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Van Sangyan

Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

by e-mail to vansangyan_tfri@icfre.org

or, through post to The Editor, Van Sangyan,
Tropical Forest Research Institute,
PO-RFRC, Mandla Road,
Jabalpur (M.P.) - 482021.

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve
Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)

From the Editor's desk

Fodder (browse) is an agricultural term for animal feed, and fodder trees and shrubs are those plants (shoots or sprouts, especially tender twigs and stems of woody plants with their leaves, flowers, fruits or pods) that are raised, used and managed to feed livestock. Fodder plants are plants which are grown in order to provide the nutritional needs of anim als. Fodder shrubs and trees (browse) play a significant role both in farming systems, where they are protected as fallow species, and in livestock production. The importance of browse increases with increasing aridity and is generally most essential in the dry seasons, when most other feed resources depreciate in quality and quantity. Generally, trees occupy a significant niche in the farming systems and overall way of life in animal production.

The potential of trees and shrubs for green fodder production has not been fully appreciated in India except in hilly states where these are major source of green fodder. Different fodder yielding trees and shrubs differ from place to place and the tree lopped extensively for fodder in one place may not at all be lopped at another place. At the same time excessive and indiscriminate lopping of some fodder yielding trees and shrubs has resulted in destruction by way of soil erosion and diseases .

In line with the above this issue of Van Sangyan contains an article on Dalbergia sissoo: An important tree with fodder value. There are also useful articles viz.. Empowering rural livelihood and sustainable management of non-wood forest products, Distribution, Seed handling technique and Plantation management of valuable timber species - Swietenia mahogany (L.) Jacq., व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंद को पहचानने के तरीके, Occurrence of Lymantria mathura in sal forests of Odisha and Drudgery of pastoral women in the Trans-Himalayan region of Zanskar, Ladakh.

I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.

Looking forward to meet you all through forthcoming issues

Dr. Pawan Rana
Scientist 'E' & Chief Editor

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Dalbergia sissoo: An important tree with fodder value

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Introduction

There is deficit of 23.4 per cent in the availability of dry fodder, 11.24 per cent in that of green fodder, and 28.9 per cent for concentrates in the country leading to 20-60% lower milk productivity than the global average. The gap between demand and supply of fodder in the country is a major area of concern which is likely to increase due to increasing pressure on land for growing more food for human being and less attention on the production of fodder crops for livestock.But ensuring quality fodder supply for our livestock is important as livestock being source of nutrition, income and employment to rural people of India. Moreover, livestock is an important part of Indian economy by contributing 4-5% to India Gross domestic products.

But livestock is India is fed with poor quality fodder as main sources of foddersupply is through crop residue of wheat and rice after harvest,cultivated fodder and fodder from common property resources like forests, permanent pastures, and grazing lands. This low quality fodder contributes 50% to the low productivity of our Indian livestock besides, poor breeds, pests & diseases, hormonal imbalance and climate change being other factors.To overcome the fodder shortage particularly in rural areas during lean periods (the period in the year when the fodder availability is shortened) is usually met through straw and stovers which are not very nutritious feed and is often deficient in some vital nutrients. In this situation, fodder demand could be met out by conserving excess of available fodder during monsoon into hay, silage and hay lageor by utilizing top feed from shrubs and trees. However during lean period (winter and summer) green fodder is required for sustaining livestock productivity which can only be ensured by utilizing top feed form fodder trees and shrubs. Every agro-climatic zone of India is bestowed with local indigenous trees/shrubs producing high quality fodder that can be utilized as source of green nutritious fodder for livestock. Moreover, such trees and shrubs can easily be grown in homestead, agricultural border lands, community land and wastelands for ensuring green fodder supply (Table 1). *Dalbergia sissoo* is one of such multipurpose tree that can be grown under vast climatic and edaphic conditions in India for sustaining supply of nutritious fodder for our livestock.

Table 1: Important shrubs and trees in different Agro-climatic zone of India

S.N	Agro-climatic zone	Taxa
1	Western Himalayas, cold arid region	*Hippophae rhamnoides*
2	Western Plains and Kutch Peninsula, hot arid with desert region	*Acacia nilotica, A. tortilis, Ailanthus excelsa, Dichrostachys cinerea, Prosopis cineraria, Ziziphus nummularia, Prosopis juliflora, Salvadora oleoides, S. persica*
3	Deccan Plateau, hot arid region	*Acacia nilotica, Albizia amara, A. lebbeck, Desmenthus virgatus, Leucaena leucocephala, Tamarindus indicus*
4	Northern Plains and Central Highlands including Aravallis, hot semi-arid region	*Acacia nilotica, A holosericea, Albizia amara, A. lebbeck, A. procera, Azadirachta indica, Dichrostachys cinerea, Hardwickia binata, Leucaena leucocephala, Sesbania grandiflora, S. sesban*
5	Central (Malwa) Highlands, Gujarat Plains and Kathiawar Peninsula region	*Albizia lebbeck, Artocarpus lakoocha, Dendrocalamus strictus, Gliricidia sepium, Faidherbia albida, Holoptelia integrifolia, Pithecellobium dulce*
6	Deccan Plateau, hot semi-arid region	*Acacia nilotica, Albizia procera, Anogeissus pendula, Bauhinia variegata, B. purpurea, Leucaena leucocephala, Moringa oleifera, Pterocarpus marsupium, Sesbania sesban*
7	Deccan (Telangana) Plateau and Eastern Ghats, hot semi-arid region	*Albizia lebbeck, Gliricidia sepium, Faidherbia albida, Holoptelia integrifolia, Leucaena leucocephala*
8	Eastern Ghats, TN Uplands and Deccan (Karnataka) Plateau, hot semi-arid region	*Ailanthus malabarica, Albizia falcataria, Erythrina variegata, E. poeppigiana*
9	Northern Plains, hot subhumid (dry) region	*Albizia stipulata, Desmanthus virgatus, Azadirachta indica, Ficus racemosa, Leucaena leucocephala*
10	Central Highlands (Malwa, Bundelkhand and Satpura), semi-arid region	*Albizia amara, A. lebbeck, Anogeissus latifolia, A. pendula, Dichrostachya cinerea, Hardwickia binata, Leucaena leucocephala, Moringa oleifera*
11	Eastern Plateau (Chhattisgarh), hot	*Bauhinia variegata, Dalbergia sissoo, Leucaena*

	sub humid region	*leucocephala, Moringa oleifera*
12	Eastern (Chhotanagapur) Plateau and Eastern Ghats, hot subhumid	*Artocarpus heterophyllus, A. lakoocha, Leucaena leucocephala, Moringa oleifera*
13	Eastern Plain, hot sub humid (moist) region	*Bauhinia variegata, Dalbergia latifolia, D. sissoo, Pterocarpus marsupium, Desmanthus virgatus*
14	Western Himalayas, warm sub humid region	*Quercus incana, Robinia pseudoacacia, Grewia optiva, Fagus sylvatica, Morus alba*
15	Bengal and Assam Plains, hot subhumid (moist) to humid region	*Artocarpus heterophyllus, A. lakoocha, Ficus hookeri, F. nemoralis, Parkia roxburghii, Morus alba*
16	Eastern Himalayas, warm humid region	*Celtis australis, Ficus hookeri, F.nemoralis, F. semicordata*
17	North-eastern Hills, warm humid region	*Dendrocalamus hamiltonii, Parkia roxburghii, Morus alba, Robinia pseudoacaci*
18	Eastern Coastal Plain, hot humid region	*Ailanthes malabarica, Erythrina variegata, Ficus retusa*
19	Western Ghats and Coastal Plain, hot humid region	*Ailanthes malabarica, Erythrina variegata*
20	Islands of Andaman, Nicobar and Lakshadweep	*Bauhinia purpurea, Erythrina variegate, Leucaena leucocephala, Pithecellobium dulce, Gliricidia sepium*

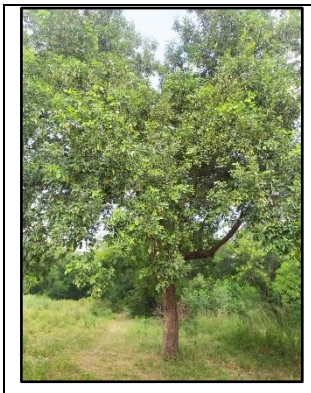
(Source: B D Patil et al., 2004)

Dalbergia sissoo Sensu Miq. (Indian rosewood, Shisham) belongs to family Fabaceae, is an important multipurpose tree speciesgrown in wide range of soil, cliamte and elevation. It has different names in different states viz, Sisu- West Bengal; Sisam- Gujrat; Agara, Biridi- Karnataka; Sissu-Manipur; Shisav- Maharastra; Iruguducettu- Andhra Pradesh; Sharai- Punjab and Maravakai, Kottakarantai- Tamil Nadu.After teak, it is the most important cultivated for timber tree in India, planted on roadsides, field bunds, and as a shade tree. It is an excellent pioneer species to restore land that is degraded and has poor soil conditions.The genus *Dalbergia* consists of 100–250 species. On the Indian subcontinent about 46 species have been reported (Thothathri, 1987), of which 25 occur in India (Sanjappa, 1992). In the Western Ghats 18 species have been recorded (Jagadeesan et al. 2015), eight of which are endemic (Singh et al. 2015).Some of the important *Dalbergia* species found in India are: *D. assamica, D. benthamii, D. cana, D. candenatensis, D. clarkei, D. confertiflora, D. congesta, D. duarensis, D. gardneriana, D. horrida, D. junghuhnii, D. matthewii, D. melanoxylon,*

D. ovata, *D. pinnata*, *D. sisso*, *D. purpurea*. *D. rubiginosa*, *D. stipulacea*, *D. thomsoni*, *D. velutina*, *D. volubilis* and *D. wattii*. Out of all the *Dalbergia* spp. *D. sissoo* is widely grown in India covering almost all the parts of India.

