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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,
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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

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From the Editor's desk

Soil erosion is major factor forland degradation.Worldwide 56% (11 millionsquare km) of land degradationis due to water erosion and 28%(5.5 million square km) is duewind erosion .In India, about 83 million ha oftotal degraded land (68%) isaffected by water erosion.

Bamboo which has globaldistribution with more than 1400 species in tropical, equatorial and semitropical region can be planted to reclaim severely degraded sites and wastelands. It is good soil binder owing to its peculiar clump formation and fibrous root system and hence also plays an important role in soil and water conservation. Most bamboo species show a very strong development and colonization ability, determining that in some temperate habitats, they can assume an invasive character.

Bamboo has many distinguishable biological characteristics which make it such a valuable tool for land restoration projects. Its root system – an extensive network of fibrous rhizomes and roots - can control floods and landslides and prevent erosion by binding the soil particles firmly together. Bamboo is also fast-growing plants. It is, therefore, able to revegetate and restore productivity to even the most damaged of landscapes within a short period.

Bamboo is part of rural livelihood in many countries, especially in developing counties like India. Due to its versatile nature and multiple uses, it is also called 'poor man's timber'.

In line with the above this issue of Van Sangyan containsanarticle on A ready reckoner for development of bamboo plants with resource conservation measures on massive erosion prone degraded lands.There are also useful articles viz.Traditional silvipastoral models in kangayam tracts of western Tamil Nadu, Kalmegh (Andrographis paniculata), अल्पाईन चारागाहें, किसानों की खेती में लागत को कम करने के लिए शून्य लागत प्राकृतिक खेती, Application of nanotechnology in insect pest managementand Tachinid fly, Sturmia species: A major larval parasitoid of teak defoliator, Hyblaea puera

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. Naseer Mohammad

Chief Editor

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A ready reckoner for development of bamboo plants with resource conservation measures on massive erosion prone degraded lands

S. Kala*, A. K. Singh, B. K. Rao, Shakir Ali, Ashok Kumar, D. Dinesh, I. Rashmi and M. Prabhavathi

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Introduction

Degraded non arable lands cover vast tract in the country and are major source for supplying fuel, fodder and timber and other minor products to the population. The productivity of these lands is poor. For sustainable production from these areas water use efficiency of rain water needs to be enhanced. For this purpose number of soil working techniques is employed. Rain water that flows away as runoff is retained in the area by these techniques. The conserved soil moisture helps in plant establishment and subsequent plant growth. This will help in bringing out a useful technology to combat degradation process through an integrated approach. Therefore, there is an urgent need to detain these problems and protect both the arable and non-arable land from further degradation. Situation specific cost-effective viable technologies and dissemination of suitable technologies for reclamation and productive utilization of degraded ravine lands in India and its highly essential for arresting ravine extension, reclamation of ravine lands and improving production of rain fed production systems in ravine infested regions. Ravine beds in medium and deep ravines have higher soil moisture than ravine slopes and ravine humps and can sustain mesophytic vegetation. Bamboo is important vegetation which provides excellent protection from soil erosion due to extensive net-like root systems and rhizomes, which bind soil together, and thus helps in prevention of land degradation. When planted in ravine beds bamboo provides good vegetative cover and helps in arresting ravine extension. It also provides good production of bamboo sticks which are much in demand for multiple uses.

Important facts and features of bamboo

Out of the 18 genera and 128 species of bamboo inhabiting India, two species are *Bambusa bamboo* and *Dendrocalamus strictus* were mostly adapted in degraded lands. Abundant bamboos growing in degraded lands in the hill slopes (e.g. abandoned shifting agricultural land) holds together the loose sandy–loamy soil formed from geologically young rocks of the eastern Himalayan plateau, and helps in slope stability, reducing run-off and soil erosion (Toky and Ramakrishnan, 1982). Bamboo is versatile not only in industry utilization and in routine life but also in environment protection. There is an old saying; bamboo is the Poor-mans timber, indicating its status in the life of countryside people and its importance in poverty alleviation. Due to bamboo's

economic benefits, the research emphasis has long been put to its biological characteristics and the techniques for its propagation, cultivation, management and utilization. In fact, bamboo possesses a great potential either in soil erosion control, water conservation, or in land rehabilitation and carbon sequestration, which is supposed to give it a promising future. More attention needs to be paid to the research on its ecological functions, with the focus on the hydrological and ecological process of bamboo forest ecosystem, the mechanism and its application of erosion control of bamboo, its capacity of carbon sequestration and etc., in the future.

