 |
| 10 | <i>Hardwickia binnata</i> | 83 | 0 | 167 | 83 | 333 |
| 11 | <i>Chloroxylon swietenia</i> | 83 | 167 | 250 | 167 | 667 |
| 12 | Miscellaneous | 83 | 333 | 167 | 833 | 1417 |
| | Total | 1917 | 1833 | 2417 | 4750 | 10917 |

Source: Primary data

Biotic pressure control

Several measures have been implemented to control fire and biotic interference in the Red Sanders forest. The following classification developed by Rajamajhi and Pokherel, 1998 was adopted for analysing the management interventions. A high score is assigned if more than 70 percent of area is affected, moderate if 30 to 70 percent area is affected and low if less than 30 percent area is affected for all the parameters discussed below. Crown density is assessment in terms of open and close canopy. If the canopy density is less than 40 percent, it is assigned as open forest and if it is more than 40%, it is defined as a dense one. Each study team member assigned his/her individual score in percentage to each of the criteria. After collecting the scores, the average was calculated for each site and for each criterion to assess management implications of programs. The implications of the programs are assessed in Table 5.

The grazing intensity in forests is moderate. In Andhra Pradesh, grazing is allowed and lots of people are practicing cattle grazing inside the reserve forests as well as in protected areas. Though peripheral trenches have been constructed, it has not had any influence in controlling grazing but it may have reduced to some extent. Still, lots of cattle were grazing near the sample plots and many shoots had been damaged due to this reason, hence it is very difficult to assess the reduction of the grazing pressure after implementation of such programmes. The

loping and the encroachment in the area are very low. It is almost negligible. The illicit felling and green harvesting of the RS can be seen sufficiently in the survey plots. The trees are felled in interval of every four or five RS. The pole size tree dominated in the survey and a large number of shoots were sprouting from coppice-felled tree. This showed the impacts of illicit felling in RS. The incidence of fire and weed is high though several mechanisms are implemented for the controlling the same. The people are burning the Boda grass for better regeneration of grass for the next session, which is adversely affecting the Red Sanders establishment. The litters and forage cover on the soil is very low. Saplings and forage due to human induced fires cover not even 20 percent area of the soil. The crown cover condition falls under the open forest conditions, as most of the Red Sanders forests exist in pole stage.

Table 5 : Impacts of management interventions

| Characteristics | S.V. National Park | Sri Venkateswara Sanctuary | Chittoor East Division | Average Score |
|-------------------|--------------------|----------------------------|------------------------|---------------|
| Grazing intensity | Moderate | Moderate | High | Moderate |
| Lopping intensity | Low | Low | Low | Low |
| Encroachment | Low | Low | Low | Low |
| Illicit felling | Moderate | Moderate | High | Moderate |
| Green harvesting | Moderate | Moderate | Moderate | Moderate |
| Weed growth | High | High | High | High |
| Fire incidence | High | High | Moderate | Moderate |
| Soil cover | Low | Low | Low | Low |
| Crown class cover | Open | Open | Open | Open |

CONSERVATION EFFORTS AND PROBLEMS

Efforts

Legislation

The Government of Andhra Pradesh in order to check the smuggling of RS wood and also to regulate the transit promulgated the Sandal Wood and Red Sanders Wood Transit rules, 1969 and Andhra Pradesh Red Sanders Wood Possession rules, 1989. These regulations are restricted to Andhra Pradesh only. The section 20 of Andhra Pradesh Forest Act, 1967 also provides specified penalty of illicit felling and removal of RS wood with imprisonment for a term, which shall not be less than 3 months. The Government of India, Ministry of Environment and Forests has included Red Sanders in the negative list of exports. It has also imposed ban on export of Red Sanders under Exim policy for a period of five years from 1992-97 under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

As per the Andhra Pradesh Forest Act 1967, the Governor of AP made the following rules regarding the possession of RS wood:

- No person shall possess RS heartwood or a piece of wood containing both sapwood and heartwood which does exceed 10 cm in diameter at the thickest end. In excess of 20 kg in any shape or indulge in manufacture or trade except under license issued in this behalf in form 2 by Divisional Forest Officer and except the circumstances mentioned here under.
- Every owner or stockist who intends to possess any consignment of RS wood shall immediately inform the DFO in writing of the actual source from which he intends to obtain

RS wood supply. DFO may require evidence to satisfy him about bonafide of such RS wood.

- Every owner or stockist shall maintain a stock register showing receipts of issue of RS wood in all products.

Forest Protection

Following units are looking after the protection of Red Sanders forest :

- Chittoor East Territorial Division
- Mobile Party stationed at Tirupati
- Flying Squad Party
- Deputy Conservator of Forests, S.V National Park, Tirupati
- Divisional Forest Officer, Wildlife Division, Antipoaching, Tirupati
- Forest Station, Manmadur
- Forest Station, Pallam

Vehicles are deployed for the protection activity. Territorial and wildlife divisions carry out the protection work as their regular patrolling job where as flying squad, mobile party and forest station are specially designated for protection work

Problems

Interstate coordination: The entire legal framework of AP is made so as to enforce strict protection and conservation of rare and valuable wood. However, the rules and regulations are applicable within State boundaries and once the material crosses the State border, it is treated as any other wood without cognizance.