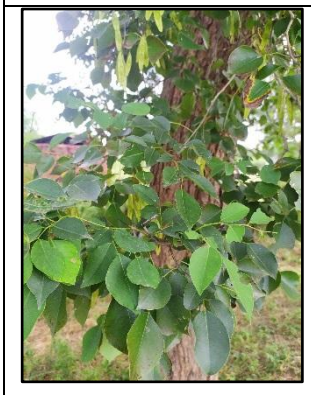
Botanical description

Dalbergia sissoo is a perennial, deciduous, medium tolarge tree of about 10 to 15 m metres high in dry areas, and up to 30 m in wet areas.Leaves are compound, with about 3-5 alternate leaflets; Leaflets round at base, brown on drying. Flowers are pink-white; axillary and terminal panicled cymes. Peduncles and pedicels brown pubescent. Calyx campanulate, 5-toothed, scattered hairy without, densely ciliate on margins. Petals creamy white; wing petals with scaly foldings. Stamens monadelphous, usually 9. Ovary 0.2-0.25 cm, laterally compressed, densely hairy without; style 0.2-0.25 cm long, curved; stigma finely tubercled. The dry fruit is a pale brown pod, flat, thin and papery, about 7 cm and its seed is light brown, kidney shaped **(**6-8 x 4-5 mm), thin and flat.The flowering and fruiting occurs in the month of April-September and trees shed leaves between November to January month that reappear during February month. Conventionally, it is propagated through roots suckers but under natural conditions regeneration by seed takes place at the beginning of monsoon.



1. Tree

2. Trunk



3. Leaves

4. Pods/ fruits

Distribution

Dalbergia sisoo is native to the Indian Sub-continent and widely distributed to the plains, low hills and mountain valleys of the sub-Himalayan regions. It grows in sub tropical to tropical area with average rainfall ranging between 700- 4500 mm and elevation up to 1300 m(Luna, 1996).

Soilsin its distribution zone ranges from pure sand, gravel to alluvium soil and it also grow well under slight saline soils. Although, it is indigenous to sub-Himalayan tract and bhabar area but from here it has been introduced in the other parts of the India as well. Therefore in India, it is widely spread in Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh andWest Bengal. Outside India, the species is found in Nepal, Bhutan, Bangladesh, Myanmar, Malaysia, Pakistan and Afghanistan.

Silvicultural characters

D. sissoo is a fast growing, light demander tree species requiring full overhead sunlight for successful regeneration and establishment (Luna, 1996). It develops deep tap root with sturdy and well developed lateral root system. Its seedlings are drought sensitive, but after sapling stage tree becomes drought tolerant (Luna, 1996). Besides this, *D. sissoo* is wind firm, moderately frost hardy and fire sensitive species (Luna, 1996). It can survive well on dry areas and irrigated conditions but not on poorly drained soils.

Propagation

D. sissoo can easily be propagated through seeds and stump planting.For sexual propagation seeds are utilized and are soaked in water for 48 hours before sowing which ensures 60-80% germination within in 7-21 days. Seeds are sown in nursery either in beds or poly bags during the month of March- April and seedlings become ready for planting out during rainy season.

Stump planting is most successful method to propagate *D. sissoo*. For making stumps,1–2-year-old seedlings with collar diameter more than 1 cm are used and they are cut in such a manner that root is kept 25 cm and a shoot 2.5 to 3 cm.Stumps are planted during third week of March or April.

Economic importance of *Dalbergia sissoo*

Timber: its wood is strong, heavy, durable, and easy to work & with mechanical properties comparable with that of teak. Its wood density is about 750–800 kg/m^3 at 12% moisture content. Thus, its wood is utilized for wooden flooring, panelling, railway sleeper, agricultural tools, musical instruments, wood laminates, plywood making etc. Moreover its fast growth as it reaches up to 5 m within three years after planting makes it most suitable species for timber purpose.

Fuel wood: due to high calorific value (5180 kcal/kg) its wood has been classified as an excellent fuel wood and is also used for charcoal making.

Erosion control: Being a tree with deep roots and extensive lateral root system, it is often used on denuded and degraded lands for controlling soil erosion.

Medicinal value: *Dalbergia sissoo*leaves are used as stimulant and anti-diabetic and bark as abortifacient, anthelmintic, Anti-inflammatory, antipyretic, blood purifier and expectorant etc. (Asif and Kumar, 2009).

Fodder value:

Its leaves, young shoots and green pods are used as an excellent source of fodder for livestock and gazing animalsin rural areas when other fodder resources may not be available. April to May month is the best time for the production of high quality fodder. But Leaves should be feed to the

cattle at an early because it becomes less palatable with age. The foliage also browsed by cattle from lower canopy of trees.

Potential and scope of utilizing *Dalbergia sisoo* as most suitable fodder tree:

Potential:

- Highly nutritive, palatable leaf fodder rich in crude protein and essential minerals (Table 2).
- Low crude fibre content in leaves.
- high dry matter digestibility of 56%
- Provides fodder for the longer period as it remains leafless for short duration (November-January)
- Ensures green nutritious fodder during dry period/summer when other source of green fodder is not available
- It can be grown in almost all the agro-climatic zones of the country
- It is multipurpose and fast growing tree that has been proved as suitable tree species under agroforestry, as boundary plantations, block plantations and on wastelands forestry.

Table 2: fodder quality traits of *Dalbergia sisoo*leaves

Traits	Content (Dry Matter Basis)
Dry Matter	43.09%
Organic Matter	0.90%
Crude protein	13.09%
Ether extract	3.35%
Crude fibre	20.67%
Nitrogen free extract	53.81%
Total ash	9.08%
Nitrogen Detergent fibre	53.88%
Acid Detergent fibre	38.80%
Hemi cellulose	15.08%
Cellulose	23.37%
Acid detergent lignin	8.98%
Calcium	1.89%
Phosphorus	0.20%
Iron	57.67mgkg^{-1}
Calcium	10.12 mgkg^{-1}
Zinc	15.81 mgkg^{-1}
Manganese	175.45 mgkg^{-1}
Copper	0.17 mgkg^{-1}
Reference: Datt *et al.*, 2008	

Scope

Despite of high fodder value it has been less exploited for fodder in India. However there is huge scope for exploiting this species for sustaining nutritious fodder supply for livestock during lean period. It can be utilized in following ways for fodder production:

Under wasteland agro-forestry

D. sissoo being legume fix high amount of atmospheric nitrogen; due to having deep tap root and extensive lateral root system can conserve soil &water and being pioneer species can be planted on wastelands for their reclamation. In India, 120 M ha wasteland areas is available and in the suitable agro-climatic zones *D. sissoo* can be planted for restoring wastelands. *D. sissoo*, when planted on sodic land in Uttar Pradesh has been reported to decrease soil pH, electrical conductivity and exchangeable sodium percentage and enhanced organiccarbon, nitrogen and availability of other nutrients in the soil (Mishra et al. 2002). Thus, besides restoring wastelands, high fodder biomass yield, timber yield and atmospheric carbon dioxide sequestration can be ensured by planting *D. sissoo* which will serve a purpose of ensuring

fodder availability to livestock, timber for wood based industries and above all climate change mitigation.

Under silvopasture

D. sissoo has been found compatible to be grown with foddergrass and a study reported cumulative fodder biomass production of 35t ha^{-1}during 5 years and with total annual biomass productivity of 8.63 t ha^{-1} during 6^{th} year under *D. sissoo* based silvopasture**.** During initial years 1-2 ton green fodder can be obtained from Shisham trees on 50% pruning with tree density of 416 trees/ha. (Rai et al. 2001). Thus, *D. sissoo* based silvopastureare best way to meet out the rising demand for fodder and timber in India.

As boundary plantations

To protect crops from adverse effect of winds *D. sissoo* trees are raised as wind breaks and shelter belt around farm boundaries which can easily be lopped for fodder production.

As block plantations

Owing to high annual growth rate of its diameter and height, high density block plantations of *D. sissoo* (2 × 2 m) are raised for pulp wood and plywood purpose. These block planted tree can also be utilized as fodder source for livestock.

Agrisilviculture

*D. sissoo*tree has been found compatible with wheat, paddy, mustard, vegetable crops and medicinal plants therefore it can be easily integrated as alleys with crops for timber as well as fodder production.

Conclusion and way forward

In the current scenario where India is facing a huge gap between demand and supply of fodder which is projected to widen up further in future coupled with reducing livestock productivity, fodder yielding trees like *D. sisoo* can prove as a boon. Tree like *D. sissoo* being multipurpose and ability to grow well under wide agro-climatic conditions should be promoted for large scale cultivation among farmers for providing high economic returns, ensuring fodder security and wasteland restoration. Following are some suggested strategies for utilizing full potential of *D. sissoo*for ensuring fodder security:

- Elite genotypes that are high quality fodder biomass yielding, resistant to abiotic and biotic stress and more compatible with agricultural crops must be identified for large scale promotion among farmers.
- Quality planting material availability should be ensured for taking up large scale wasteland plantation, afforestation programmes and for seedlings supply to farmers.
- Growers and wood based industries should be linked together and minimal support price should be fixed for tree based products, timber, logs etc. to ensure high economic returns for growers.
- Awareness must be generated among farmers regarding need for quality fodder from fodder trees to enhance productivity of their livestock.