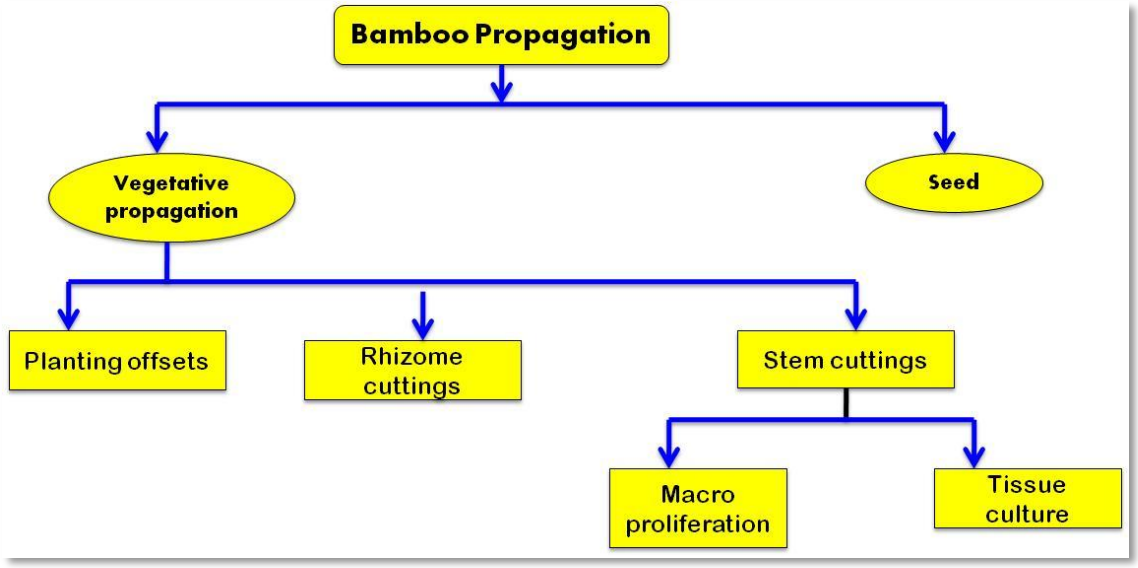
Soderstrom and Calderon (1979) considered bamboos to be one community that rapidly colonizes the disturbed lands in the region, and due to their adaptability and nutrient conservation role (Rao and Ramakrishnan, 1988), they play a special role in succession. While the impact of bamboo growth on the soil may differ at species level, it is expected to increase the microbial biomass, particularly, in the rhizosphere zone by providing a larger root surface area that would help in enriching soil fertility by acting as a 'sink' and 'source' of the available plant nutrients (Singh et al., 1989). The study is a part of a major research project that aims to identify potential bamboo species for rehabilitating ravine lands. Considering the above characteristics, it is easy to believe that bamboo is the fastest growing, highest yielding renewable natural resources (Lessard and Chouinard 1980). In addition to many industrial and construction uses, bamboo also is valuable for controlling soil erosion. It grows well on steep hillsides, road embankments, gullies, or on the banks of ponds and streams. The valuable features of bamboo for controlling soil erosion are its extensive fibrous root system, connected rhizome system, the leafy mulch it may produce on the soil surface, its comparatively dense foliage which protects against beating rains, and its habit of producing new culms from underground rhizomes which allows harvesting without disturbing the soil.

Bamboo has evergreen leaves, dense canopy and numeral culms, which can help to intercept considerable amount of rainfall. Falling raindrops change their direction and ways, and reduce velocity, and therefore decreases its direct soil erosion after multiple interceptions by tens of shoot layers and larger amount of culms. Bamboo is healer of lands wounded through human enterprise. The ability to grow in a wide variety of soils, from marginal to semi-arid, makes bamboo perfect for rehabilitation; it also serves to conserve soil and manage water flows. Bamboo is also a prolific generator of biomass, ideal for regenerating soil. The plant is thus well-positioned to be used as an instrument for land repair and maintenance. With its evergreen canopy, large biomass accumulation and abundant litter fall, bamboo has been playing a great role in rehabilitation of degraded land. In China, India and Thailand, appropriate bamboo agro-forestry modes for cultivation on degraded lands have been developed.