Offence identification: The fellers who are instigated by the smugglers to go to the interior parts of the forests in large numbers and come out carrying RS log on their shoulders, after felling and dressing process inside the forests. Before, they bring the wood to the loading point; they will change location in at least 2 to 3 points by deploying separate people for each shift. So, many people don't know a storage point at any given time. Loading of wood is done in fast moving vehicles at mid night and transported by road while being concealed under fruits, coconuts etc. to distant places like the northern parts of the country.

Informers' reluctance to provide information to DFO office: During the process of smuggling, forest staff go and book cases as per the information gathered. Generally detected sites are tanks and scrub forests near the road points. Informers owe more to flying squad party as they have a secret service fund, which can be paid in cash reward to informers.

Lack of funds: Whenever RS is detected in the interior; transportation cost is met from the merge budget provided under the forest protection head. It is very costly to transport wood up to the road point itself.

Offender identification: Forest staffs are able to arrest the fellers and book cases. However, during interrogation of the accused, it is revealed that some of the people are actually paying them in advance and sending them to forest to fell the tree. The present laws provide no scope to tackle the abettors that are encouraging to fell the trees. A serious thought must be given in this direction also.

Judicial system: For any offences, the offender can get a bail within a twenty four hours of arrest from the court. It is very difficult to catch the international smugglers and proceed with inquiry. Before the inquiry proceeds, they take the advantage of the system.

Disposal of Red Sanders stock: There is a huge stock of Red Sanders wood in the district. There is a need to dispose the product to meet the market demand. It is evident that users will try all the methods to meet their demand at any cost. The local socio-economic conditions are supporting the clandestine activity. Meeting the market demand will also lead to reduction in smuggling activity.

Poverty and awareness among local people: The local people living in the fringes of RS forests are involved in felling the Red Sanders trees for their livelihood and food security. They are felling the trees for smugglers at a rate of Rs. 20 per kg of wood, whereas the market price of the wood in the nearest village is Rs 200 per kg. Lack of awareness and poverty is promoting the destruction of RS.

Biotic factors: Fire causes great damage to the regeneration of RS. The people light fire to facilitate the regeneration of Boda grass, which destroys the whippy seedlings of RS. Similarly, grazing has led to the destruction of new shoots leading to trampling effects on the soil which is again influencing regeneration.

Poor monitoring and infrastructures: Lack of incentives for catching RS by taking high risk has also created problems in conservation. The flying squad is getting incentives while the general Forest Department is deprived from them. So, the department staff is generally reluctant to take the risk for catching smugglers. Lack of firearm, transport and communication facilities within the Forest Department also creates problems toward conservation.

Inaccessibility: Patrolling deep inside the forests in this region is very difficult due to lack of transportation facilities as well as difficult terrain of the forests. No additional manpower has been provided for the protection of RS. Hence, it is very difficult to watch the same forests regularly with high work pressure on the beat officers.

Conclusions and Recommendations

There are very few trees above fifteen years of age. The smugglers have done a near through job of chopping them. The tree exists in the forests because of its good coppicing characters. Effective mechanism and facilities for patrolling must be developed.

There is discrimination in incentive systems for catching RS wood through flying squad and regular Forest Department and also in providing incentives to villagers. No discrimination in providing incentives for catching of Red Sanders wood must be practiced.

There is poor inter state coordination for the protection of RS. Hence, the same must be done in the area. Necessary steps must be carried out to develop inter state coordination which may be enlisting the species under CITES or formulation of guidelines for protecting RS by Central Government.

Several management interventions are being carried out for improving the status of RS forests. Though the regeneration and tree numbers have increased drastically in recent years, still the forests are not free from biotic interference as poaching, illicit felling, fire etc. Due care must be given to protect the forests from these aspects also.

The judicial system of the State appears less sensitive to the importance of Red Sanders forests. The sensitisation of judicial system on a political base must be carried out for the control of smuggling of RS in the State.

The growth performance of RS saplings is not encouraging though many management inputs are being given. The plots are not given due management care e.g. it is facing problems of weeding, sprouting etc. Similarly, it is difficult to obtain the established regeneration of RS due to dying back phenomenon. Hence care must be taken for high management interventions in RS forest.

The RS are not supplied to the market for the last three years. Meeting the market demand will result in decreasing the smuggling activity. Certain amount of RS should be sold annually to global and national markets to reduce smuggling activity.

The socio-economic conditions of people are supporting the clandestine activity. Awareness must be raised about the importance of environment and trees to the rural communities living near RS forests. Apart from it, several income generating programs must be designed to reduce the people's dependence on the forest.

Banning export of plant species is only a short term measure for crisis management as it does not address the broader issue of burgeoning domestic and international demand and the absence of national strategy to ensure a continued and sustainable supply of medicinal plants. It is important to develop scientific harvesting technologies so that plants are harvested in the proper season, at the proper stage of their physiological growth, from the proper habitat and in a non-destructive and sustainable fashion. Agro-technologies urgently need to be developed for such rare and endemic species that are in high demand but short in supply and which cannot be sustainably collected from the wild.

State Forest Departments and local communities for *in situ* conservation, industry, research institutes, NGOs and village communities (especially women groups) for *ex situ* conservation and planting programs can play a very effective role in ensuring the long term conservation and, more immediately, the sustainable supply of wood.

Successful implementation of activities related to conservation and their sustainable utilization needs the involvement of local communities, especially women groups and provides scope for income, employment and empowerment of primary users of natural resources. Market links also need to be developed between the collectors and growers of medicinal plants and the end users. The agro-technology developed in experimental fields needs to be transferred from the lab to the land and ultimately to the market place

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