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Empowering rural livelihood and sustainable management of non-wood forest products

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Abstract

Rural livelihood and sustainability is the major concern in developing countries of the world. The population rise, climate change, forest fragmentation, deforestation, landuse change and non-judicious utilization of the resources are disrupting the natural recovery and balance. The forest resource is one among the precious natural resources which offer variable product and services for human wellbeing and prosperity. The tribal and rural peoples directly or indirectly rely on the forest for their diversified needs of food, shelter, fuel, fodder, timber, medicinal, edible products, and other various types of non-wood forests for economic gain or livelihood. The overexploitation of the economically important species leads to gradually decline of such species in their natural range. This therefore, altered the availability and production capacity of the forest products and ultimately the livelihood of the people involved in collection and marketing process. For strengthening the rural and tribal livelihood from the forest judicious and scientific processing, utilization, marketing along with sustainable harvesting within the carrying or productive capacity of the forest are the key concerns for effective resource utilization and management. Therefore, scientific forest management is the need of the hour to fulfill the current and future demand of the people in a sustainble manner.

Keywords: Livelihood, Forest, Non-wood forest product, Sustainble harvesting

Introduction

India has rich floral and faunal biodiversity which offers various direct and indirect benefits to the people. India is the 2nd largest country in the Asia and holds 7th rank (2.7% world's area) among the largest country of the world. The rising population of the world is creating the huge pressure on the existing natural resources as well as accelerates the demand of various food and other products in a great extent. The resource depletion beyond the carrying capacity may alter the nation's economy and livelihood of the people (Jhariya *et al*., 2019a, 2019b).

India has nearly forty five thousand species of wild plants accounting 8.50% to global known biodiversity. India is home for about 68 million tribal people, they directly or indirectly rely on the various forests and natural products for sustaining their lives and economic gain. As per a report, in India about 176 million poor people are residing. Therefore, information of various products with their values needs to be expanding among these rural or tribal people along with scientific practices right from collection to harvesting, processing to storage or marketing to strengthening their socio-economic status in the society.

Non-timber forests products (NTFPs) are the minor products of forest rather than

wood. NTFPs include wild foods, forage, medicinal plants, construction materials, fuelwood, and a raw material for handicrafts is increasingly being recognized (Figure 1). In bio-economic point of view forest products and NWFPs play vital role in contributing raw materials and resources as well as create income generating resources or livelihood to people living in rural areas or in the proximity of the forest. Further, NTFPs help towards increasing to build local economy of forest dwelling communities dependent upon the forest for their livelihood (Weiss *et al*., 2020).

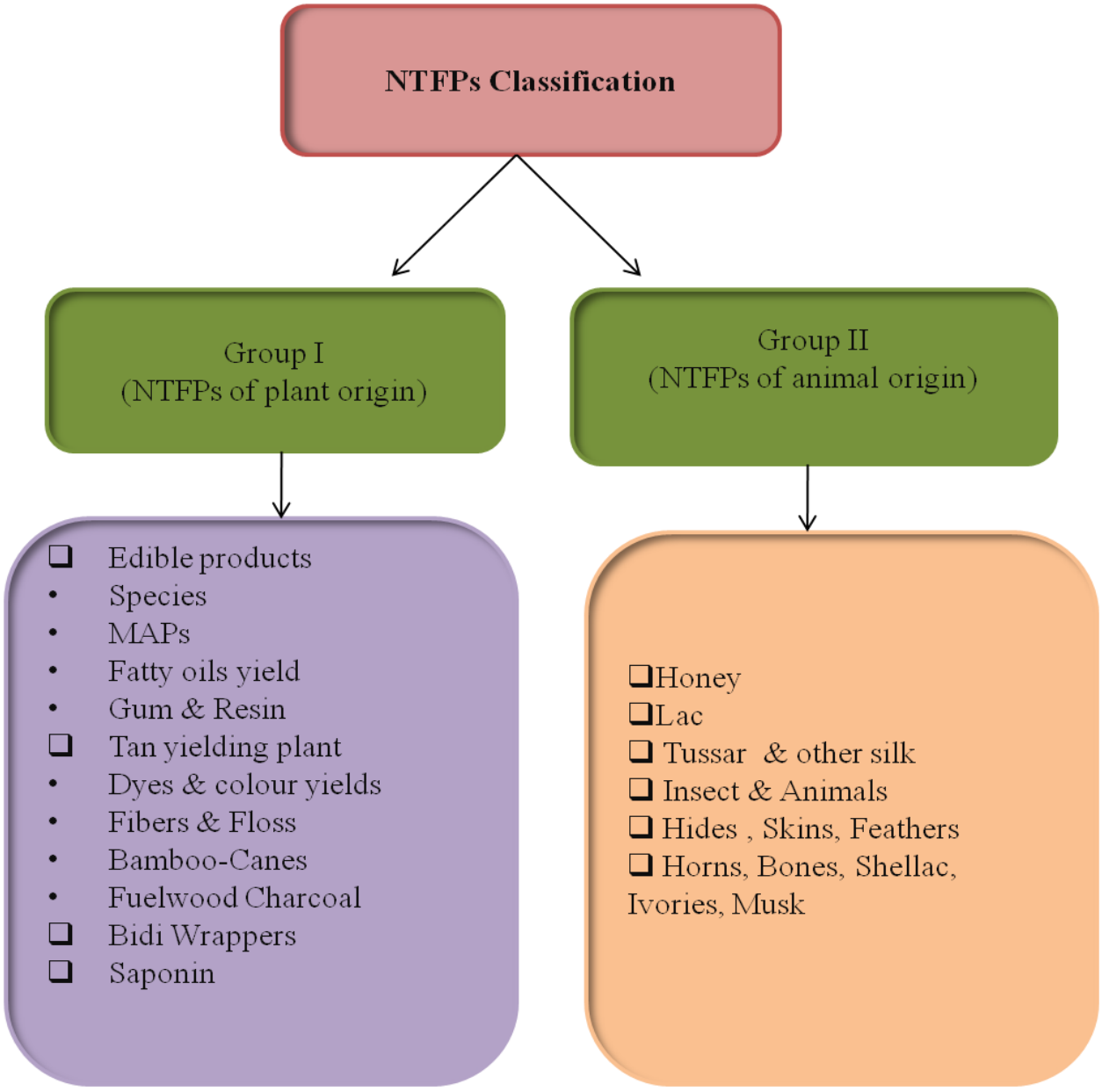
Forest provides numerous direct, indirect, social as well as ecological benefits to humankind. Rural or tribal family living in forest area gets many benefits and provides various ways for livelihood (Khan *et al*., 2020a, 2020b). Forest products contribute very much to food and economic security of the rural/tribal people (Shukla and Pandey, 2015). Various studies have revealed the role and contribution of NTFPs in fulfilling the demand and also in maintain the livelihood status of rural and tribal people living inside forest or its proximity across the country and in the world.

Figure 1: Some prevalent NTFPs of the central India

Empowering Livelihood of Villagers through NTFPs Collection

Forest and forest products play a significant role in natural capital and economy. It has a broad spectrum includes products, food, fiber, fodder, medicinal and aromatic plants, gums and resin which has great economic importance and nature of origin (Figure 2). Women play important role in collection and local selling of NTFPs from forest. They also collaborate with the local forest departments for gathering of forest products from forest handling and processing of products. Local communities living nearby forest are also benefitted; they get products from forest for their own use and use better knowledge of resources (Padvi, 2016).

Figure 2: Classification of NTFPs



Rural families get many livelihood opportunities and forest tree provide various complex ways for generating livelihood. People living in forest along with their agricultural production combine collection of forest product and use this resources in multiple ways. In collection of forest products women play vital role, they play principle role in collecting, processing and selling this products to market place. State forest department also collaborate with them for collection and handling of this resources and they provide some of the benefits with the rural people who are involve in this work. Many research revels that's the participation percentage of male and female in NTFPs collection shows higher female involvement as compare to male (Shukla and Pandey, 2015). In many states, government allows collecting fodder and fuelwood for themselves who are involve in collection process of NTFPs. NTFPs also provide nutritional sources from different forest products to primitive tribes living in forest area.

As per the FAO (2005), in India harbour about 3000 species of NTFPs among them nearly 126 species of NTPFs are potentially marketed across the country. Therefore, more research and development on NTFPs, their distribution, utility, production potential, etc. needs to be explored for offering more products of economic importance. A global estimate by Killman (2003) revealed that nearly 350 million people lives in or proximity of forest and 25% people depends upon this resource directly or indirectly. As per Mitchell et al. (2003), in India about 3/4th of the total NTPFs collection were obtained from the tribal belts of the nation. This offers livelihood to 55% of tribal/rural peoples in India (Joshi, 2003). For example, in Gujarat about 20-34% and in West Bengal about 27-56% of total incomes of household are contributed by NTFPs in rural areas (Kant, 1997). This therefore signifies the role of NTFPs in rural livelihood and through it the lives of forest dwelling can be improved by good governance and scientific management of these resources through community participation.

Sustainable Management and Conservation of NTFPs

Sustainable management of forest and forest resources are very important. Sustainable management means using resources without compromising the ability of future generation. Sustainable Forest management helps in improving ecological, economical and socio-cultural well being. ITTO (1998) mentioned that the management of forest resources in such a way that the current requirement and continuous flow of various sort of NTFPs would obtained without altering the forests values, productivity and undesirable change to the physical and social environment.