Climate, soil and ecological factors

The *D. strictus* grows on practically all types of soils provided there is good drainage. It does not grow on water-logged or heavy soils. Well-drained localities with

sandy loam are the best for bamboo growth. *D. strictus* is widely adaptable to temperatures as low as -5 ^{o}C and as high as 45 ^{o}C. This species is mainly found in drier open deciduous forests in hill slopes, ravines and alluvial plains. It prefers well-drained, poor, coarse, grained and stony soils. The species is found growing well in the areas having a rainfall between 750-4000 mm. It can flourish in regions where the relative humidity of the air is low. It is the hardest of all Indian bamboos; thrives even in areas which are under successive period of severe drought. It is a frost hardy species. Plantations of bamboo are either raised from seeds or by vegetative means (Photo-1).



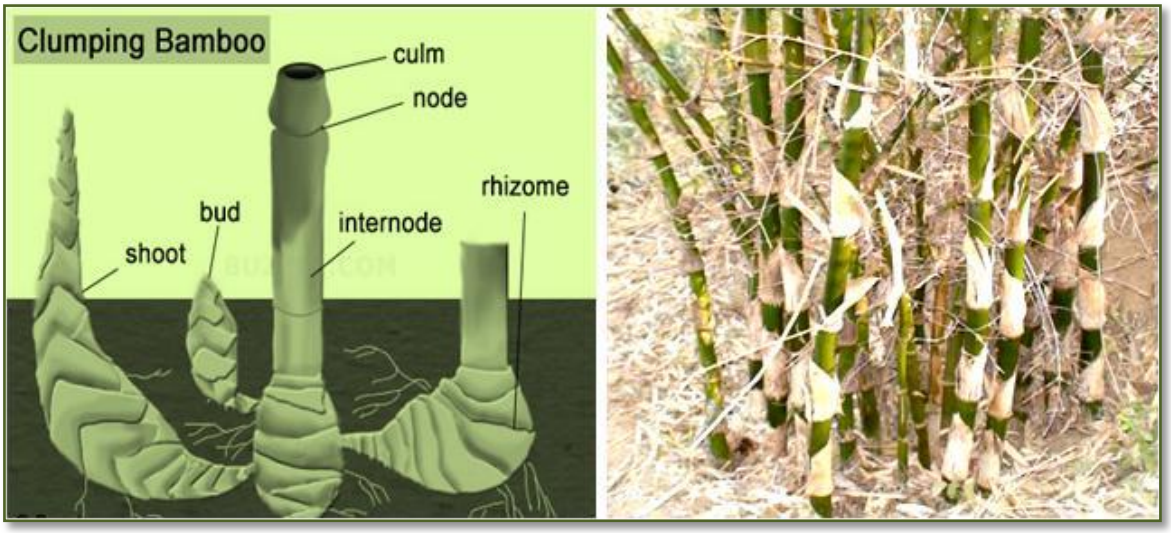


Photo 1: Propagation methods of Bamboo, Sympodial Bamboo Species and nursery establishment - Resource conservation value Self- reproliferation in degraded ravine and gullied lands

Environmental site suitability

Bamboo can form a closely woven mat of roots and rhizomes underground, which are effective in holding soil. The soil around bamboo plants is permeated by a mass of intertwining roots. A lot of studies showed that most of the rhizomes and roots, around 80%, were present in the upper 0-30 cm soil layer that is the area where roots and rhizomes serve best in controlling soil erosion. The extensive underground root and rhizome system has a significant capacity to bind the topsoil. A study estimated that a single bamboo plant can bind up to 6 m 3 of soil (Anonymous 1997). Because of this, it is perfect for arresting the ravages of water erosion in areas prone to it (such as slopes and lowlands). Bamboo planted along stream and river banks, grows particularly well because of a more even and abundant supply of moisture. The fibrous mass of roots binds the soft banks, and the thick culms arrest strong currents during flood periods. The soil behind the revetment is reinforced further by plantings of bamboo, thus building a solid wall of living plant material on the banks of the river, and solved the problem forever.