Presently forest degradation in term of productivity, acreage, quality, etc. has threatened the livelihood of forest dwelling communities across the globe. Forest resources are valued for these communities towards well-being and prosperity. In India, it is helpful and more valuable in the context of tribal development, eradication of poverty, socio-economic upliftment and achieving the sustainability. A well managed and healthy forest offers various benefits besides its protective and regulatory functions. Therefore, sustainable management of NTFPs through advanced, scientific and tested practices needs to be linked for long term viability of these resources.

The conservation and proper management of economically important species and other prioritized forest resources (Figure 3 & 4) must be taken into consideration to avoid the overexploitation and move forward to sustainable harvesting. The NTFPs should be included in national strategy plan towards good governance in NTFPs sector. Further, proper research and development activity should be done towards sustainable forest management. Good supportive policy and plan must be framed in relation to NTFPs and livelihood supports to the tribal or rural peoples. Further, people involvement in various conservation measures i.e., *ex-situ* and *in-situ* must be an integral part of forest management, development as well as for sustainble development

Figure 3: Prioritized NTFPs at Indian and global perspectives.

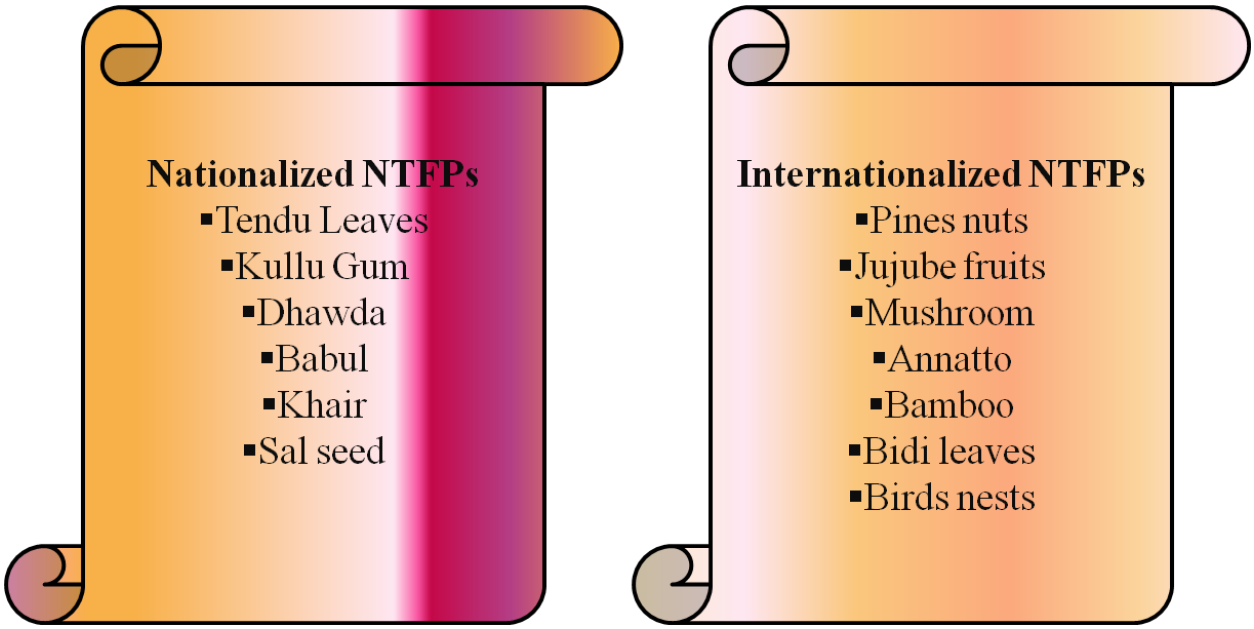
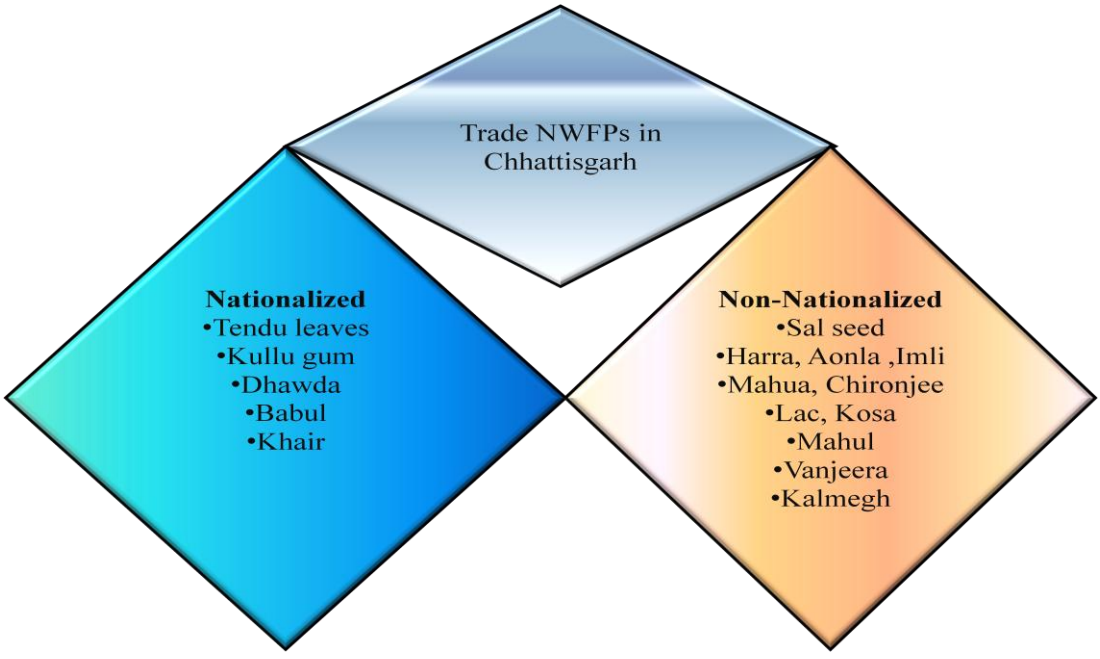


Figure 4: Nationalized and Non-nationalized NTFPs in Chhattisgarh.



Conclusion

The forest product contributes significantly to the livelihood of forest dwelling community. Their main source of income is collection and harvesting of products of the natural origin. Therefore, it is essential to prepare a economic-reform based action plans for these forest dwelling community for sustainble management, conservation and utilization of these valuable resources for strengthening their livelihood and economic sustainability. Beside this, proper schemes and policies of these people oriented needs to be designed at regional level to check its effectivity and implications.

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Distribution, seed handling technique and plantation management of valuable timber species - *Swietenia mahogany* (L.) Jacq.

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About the species

Swietena mahogany commonly known as West Indian mahogany belongs to the family of Meliaceae. The vernacular names are small leaved, West Indian, Spanish or Cubanmahogany (English), caoba (Spanish), madeira (Bahamas) and coabilla (Cuba). *S. mahogany* is a humid zone species, with natural distribution in the Caribbean region (S. Florida, Bahamas, Antilles, Haiti and Jamaica). The wood of mahogany species has unique reputation in the international market due to its desirable characteristics such as attractive appearance, good dimensional stability, ease of working with both hand and machine tools, excellent finishing qualities and a high degree of natural durability. The species is over exploited in much of its natural area of distribution. It has been extensively planted mainly in Southern Asia (India, Sri Lanka and Bangladesh) and in the Pacific (Malaysia, Philippines Indonesia and Fiji), and has been introduced into cultivation in West Arica. Mahogany grows well on sites receiving mean annual rainfall of 1000-4000 mm with temperature of 15-35° C range (Bergo Maria *et al.*, 2016). Mahogany appears to grow satisfactorily on a wide range of soils from clays to coarse sandy soils. Direct seedling is an effective means of establishing the plantation. 2 or 3 seeds are sown per mound at a depth of about 2 cm towards the end of dry season. This technique is done on drained soils. Thinning should be carried out on a 5-10 year cycle depending on growth rates. For plantations stocked at densities that are sufficient to encourage the development of acceptable tree form and timber quality, a rotation length of 30-50 years is anticipated depending on site quality (Rajput *et al.*, 1996) The yield tables provide evidence that mahogany plantations can be relatively protective for a hard wood species. If managed correctly the maximum mean annual increment for densely stocked plantation ranges between 10 and 25 m^3 ha^{-1} yr^{-1} depending on site quality. Low density line plantings have a mean annual increment of only 4-8 m^3 ha^{-1} yr^{-1}.

Environmental conditions required

Big-leaf mahogany grows in a variety of soils and the best growth is found in deep, fertile soil on well drained slopes in regions where rainfall is abundant. However, timber from the less moist region is reported to be more valuable. It grows well at elevations up to 1300 m but best

growth is found up to 900 m. Further, the big-leaf mahogany is less exacting than the true mahogany. Further, the *S. mahagoni* is regards both soil and climate for best growth. The big–leaf tree is suited to laterite soils, which is not suitable for Teak cultivation. In North Bengal, it is doing well on the soil where Sal is growing. Mahogany tree appears to thrive best in a warm moist climate with the temperature ranging from 21 to 350C and mean annual rainfall from 1000–2000 mm. It is a moderate shade-bearer and can be grown as an under storey in Teak plantation after mid-rotation age when the final crop of Teak is widely spaced. It is very sensitive to frost and plants raised in the open in Dehra Dun are most often killed due to frost

Maturity and collection of seed

Mahogany trees flower annually in the month of February. Seeds ripen from February to March and fruit attains maturity in 11-12 months after flowering. From phenotypically superior pest- disease free trees, mature fruits (capsules) are collected during November - April when fruit become whitish brown in colour and they begin to dehisce. The mature pods dry for 2-3 days in the sun to dehisce longitudinally to release seeds. A fruit contains 25-30 viable seeds and 1 kg seeds have 2000-2200 seeds. The seeds lose their viability after two or three months, if expose to the open air, but may retain it for a year if kept mixed with saw dust in closed containers. Depending on maturity, the fruits will split open after 1-4 days of drying. The seeds are easily released by raking or gently shaking the fruits. Fruit parts (valves and columella) are removed by hand. The bulk can be further reduced by manually. After extraction, the seeds should be dried to a moisture content of approximately 6-7% for short term storage, or down to 4% for long term storage. Storage and viability: Seeds can be stored to several months. Storage at *15°C* prolongs viability to 3-6 months. Cold storage (*25°C)* with 4-5% moisture content extends viability several years. The seeds must be stored in air-tight containers (Lamb, 1966).

Dormancy and pretreatment

Pretreatment is generally not necessary but if the seeds stored at low moisture content soaking in water for 12 hours can improve germination.

Nursery and planting stock production

Freshly collected seeds are subjected to over-night soaking in cold water and are dried in shade for 15 minutes after decanting the water before sowing. Then, seeds are spread on sand-beds uniformly and fine sand/soil is broadcasted over the seeds for about 1 cm thickness to cover. After regular watering, seed germination starts on 15th day from date of sowing. The speed of seed germination and germination percentage may vary with seed source and site conditions. Peak time of germination was observed 15-20 day after seed was sown. At 3rd leaf stage, seedlings are transplanted from nursery bed into poly bags. The container seedlings are maintained for about 6-months for out-planting.

Soil type

Mahogany seeds have a high fatty

content and require more oxygen during germination than starchy seeds, germination may therefore be faster in well aerated soils.

Soil moisture

Seeds require an abundant supply of moisture. Germination may hence be faster, although soils should not become waterlogged due to risk of de-oxygenating the soils and damping off.

Vegetative Propagation

Mahogany may be propagated vegetatively. Stumps of seedlings and young trees are able to coppice, providing a source of new shoots suitable for propagation by leafy cuttings.

Establishment of plantation

Big-leaf mahogany is being cultivated for timber, shade, avenue tree and in agroforestry systems. In mahogany based agroforestry systems, pumpkin, maize, sugarcane, banana, fodder grasses, chilli and leafy vegetable are common intercrops. The recommended spacing is given below:

(i) Seedlings are planted at 2×3 m or 3×3 m or 3×4m for block plantation for timber production. (ii) In the open (invariably attacked by the borer, *Hypsipyla robusta*) at an espacement of 3×3 m. (iii) Planting spacing in secondary-growth forest is 3×3 m. (iv) In taungya system, the recommended espacement is 4×4 m and field-crops being raised for about two years.

It is found that shade tree such as *Trema orientalis* not only provides protection to big-leaf mahogany plants against undue exposure to the sun but also reduces damage by shoot borers during early stage. Big-leaf mahogany can be successfully established under teak at mid-rotation age in Tamil Nadu and Kerala, if deer and other browsing animals are excluded. Damage from browsing can be diminished if transplanting is done in dense lines. The big-leaf mahogany grows rapidly and thrives better in India than small-leaf mahogany (*S. mahogani*). Under favourable conditions, the rate of growth is very fast (Mayhew and Newton, 2000).

Rotation period and timber yield

Mahogany plantations are predicted to reach maximum mean annual increment (MAI) and volume of 38.1 $m^3 ha^{-1} year^{-1}$ and up to 572 $m^3 ha^{-1}$ in 15 years in the best sites, respectively and the medium-quality sites produce a volume MAI of 19.7 $m^3 ha^{-1} year^{-1}$ with volume up to 493 $m^3 ha^{-1}$ in 25 years. If the rotation is set to 30 years, stands can attain a mean height of 24.4 m and a mean diameter of 35.4 cm and produce total volume 583 $m^3 ha^{-1}$ including thinning in moderate sites. Thus, the estimated total timber volume is between 200.5-501.6 $m^3 ha^{-1}$ with MAI of 7.7–19.3 $m^3 ha^{-1} year^{-1}$ in rotation age of 15-30 years (Jayaraman *et al.*, 1992).

Swietenia mahogany

Mahogany tree

Mahogany fruit

Mahogany seed

Mahogany seedling

Mahogany wood

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व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंद को पहचानने के तरीके

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प्रस्तावना

पौधों से प्राप्त प्राकृतिक गोंद की उत्पत्ति या तो वृक्ष से स्राव अथवा बीज से होती है। इन प्राकृतिक गोंदों की व्यावसायिक रूप से संग्रह ज्यादातर लेगुमिनोसी, कॉम्ब्रैटेसी और स्टर्कुलेसी परिवार के पौधों की प्रजातियों से किया जाता है। वृक्ष स्रावित गोंद द्वितीयक चयापचय उत्पाद हैं जो मुख्य रूप से कीटों या जानवरों द्वारा छाल या लकड़ी पर प्रतिकूल जलवायु परिस्थितियों , बीमारी या बाहरी चोट के परिणामस्वरूप उत्पन्न होते हैं। भारत में गोंद के लिए प्रख्यात पेड़ों की प्रजातियाँ

कुम्ठा (एकेसिया सेनेगल), देशी बबूल (एकेसिया निलोटिका), खैर (एकेसिया के टेचू), धावड़ा (एनोगाइसिस लेटीफोलिया) , कराया (स्टरकुलिया यूरेन्स), सेमल (बॉम्बेक्स सीबा), पीले रेशम का वृक्ष (कोक्लोस्परमम रिलिज़ियोसम), झिंगन (लिनिया कोरोमेंडेलिका), नीम (एजाडिराक्टा इंडिका), सादड़ (टर्मिनेलिया टोमेंटोसा), पलास (ब्यूटिया मोनोस्पर्मा), चिरोंजी (बुचनेनया लानज़ान), विलायती बबूल (प्रोसोपिस जूलीफ्लोरा), काजू (एनाकार्डियम ओसिडेंटेल), बीजासाल (टेरोकार्पस मार्सुपियम), इज़राइली बबूल (एकेसिया टोरिटीलिस), सफेद छाल बबूल (एकेसिया ल्यूकोफ्लोया), मीठा बबूल (एकेसिया फरनेसियाना) और सहजन (मोरिंगा ओलीफ़ेरा), इत्यादि हैं। इन पेड़ों की प्रजातियों में, अरबी गोंद या बबूल गोंद (एकेसिया सेनेगल तथा समान तरह के बबूल की प्रजातियाँ) , घट्टी गोंद (एनोगाइसिस लेटीफोलिया) , और कराया गोंद (स्टेरिकुलिया यूरेन्स या भारतीय ट्रेगाकैंथ गोंद) व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंद हैं जो भारत में उत्पादित होते हैं।

वृक्ष स्रावित गोंद (बीज गोंद, राल और गोंद-राल को छोड़कर) का औसत वार्षिक उत्पादन २०११ से २०१८ के दौरान लगभग ९३० टन था जिसमें से कराया गोंद, घट्टी गोंद और अरबी गोंद सहित अन्य गोंद के उत्पादन का हिस्सा क्रमशः १७%, ३०% और ५२% था। इन प्राकृतिक गोंदों का उपयोग कई औद्योगिक अनुप्रयोगों में किया जाता है जैसे कि भोजन , दवाइयों, लुगदी और कागज , कपड़ा, सौंदर्य प्रसाधन , चिपकानेवाला पदार्थ , रंगलेपन, पेट्रोलियम उद्योग, चमड़ा उद्योग , शिलामुद्रण इत्यादि। अधिकांश वृक्ष स्रावित गोंद खाने योग्य होते हैं तथा अरबी गोंद , घट्टी गोंद और कराया गोंद के विकल्प या मिलावट के रूप में उपयोग किए जाते हैं। बाजार में इन मिलावटी गोंदों को पहचानना मुश्किल होता है। इसलिए, व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंद की पहचान करना आवश्यक है जिसमें अरबी गोंद और इसी तरह के समान गुण वाले बबूल , घट्टी और कराया गोंद ,

या भारतीय ट्रेगाकैंथ गोंद शामिल हैं, जो मुख्यतः अपने भौतिक-रासायनिक गुणों पर आधारित हैं।

गोंद, राल, गोंद-राल, म्यूसिलेज और लेटेक्स

गोंद मुख्य रूप से स्टार्च रहित पॉलीसेकेराइड होते हैं जो पैथोलॉजिकल उत्पाद माने जाते हैं और ये किसी भी तरह से पौधों के ऊपर चोट या बिमारी लगने के कारण उत्पन्न होते हैं। ये आमतौर पर पानी में घुलनशील होते हैं या पानी को अवशोषित करके सस्पेंशन जैसी चिपचिपी जेली बनाते हैं और आमतौर पर तेलों या कार्बनिक विलायक जैसे की हाइड्रोकार्बन , ईथर या अल्कोहल में अघुलनशील होते हैं। *राल* वाष्पशील पदार्थों के साथ-साथ गैर-वाष्पशील टरपिन्स (रोजिन) और फिनोलिक यौगिकों तथा वसायुक्त पदार्थों का जटिल मिश्रण है। ये पानी में अघुलनशील और कार्बनिक विलायक में घुलनशील होते हैं। *गोंद-राल* गोंद और राल से बना एक मध्यवर्ती यौगिक है , जो अलग-अलग अनुपात में होता है। ये गोंद और राल के अनुपात के आधार पर पानी और कार्बनिक यौगिकों में घुलनशील होते हैं। *म्यूसिलेज* पॉलीसेकेराइड या मिश्रित मोनोसेकेराइड और यूरिक एसिड के संयोजन हैं जो किसी भी बाहरी चोट के बिना पौधे की सामान्य चयापचय प्रक्रिया द्वारा कोशिका के भीतर बनते हैं। ये पानी में आसानी से घुलनशील नहीं होते हैं लेकिन चिपचिपा द्रव्यमान के साथ पानी में कोलॉइडल घोल बनाते हैं। *लेटेक्स* एक दूधिया सफेद रंग का तरल पदार्थ है जो मुख्य रूप से टरपिनोइड्स , फिनोलिक्स, प्रोटीन और एल्कलॉइड के जटिल मिश्रण से बना है। यह आमतौर पर लिपिड में घुलनशील होता है तथा गोंद , राल और म्यूसिलेज की तुलना में अधिक भिन्न होता है।