The ravine regions are characterized with very scarce natural vegetation largely due to much eroded soils having low fertility status as well as very unsuitable climatic and topographic conditions for most of the economical tree/grass species. The climate of the ravine region in Rajasthan, Madhya Pradesh, Uttar Pradesh and Gujarat is semi-arid to sub-humid (Agro-climatic zone IV) with annual average rainfall of600 mm to 800 mm, mostly received from July to October in intense storms. The temperatures may vary from 3 to 47º C during coldest to hottest months. Humidity may be as low as 7% and evaporation very high during May and June. (Bhushan and Saxena, 1984;Singh *et al.*, 1972; Singh *et al.*, 1976; Prajapati *et al.*, 1977; Prakash and Rao, 1986). Environmental suitability is understandably a relative term as it is difficult to find best suitable ecological combinations at single place. Luxuriant growth of different species of bamboo observed in north east part of the country indicate higher climatic and soil suitability. Though bamboo is not very specific to the soil type as it is observed almost throughout the India on different soil type, yet for optimum growth, soil and site parameters are listed in Table 1.

Table-1: Soil and climatic suitability conditions for Optimum growth of Bamboo

Parameters	Optimum Range
Soil texture	Loam, sandy loam, sandy clay loam, clay loam
Soil structure	Crumby/spheroid
Soil bulk density(g/cm^3)	1.3-1.5
Saturated hydraulic conductivity (cm/hour)	1-4

Organic carbon (%)	>0.8% (No specific information)
Soil pH	5.7 – 7.2
Electrical conductivity (dsm^{-1})	0.1-0.75
Available nitrogen (kg/ha)	350-600
Available Phosphorus (kg/ha)	25-40
Available Potassium(kg/ha)	>150
Land slope (%)	1-6
Soil depth (cm)	>90
Average annual rainfall (mm)	>1600
Average air temperature (^oC)	8-35
Relative humidity (%)	>80

Soil pH and Electrical conductivity were in the range of 7.6-7.9 and 0.12-0.18 dsm-1. Soil depth is higher than 1.5 m. Soils are moderately suitable in terms of pH, highly suitable as EC and soil depth and slope but unsuitable for bamboo as poor water holding capacity and fertility. Various soil and water conservation measures, closure of biotic interferences, along with life saving irrigations and addition of organic matter and fertilizers will make the degraded lands suitable for economically viable plantations.

Planting design with soil moisture conservation measures

Bamboo is not only an ideal economic investment that can be utilized in many different manners but also has enormous potential for alleviating many problems, both environmental and social, facing the world today. The increasing rate of tropical deforestation makes the search for alternative natural resources important. The characteristics of bamboo make it a perfect solution for the environmental and social consequences of tropical deforestation. Its biological characteristics make it a perfect tool for solving many environmental problems, such as erosion control (Austin *et al.* 1970) and carbon dioxide sequestration. On account of extensive shallow rhizome-root system and accumulation of leaf mulch, bamboo serves as an efficient agent in preventing soil erosion and conserving moisture, reinforcement of embankments and drainage channels, etc.. Additionally, its qualities of strength, light weight and flexibility make it a viable alternative to tropical timbers that typically supply the furniture and building materials industries.

Sl. No.	Important techniques should be followed in establishment of bamboo plantation under ravine lands	
1.	Survey and demarcation of ravine area for planting : selected areas for bamboo planting - medium and deep gullies and ravines, Preparation of Planting stock: Establishment of seedlings or purchase planting stock/ rhizome stock from old plantation : seedling and rhizomes can be used for planting	
2.	Initial cleaning of plantation area: by remove jungle scrub and bushes wherever necessary and make peripheral bunds to harvest rainwater. Digging planting pits: pit size (0. 50 x 0. 50 m x 0.50 m) (April & May), Filling up planting pits with application fertilizer with mother soil (basal 25 gram) (June and July): Chose fair weather day for application fertilizer. Note that there is sufficient moisture in the field before applying fertilizer	
3.	Planting programme: During rainy season potted seedlings should reach planting site. (At onset of monsoon & by 31st July at the least), Ist live saving irrigation and weeding, cleaning and including application of fertilizer (25 gram / plant), Live saving irrigation must given at 10 day interval at least for first one year of establishment and it is essential in the hot summer prevail in April, May, June months in ravines)	

4.	Weeding and Management: Second weeding and cleaning (weed material can be used as a mulch material for plants) and Filling vacancies with potted seedlings from nursery to plantation site. Termites are harmful bamboo plant development. Application of insecticide-subterranean termite killing powder Chloropyriphos 25 EC through water application for termite control	 
5.	Post plantation care : It should be involved of protecting plants from damages humans and animals through fixing /adapting watch and ward from nearby village to protect plants and necessary to create awareness among villagers not entertain any grazing, restrict felling and firing activities.	 
6.	Decongestion of clump and Harvesting culms: Singling or de-congestion of clumps is necessary for healthy culm development in bamboo after three years of planting. Allow three to four good culms per clump. Felling of matured culms can be removed from clump after 4 -5 years of planting. All the new culms and 25% of the old culms should be retained and 10 % of clumps should be removed.	 