खाने योग्य वृक्ष स्रावित गोंद और उनके विकल्प

अधिकांश वृक्ष स्रावित गोंद विषरहित , खाने योग्य, रुचिकर और स्वाद में मीठे होते हैं और कुछ कसैले और कड़वे हो सकते हैं। इसलिए , इन वृक्षों को कई खाद्य पदार्थों और मिष्टान्न में प्रत्यक्ष या अप्रत्यक्ष रूप से उपयोग किया जाता है। व्यावसायिक रूप से बाजार में उपलब्ध सबसे लोकप्रिय वृक्ष स्रावित अरबी , घट्टी और कराया गोंद या भारतीय ट्रेगाकैंथ गोंद हैं। इसके अतिरिक्त, हॉग गोंद और किनो गोंद भी बाजार में जाने जाते हैं और उपलब्ध हैं।

एकेसिया सेनेगल, सूडान और अरब देश का एक मूल वृक्ष है और यह अरबी गोंद का एक सच्चा स्रोत है जो खाद्य उद्योगों में व्यावसायिक रूप से उपयोग किया जाता है। बाजार में उपलब्ध इस गोंद के अच्छे विकल्प धावड़ा और कई बबूल की प्रजातियां हैं जैसे कि देशी बबूल, खैर, मीठा बबूल और इज़राइली बबूल हालांकि, झिंगन , नीम, काजू, सफेद छाल बबूल और विलायती बबूल जैसे वृक्ष के गोंद का उपयोग खराब विकल्प या अरेबिक गोंद के मिलावट के रूप में किया जाता है।

एनोगाइसिस लेटीफोलिया का वृक्ष विभिन्न खाद्य अनुप्रयोगों में इस्तेमाल किया जाने वाला घट्टी या धावड़ा गोंद का एक स्रोत है। इसकी श्यानता (विस्कोसिटी), अरबी गोंद और ट्रेगाकैंथ गोंद के मध्यवर्ती है जिसके कारण इसका बाजार में उल्लेखनीय व्यावसायिक स्थिति है। यह लगभग सभी अनुप्रयोगों में जहां मध्यम श्यानता की आवश्यकता होती है , वहाँ अरबी गोंद का एक अच्छा विकल्प है। सादड़ के वृक्ष से स्रावित गोंद इस गोंद का एक अच्छा विकल्प है और इसे घट्टी गोंद के नाम पर बेचा जाता है या व्यापार के लिए घट्टी गोंद के साथ मिलाया जाता है।

एस्ट्रागैलस गमीफर , दक्षिण-पश्चिम एशिया का एक झाड़ी नुमा पौधा है जो मूल रूप से ट्रेगाकैंथ गोंद का एक सच्चा स्रोत है। इसका उपयोग मुख्य रूप से खाद्य उद्योग में गाढ़ापन बढ़ा ने के लिये

किया जाता है। भारत में, इस गोंद का सबसे अच्छा विकल्प स्टरकुलिया यूरेन्स है, जिसे कराया या कतीरा गोंद अथवा भारतीय ट्रेगाकैंथ गोंद के नाम से जाना जाता है। यह गोंद मूल ट्रेगाकैंथ गोंद के गुणों के समान है क्योंकि यह चिपचिपी जेली बनाते हुए पानी में फूल जाता है। शुरुआत में इसे यू.एस.ए में मूल ट्रेगाकैंथ गोंद की मिलावट के रूप में बेचा गया था , लेकिन यह गोंद १९२० के बाद से अद्वितीय व्यावसायिक स्थान पर है। अब , भारत कराया गोंद का प्रमुख उत्पादक देश है और दुनिया में इसका निर्यात करता है। ट्रेगाकैंथ गोंद के अन्य विकल्प पीला रेशम वृक्ष से स्रावित गोंद है और कुछ हद तक सेमल और सहजन के वृक्ष से निकला हॉग गोंद है। टेरोकार्पस मार्सुपियम के वृक्ष से स्रावित गोंद को भारतीय किनो या मालाबार किनो के नाम से जाना जाता है जिसे मुख्यतः कामोद्दीपक खाद्य पदार्थ 'कमरकस के लड्डू' (एक यूनानी व्यंजन) के मुख्य घटक के रूप में इस्तेमाल किया जाता है। भारत में इस गोंद को पलास वृक्ष से स्रावित गोंद द्वारा प्रतिस्थापित किया जाता है। व्यापार में यह बंगाल किनो के नाम से जाना जाता है। चिरोंजी वृक्ष से स्रावित गोंद एक और महत्वपूर्ण खाने योग्य गोंद है जो कई पेय पदार्थों में इस्तेमाल किया जाता है। यह लोबान (स्टाइरेक्स बेंज़ोइन) के वृक्ष से निकाले गए बेंज़ोइन गोंद के गुण के समान है, लेकिन माना जाता है कि यह गुणवत्ता में उसके नीचे है।

वृक्ष स्रावित गोंद पहचान ने के भौतिक-रासायनिक तरीके

व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंद की भौतिक-रासायनिक विशेषताओं को यहाँ संक्षेप में प्रस्तुत किया गया है।

भौतिक परीक्षण के तरीके

देशी बबूल (एकेसिया निलोटिका) और खैर (एकेसिया के टेचू) के वृक्ष से स्रावित गोंद हल्के पीले-भूरे या भूरे अथवा गहरे भूरे रंग के होते हैं । इन दोनों वृक्षों का गोंद गंधहीन और स्वाद में मीठा होता है , जबकि अरबी गोंद (एकेसिया सेनेगल) बेस्वाद, गंधहीन और रंग में पीला से लेकर नारंगी भूरे रंग का होता है। अरबी गोंद सहित दोनों प्रकार के बबूल गोंद लगभग पूरी तरह से पानी में घुलनशील हैं , लेकिन ये कार्बनिक घोल में अघुलनशील हैं। खैर, देशी बबूल और अरबी गोंद की पानी में घुलनशीलता (शुष्क आधार पर २% घोल में) क्रमशः लगभग ९४%, ९८% और ९९% होती है। देशी बबूल के गोंद का आणविक भार अरबी गोंद और खैर गोंद की तुलना में अधिक होता है। अरबी गोंद और देशी बबूल से स्रावित गोंद की श्यानता (विस्कोसिटी) समान होती है, जबकि खैर के गोंद की श्यानता थोड़ी कम होती है। देशी बबूल और खैर के गोंद की चिपकने वाली ताकत अरबी गोंद से थोड़ा कम होती है। गोंद का प्रकाशीय घूर्णन (ऑप्टिकल रोटेशन) जलीय घोल में या तो डेक्सट्रोरोटेटरी (दाहिने घूमनेवाला) या लीवोरोटेटरी (बाई ओर घूमनेवाला) होता है। आमतौर पर, भोजन और दवा के प्रयोजनों के लिए उपयोग किए जाने वाले बबूल गोंद के प्रकाशीय घूर्णन को लीवोरोटेटरी होना चाहिए। अरबी गोंद का प्रकाशीय घूर्णन लीवोरोटेटरी होता है, जबकि देशी बबूल के गोंद का प्रकाशीय घूर्णन थोड़ा-थोड़ा डेक्सट्रोरोटेटरी होता है। किन्तु, खैर के गोंद के प्रकाशीय घूर्णन की जानकारी अल्प है। सामान्यतः बबूल के गोंद का पीएच मान ४.८ से ६.४ तक होता है

घट्टी गोंद आमतौर पर गंधहीन , बेस्वाद और पीले-सफ़ेद रंग से लेकर लाल भूरे रंग का चमकदार, अनाकार और पारभासी रूप का होता है ।यह कोलॉइडल घोल बनाने के लिए पानी (८० से ९०% घुलनशीलता) में आंशिक रूप से घुलनशील है और साफ़ घोल नहीं देता है। यह नब्बे प्रतिशत अल्कोहल में अघुलनशील है। घट्टी गोंद का आणविक भार और श्यानता (विस्कोसिटी) अरबी गोंद और ट्रेगाकैंथ गोंद के मध्यवर्ती है। पानी में इस गोंद का फैलाव गैर-न्यूटोनियन व्यवहार दिखाता है। इस गोंद की चिपकने वाली शक्ति देशी बबूल और खैर के गोंद से बेहतर है। घट्टी गोंद ट्रेगाकैंथ गोंद की तरह एक अच्छा चिपचिपा जेली नहीं बनाता है तथा अरबी गोंद के अच्छे विकल्प के रूप में उपयोग किया जाता है, जहां मध्यम से ऊँचा श्यानता की आवश्यकता होती है। जलीय घोल में घट्टी गोंद का प्रकाशीय घूर्णन लीवोरोटेटरी होता है। आमतौर पर घट्टी गोंद का पीएच मान ४.९ से ५.१ तक होता है।

कराया गोंद पारदर्शी, हल्का पीला या गुलाबी भूरे रंग का, सिरके की गंध और स्वाद वाला होता है जबकि, ट्रेगाकैंथ गोंद गंधहीन , बेस्वाद, पारभासी और धूमिल सफ़ेद से लेकर हल्के पीले रंग का होता है। कराया गोंद सामान्य पानी में पूरी तरह से घुलता नहीं तथा फूल जाता है और एसिटाइल समूह की उपस्थिति के कारण पानी में गाढ़ा-मुलायम जेली जैसा चिपचिपा कोलॉइडल घोल बनाता है। यह गोंद पानी को अवशोषित करके अपनी मूल मात्रा से साठ गुना अधिक फूल सकता है। कराया गोंद को गर्म करने के बाद श्यानता (विस्कोसिटी) कम हो जाती है जो इसकी बहुलक रचना में परिवर्तन के परिणामस्वरूप होता है तथा समय के साथ इसकी घुलनशीलता बढ़ जाती है । हालांकि, ट्रेगाकैंथ गोंद सामान्य और गर्म पानी दोनों में फूलकर चिपचिपा घोल बनाता है। इसकी श्यानता (विस्कोसिटी) गर्म करने के बाद बढ़ जाती है और समय के साथ घुलनशीलता कम हो जाती है। इन दोनों गोंद का आणविक भार और श्यानता (विस्कोसिटी) आमतौर पर बबूल गोंद और घट्टी गोंद से अधिक होता है। यूरिक एसिड अवशेषों की उपस्थिति के कारण कराया गोंद के १% घोल का सामान्य पीएच ४ .५ से ४.७ तक होता है, जबकि १% ट्रेगाकैंथ गोंद के घोल का पीएच ४.५ से ६ .० तक होता है। कराया और ट्रेगाकैंथ गोंद की गीली अवस्था में चिपकने वाली शक्ति घट्टी गोंद और बबूल गोंद से ज्यादा होती है।

रासायनिक परीक्षण के तरीके

अरबी गोंद का घोल १०% कॉपर सल्फेट और १०% सोडियम हाइड्रॉक्साइड घोल के मिश्रण के साथ गर्म करने पर गहरे रंग का घोल देता है और यही रासायनिक परीक्षण ठंडी स्थिति में रंगहीन घोल या नीला अवक्षेप (प्रेसीपिटेट) देता है। यह गोंद फेरिक क्लोराइड और अल्कोहल के मिश्रित घोल में भी अवक्षेप देता है।

घट्टी गोंद १०% कॉपर सल्फेट और १०% सोडियम हाइड्रॉक्साइड घोल के मिश्रण के साथ गर्म करने पर कोई अवक्षेप (प्रेसीपिटेट) नहीं बनाता या थोड़ा कम अवक्षेप देता है और यही रासायनिक परीक्षण ठंडी स्थिति में गहरे नीले बादल वाले रंग का घोल देता है। यह गोंद जब फेरिक क्लोराइड और अल्कोहल के साथ मिलाया जाता है तो लगभग साफ़ घोल देता है ।

जब कराया गोंद का घोल २०% हाइड्रोक्लोरिक एसिड के साथ उबाला जाता है तो यह ठंडा होने के बाद गुलाबी रंग बनाता है , जबकि ट्रेगाकैंथ गोंद का म्यूसिलेज १०% सोडियम

हाइड्रॉक्साइड घोल के साथ पीला रंग बनाता है और बोरेक्स और फेरिक क्लोराइड के साथ कोई स्पष्ट अवक्षेप (प्रेसीपिटेट) नहीं बनाता है , लेकिन जब घोल में अल्कोहल मिलाया जाता है तो थक्कों के रूप में अवक्षेपन (प्रेसीपिटेशन) होता है।

निष्कर्ष

पौधों से स्रावित गोंद कैल्शियम , मैग्नीशियम, पोटेशियम और सोडियम लवण , प्रोटीन और अल्प मात्रा में वसा , स्टार्च और सेल्युलोज के अणुओं के साथ मिश्रित बहुशर्करा (पॉलीसेकेराइड) है। व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंद में अरबी गोंद और इसी तरह के समान गुण वाले बबूल , घट्टी और कराया गोंद या भारतीय ट्रेगाकैंथ गोंद शामिल हैं। इन प्राकृतिक गोंदों को उनके भौतिक-रासायनिक गुणों जैसे रंग , गंध, स्वाद, घुलनशीलता, श्यानता (विस्कोसिटी), पीएच और गर्मी स्थिरता, प्रकाशीय घूर्णन, चिपकने की शक्ति, रासायनिक बनावट और संरचना की तुलना करके तथा प्रामाणिक रासायनिक परीक्षण करके पहचाना जा सकता है। यद्यपि, घुलनशीलता, श्यानता, रंग और प्रामाणिक रासायनिक परीक्षण व्यावसायिक रूप से महत्वपूर्ण वृक्ष स्रावित गोंदों को पहचानने के प्रमुख भौतिक-रासायनिक तरीके हैं।

स्वीकृतियाँ

हम राष्ट्रीय कृषि उच्चतर शिक्षा परियोजना (एन.ए.एच.ई.पी.) की उप-परियोजना , उन्नत कृषि विज्ञान एवं प्रौद्योगिकी केंद्र के तहत "नवसारी कृषि विश्वविद्यालय, नवसारी में छात्रों और किसानों में कौशल विकास के लिए माध्यमिक कृषि इकाई की स्थापना " नामक परियोजना के अनुमोदन और वित्तीय सहायता के लिए भारतीय कृषि अनुसंधान परिषद , नई दिल्ली और विश्व बैंक के आभारी है। इस परियोजना की गतिविधि को प्रोत्साहित करने के लिए हम विश्वविद्यालय के अधिकारियों के प्रति भी आभार व्यक्त करते हैं।

देशी बबूल का तना

भारतीय अरबी गोंद

धावड़ा वृक्ष का तना

घट्टी गोंद

कराया वृक्ष का तना

कराया गोंद

चित्र १: व्यावसायिक रूप से महत्वपूर्ण भारत के वृक्ष स्रावित गोंद

Occurrence of *Lymantria mathura* in sal forests of Odisha

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Abstract

The present article reports the occurrence of a potential insect defoliator, *Lymantria mathura* Moore (Lepidoptera: Lymantriidae) in sal (*Shorea robusta*) forests of Odisha. This insect species is one of the principal defoliators of sal in India. The pest profile has been described and control measures are highlighted.

Key words: *Shorea robusta*, defoliator, *Lymantria mathura*, Odisha

Introduction

Shorea robusta Gaertn.f. (family Dipterocarpaceae), commonly known as sal in India, is a large deciduous, resiniferous tree having majestic shining foliage. Sal is of Indian origin, the north east India is considered as homeland of sal (Kulkarni, 1956). This potential species is one of the most important timbers of India both ecologically and economically (Tewari, 1995). In Orissa, vegetation cover occupies 43.67% of total geographical area (Reddy et al., 2009). While, forest cover of the State is estimated to 48,703.39 km^2, accounting for about 31.28% of total geographical area. Sal forests comprised 29,471.11 km^2 (60.51%) of the total forest area.

Sal entomology has received special attention, since inception of forestry research in India (Stebbing, 1914; Beeson, 1941), because it has a major pest problem. This potential tree species has a highest number of insect fauna among the forest trees. Of about 346 insects recorded on sal, about 155 species are associated with living tree, encompassing mainly defoliators (114), seed-feeders (19) borers (18), and sap-suckers (4) (Stebbing, 1914; Beeson, 1941; Mathur and Singh, 1960; Browne, 1968; Thakur, 2000; Nair, 2007; Roychoudhury, 2015). Among the defoliators, *Lymantria mathura* is rated as a serious problem (Beeson, 1941; Browne, 1968; Roonwal, 1979; Dey and Tiwari, 1997). The present article deals with this potential insect defoliator of *Shorea robusta* Gaertn.f. (family Dipterocarpaceae), collected from sal forests of Sambalpur, Odisha (Fig. 1). The determined specimen of *L. mathura* is preserved under accession No. 22 in TFRI Insect Repository which is notified as a National Repository for Insects.

Fig.1. Sal forests at Sambalpur, Odisha

Pest profile

***Lymantria mathura* Moore (Lepidoptera : Lymantriidae)**

Lymantria mathura, is commonly known as the rosy gypsy moth or pink gypsy moth, found in India, China, Nepal, Japan, the Korean Peninsula and the Russian Far East. The species was first described by Frederic Moore in 1866 (Hewitson and Moore, 1879).

L. mathura lay eggs in masses, usually on the tree trunks or stems or larger branches of the host. The larva reaches a length of 50 mm in the male and 90 mm in the female, colour ashy with yellow bands across the thorax, abdomen with rows of papules bearing tufts of long hairs, two long plumes of hair project on either side of the head (Beeson, 1941). Pupation takes place in a leaf fastened with a few stands of silk. The pupa is of the obtect adecticus type, and the appendages are firmly soldered to the body. It is buff to dark brown, about 20- 36 mm long, and shows sexual dimorphism, the female pupa is paler, larger and heavier than the male (Molet, 2012).