Photo. 2: Stages of Bamboo Based Rehabilitation Techniques in Ravines

Before planting the bamboo in ravine lands, the bushes should be removed. *Dendrocalamus strictus* can be grown very well in the degraded areas and has been demonstrated to be very useful specie for economic utilization of ravines. The bamboo seedlings shall be planted at 5 m x 5m spacing in pits on ravine beds and mildly sloping humps in medium and deep ravines. Pits of size 0.5 x 0.5 x 0.5 m are dug at a desired spacing during the month of April- May. The dugout soil is left for desiccation during May-June. Pits are prepared for planting of seedlings as detailed in the description for other forestry land-uses. One year old bamboo

seedlings of 30-40 cm in height raised in nursery or rhizome cuttings should be planted with the ball of the earth, 4 to 6 cm below the ground level at the centre of the pit or trench after filling the excavated soil with 1 or 3 kg of FYM and then top soil firmly compacted to prevent evaporation of soil moisture. Planting should be done in the early part of the rainy season, but after the soil has become sufficiently moist. Particularly for rhizome planting special care will be taken for life saving watering after planting. Since rain is a major source of water in the region, every drop of it must be conserved in the soil through in-situ rainwater conservation. Bamboo plantation (*Dendrocalamus strictus)* at 5 m x 5 m spacing with supportive staggered trenches (2.0m x 0.5m x 0.5m) in degraded wide, deep gullies and gully beds of ravines, Treating gully beds with small earthen check dams (made of sand bags etc) and bamboo plantation (2 rows one each at upstream and downstream edge at 2 m x 2 m spacing) for medium and small gully beds or bamboo plantation in staggered fashion with close spaced rows & close spaced plants (at 2 m x 2 m spacing) to act as live check dam for arresting small gully beds. Otherwise, adopt at least one year age of seedlings of the *Dendrocalamus strictus* are planted after onset of first monsoon rains. Half moon shaped micro catchment shaping is prepared by providing mild slope to the land on the upstream of planted seedling leading the rainwater to the roots of planted seedling and making a crescent shaped bund on the downstream side of pit at a distance of 1m from the stem of tree. During dry periods, if you find any incidence of termite attack which cause mortality of young plants. Though these plants are rarely affected by insects, drenching with 0.2% solution of Chlorpyriphos (25 EC) helps to avoid infestation with termites. Periodic drenching with the solution of these insecticides helps in reducing the recurrence of termite attack. Where termite infestation is high, 2.5 liters solution may be applied to the soil near the planted saplings.

In ravine lands, Bamboo acts as good soil binders owing to their dry hardy nature, peculiar dense clump formation and extensive interlocking fibrous root system, natural capacity to regenerate through its rhizomes which play important role in preventing erosion, water holding capacity and nutrient cycling under gulley beds. This result proved that Bamboo is an ideal tropical hardy bamboo species for massive rehabilitation of degraded ravine lands. This moisture conservation technique is substantially quite effective in reducing runoff volume and soil loss. The better insitu rain water harvesting and moisture conservation techniques helps bamboo plants in sustaining its growth during hot and drought period. The highest average culm height and culm diameter and no. of culms /clump was recorded in T1 which may be attributed to high insitu moisture availability in subsoil. Using bamboo based conservation technology has a quite promising in biomass productivity and enhancing the insitu moisture use efficiency. Through this finding we could reclaim major ravine land ecosystem using Bamboo along with recommended moisture conservation measures. It has been identified as potential species for efficient resource utilization in non arable

lands, vulnerability analysis of livelihood support systems etc. This measure is highly applicable to light textured well drained soils including reclaimed ravine land where moisture and nutrient resources are scarce. The technology can suitably be adopted on the cultivable wastelands distributed in the north-western of India and in other areas having similar agro-climatic and soil conditions.

Felling cycle and harvesting

Efficient and regular clump management is important to ensure high productivity. Clump congestion should be minimized. Extraction of culms starts from 4-12 years after planting from well managed plantation for sustainable production. 3 to 5 years felling cycle is adopted for harvesting of *Dendrocalamus strictus*, as it allows the clumps rest and the rhizomes are not disturbed too frequently. Conservation can occur by cutting the culms from the periphery of the clumps, grazing and extraction by neglecting the cutting rules. This can be avoided by observing the general 'horse shoe' pattern for cutting. Cultural operations like thinning, cleaning protection from fire and grazing need to be followed. Coppice shoots arising from harvested or injured clumps should be removed as these are thinner than culms and lead to congestion in the clump.

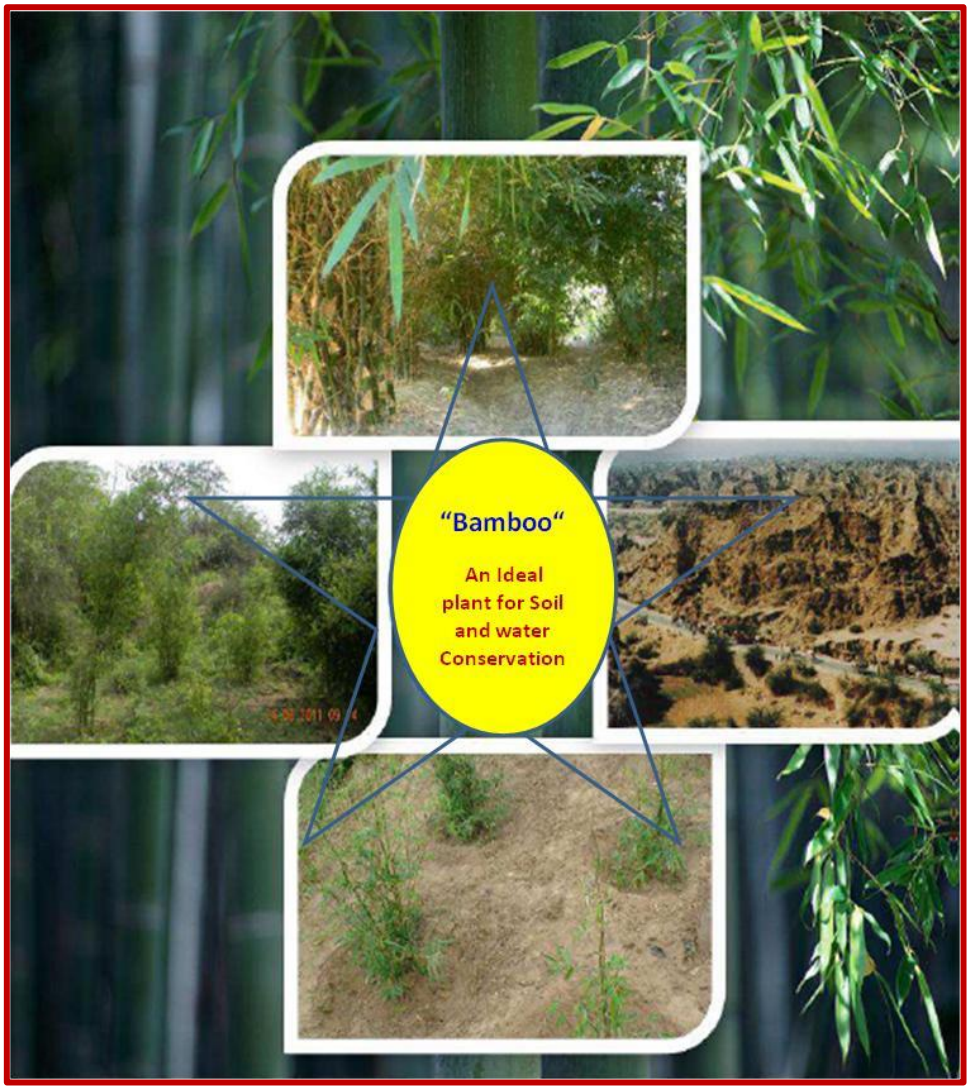
Yield and benefits

Deep and narrow gullies are recommended to be put under permanent vegetation of grasses and trees. Bamboo plantation for productive and protective utilization of such degraded lands is not only a profitable option for local stake holders but also financially and economically viable policy option for funding agencies and Government and Non-Government agencies. Due to bamboo plantation runoff from the ravenous watershed have been reduced from 10 % to 2% and soil loss from 4.2 t/ha /yr to 0.6 t /ha/yr. The analysis carried out using data from the Yamuna ravine system suggests a cash outflow ranging from 39550 / ha to 48000 /ha from 7th year onwards to individual stakeholders in the region, in addition to the benefits accrued to society at large in terms of enhanced soil health. Harvesting commences from 7th year onwards. The sale price per piece of bamboo is considered at Rs.35 - 40 /-. Depending upon the growth parameters of bamboo indifferent treatments, the harvestable culms differ and the net annual return varies among the treatments. On average 12-15 culms per clump are projected based on the growth data from field. Considering 10 % harvestable bamboo culms per clump (1m x 1m) spacing from 7th year on wards 2 bamboo culms per clump are available. Bamboo harvest cycle continues for a long time in ravines if a recommended practice of harvesting one third culms per clump is followed. The soil carbon build up would enhance with the age of plantation due to litter fall.

Economics of bamboo plantation

These systems can be practiced in ravine beds in the Chambal ravine region of Rajasthan and adjoining Madhya Pradesh, Yamuna ravines in Uttar Pradesh and Mahi ravine system in Gujarat. Studies conducted at ICAR-IISWC, Research Centres at Kota, Vasad and Agra suggested that annually 3000-4000 culms of bamboo/ha can be harvested by planting of *Dendrocalamus strictus* in ravines (Singh *et al.*, 2015). Considering average

weight of 15 kg per bamboo, the average productivity of bamboo in ravine far exceeds the average productivity of bamboo (11 t/ha) in India. The average cost of raising bamboo in ravines at 2011 prices for seven year period varies from Rs 1,00,893 to 1,06,748/ha in Chambal and Yamuna ravines. Net income from bamboo, similarly varies, beginning from Rs 39,500/ha in 7th year, Rs 34,000/ha in the 8th and Rs 51000/ha/year, thereafter (Singh *et al*., 2014). Thus the benefit cost ratio of *Dendrocalamus strictus* plantation in ravines is