L. mathura is a moderate sized moth. There is marked sexual dimorphism in size and colour. The female is larger than male. The diagnostic features of adult moths are described by different authorities (Hampson, 1892; Beeson, 1941; Browne, 1968; Roonwal, 1979; Molet, 2012; Gurule, 2013). The female moth has a white forewing with dark markings and edged with pink, hindwing pink with a band of dark brown, abdomen half white half pink, legs pink and black and wing expanse 70-90 mm. The male with the forewing mainly marked with dark brown, hindwing yellow with a black spot and line and wing expanse 40-50 mm.

Fig.2. Adult female moth of *Lymantria mathura*

Fig. 3. Adult male moth of *Lymantria mathura*

L. mathura is univoltine or bivoltine (Beeson, 1941; Browne, 1968; Roonwal, 1979). The first generation occurs between April and October. A brood larvae is found in April with moths in May after a pupal period of 8-10 days, larvae occur again during the hot weather and early rains, pupation occurs from July to September with moths after about ten days. Eggs of another generation are laid in October.

L . mathura is one of the principal defoliators of *S. robusta* in India. Other preferred food plants are *Quercus leucotrichophora*, *Q. serrata*, *Syzygium cumini*, *Terminalia arjuna* and *T. myriocarpa* (Roonwal, 1979).

L. mathura larvae are gregarious defoliators. The larvae are able to consume whole leaves and sometimes avoid tough veins in older foliage growth. Larvae may also feed on flowers and tender young shoots (Browne, 1968; Roonwal, 1979). Damage of this nature can result in decline in overall growth and development of host trees, a reduction in yield or total crop loss in fruit crops, or even tree death (Singh, 1954; Roonwal, 1979).

L. mathura is considered a pest, since it is a major defoliator of deciduous trees. The caterpillar of *L. mathura* occasionally builds up in large numbers on *S. robusta* in Assam and Madhya Pradesh in India, causing defoliation (Beeson, 1941; Dey and Tiwari, 1997). The successive defoliations of *L. mathura* in Assam and north India have been known to kill sal trees (Appanah and Turnbull, 1998).

L. mathura is attacked by many natural enemies. According to Roonwal (1979), when the population density of *L. mathura*

is high, parasitism by hymenopterans (mainly *Apanteles* spp.) and dipteran (mainly Tachinidae) larval-pupal parasitoids can be observed to kill larvae and pupae. Caterpillars are often infested by nuclear polyhedrosis viruses. All these may result in high mortality of larvae and pupae of *L. mathura*. Natural enemies play a very important role in pest suppression.

Regarding the control measures of *L. mathura*, the biocontrol options like spraying of water solution of bacterium, *Bacillus thuringiensis* (B.t.) var. *kurstaki* 1%, i.e. @10 gm wettable powder dissolved in one litre on larvae bearing foliage. In China, infestations of *L. mathura* have been controlled in chestnut orchards by the application of pesticides to tree trunks (Zheng et al., 1994).

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Drudgery of pastoral women in the Trans-Himalayan region of Zanskar, Ladakh

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Highland pastoralism (Doksa)

The *Doksa* system as practiced in Zanskar is different from other livestock farming practices followed elsewhere in Ladakh (Bhasin, 1988). Unlike nomadic pastoralists of Changthang, who keep on moving with their herds from one pasture to another round the year (Namgyal et al., 2007), Zanskaris move with their herds to one of the pastures and remain stationed there for about three-and-a-half months in summer and return to permanent settlements in their villages after the crop harvest (Raj, 2017). Unlike the long distance transhumance practiced in the Mediterranean or nomadism in Changthang, there is vertical movement of stock to pastures in Zanskar. Vertically their movement covers approximately 800 meters, from 3600 m to up to 4400 m above mean sea level. Longest horizontal migration distance is from Hamiling to Panzum *doksa* (35 km). There was not any instance of conflict regarding grazing rights by a particular group of herders to any grazing land or settlement. Traditionally, allocation is decided by first-come-first basis, during which the herders prefer to occupy their last year's locations. Once a herder along with her own stock get settled at the *doksa*, other owners bring their cattle and hand them over to one of the herder (mostly an acquaintance) during their stay period at the *doksa*. Behind this system an informal agreement lies wherein the herders at *doksa* had to pay back 3 kg of butter per animal per month to the animal's owners. Over the years, the contract value is decreasing and the cattle owners are even ready to abolish the contract in lieu of the good quality pasture available to their animals during their stay at the *doksa*. Quality of natural grazing in the high pastures has been estimated as between twice and four times higher than in the lower zones of the arid mountain valleys (Sheikh and Khan, 1982). The herders do not take responsibility if the animals are killed by any wild animals or they go astray.

Fig. 1. Women pastoralist at Oma Tangtse *doksa*

Traditional significance

The system of *doksa* is an example of how indomitable spirit and human ingenuity has made it possible to sustain livelihood in the harsh environment prevailing in the

Zanskar region of the Himalayas. This strategy primarily evolved to provide them with sustainable livelihood, though commercial angle was attached to it in recent past. The system evolved for centuries in the climatic and socioeconomic setup prevailing in the Zanskar valley. The strategy involves harnessing the various resources distributed over spatial distance at various altitudes in the region. In addition, this system helps proper field crop management down in the valley during summer, when danger of damage caused to the standing crop by domestic animals always lurks around (Ahmad et al., 2018).

Fig. 2. Herd at Oma Tangtse *doksa*

Fig. 3. Churning milk by women pastoralist

The pastoralism system is tightly woven in the socio-economic and religio-cultural fabric of the inhabitants (Shergojry et al., 2017). Butter, the primary tangible product is essential not only for bodily nourishment of the natives, but also for spiritual fulfilments among these Buddhist communities. It is a religious perceptual requirement for them to offer handmade butter (considered more 'pure' than the butter readily available in the market) to monasteries for lamps and offering to the *lamas* as it is emanated from the fact that extreme hard work is involved in producing it. Provision of butter has 'status value' also. Its trade in Leh has other attraction too, like renew acquaintances and visit the capital (Crowden, 1994).

Fig. 4. Butter extraction from churned curd

Drudgery of pastoral women

These herders were generally veteran women (Fig. 1) who are expert in every aspect of dairying like milking, milk processing, packaging of butter etc. The herders lead hard lives and perform gruelling works in dairying activities (Fig. 2). The day starts for them early in the morning before day-break, around 3.00 a.m. until dawn, around 7 p.m. in the evening. Their daily activities involve primarily milking twice a day, churning yoghurt (Fig. 3), making and packing butter (Fig. 4), drying *chhurpey*, collecting dung and making dung cakes. The most difficult task, as apparent to them, was milking manually 20-35 animals twice a daily. The problem was further aggravated

because of smaller tits of *zhomo* that were difficult to hold properly while milking. This resulted in blisters in upper portion of their palm and fingers (Fig. 5). Current dairying practices are so cumbersome and exhausting that the herders hardly have time and energy to take care of them. The food habit of the herders is very poor as they took only one proper diet in whole day. The inability to feed adequate food in quantity and quality has resulted into undernourishment, malnutrition and ill-health. They reported a number of diseases like backache, sore throat, joint pains, gastric problems, eye sore etc. Occasional rains and associated snowfall on adjoining higher ridges compounded their problems. Strong cold wind caused death of almost 2-3 calves at each settlement surveyed (Fig. 6). There was also problem of animals going astray. One of the herders at OT, Yangdol Dolkar reported that out of 29 *zhomos* she started the season with, 20 drove away in August leaving her with only 9 milking animals owned by her for rest of the season. Besides these difficulties, the herders had to face threat of wild animals too as brown bears are frequent visitors to the *doksas*. They target mainly the store room where provisions and finished milk products are kept. The area is habitat of many wild animals like Himalayan marmots, fox, wolf, wild dog, snow leopard and Himalayan brown bear. Their raids gave the herders sleepless nights many a times because they also attacked their animals. Provision of watchdog for advance warning and protection were also not feasible because the dogs escape away for fear of wild animals whenever they were kept at the *doksa*.

Fig. 5. Blisters on hands due to heavy workload

Fig. 6. Calf mortality due to excessive cold at Oma Tangtse *doksa*

The women herders were fully satisfied of their status in the family. They justify non-involvement of male counterparts– fathers and brothers– in this system as they migrate to other places (cities) for better economic opportunities. When the herders return back to their homes down in the valley they were not given any special status and they had to perform all their duties of homemaking as done by the other women in their homes or villages (Fig. 7). Instead, young girls were provided with one new set of dress brought from Leh when their father/ brother go to sell butter/ *chhurpey*. The elder women offer pilgrimage which materializes only occasionally. Most of them had never travelled outside the Zanskar valley. They do not get any monetary reward in any case.

Fig. 7. Collection and transport of dung cakes at the *doksa*

The women folk who are the real custodian of this tradition have to bear the brunt of this system. However, harsh climate, threat of wild animals, excessive workload and very pathetic living conditions are some of the distressing problems facing these women. These dispelling factors combined with pulling pressures arising out of modern education and associated employment opportunities for aspiring young girls are driving them out of this system. There are many examples of abundant *doksas* in central and lower Zanskar. Unless this issue is addressed adequately and promptly by all stakeholders- farmers, religious communities, scientists and policy makers, we are going to witness more of these *doksas* being abandoned, as was observed at Panzum, Drangdrung, Balti *pulu* and Dabong*sa* during this study. The pastoral women are major care-takers of their families and undoubtedly play a predominant role in the socio-economic set up of the household economy. However, instead of giving credit, rewards and recognition, they are generally ignored and their male counterparts dominate the limelight (Borah, 2019). Hence, policy implications are needed towards minimizing their drudgery by intervening science and technologies in their lifestyle.

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