lucrative 1.98 with an economic return of 19.3% over a twenty year period. The non-tangible benefits of carbon sequestration and prevention of soil erosion are the added benefits. Protection from biotic interference during first two years especially from wild pig and porcupine, which damage the roots and browsing animals, is important. Measures for soil moisture management may improve the survival and growth of bamboo in ravines. The gully head and gully stabilization measures with bamboo interventions have been found useful for the ravine areas.



- Check the soil erosion
- Increase fodder availability
- Improve the livelihood options
- Maintenance or improvement of the organic matter
- Conserve soil moisture
- Higher water-use efficiency
- Higher production stability and sustainability
- Lower production costs
- Increase green cover/forest cover

Photo.2: Tangible and Intangible benefits from Bamboo Plantation

Conclusion

The technology requires fairly less initial investment. The returns from bamboo culms are also accrued after a gestation period of 4 or years. Therefore, this technology would be more suitable to medium and large farmers who have fairly large holdings, greater capacity of capital investment and better access to credit facilities. This technology is applicable to light textured well drained soils including reclaimed ravine land where moisture and nutrient resources are scarce. The technology can suitably be adopted on the non-cultivable wastelands in Chambal ravines Madhya Pradesh, Rajasthan, Mahi ravines of Gujarat and Yamuna ravine lands of Uttar Pradesh. The techniques are very much useful to various stake holders and officials of forest and agriculture department and other user agencies for improving livelihood through reclamation and productive utilization of ravine lands. Use of bamboo based conservation measures in resource poor degraded lands is eco-friendly, viable, easy to adopt and socially acceptable to all categories of stake holders like farmers, forest departments, industry peoples and waste development boards in ravine lands covering states of Uttar Pradesh, Rajasthan, Gujarat and other states which includes waste lands. Therefore, the use of bamboo in watershed management, soil and water conservation, rehabilitation of degraded land could be possible and bamboo farming and material processing are well suited to this region due to twin concerns of livelihood enhancement and environmental protection - the key components for developing these resource poor lands. Hence, an effective organized massive cultivation of bamboo species through community participation could helpful to increase the green cover and establish industries that provide sustainable livelihood development to the local community.

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Traditional silvipastoral models in kangayam tracts of western Tamil Nadu

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Silvopastoral systems are land use techniques that intentionally combine trees, woody shrubs, and animals on the same land management unit in some kind of spatial arrangement or temporal sequence, resulting in substantial ecological and economic interactions between tree and livestock components. In many places, livestock is considered to be a significant factor in agricultural output. Trees give animals in arid tropical regions access to dry-season food including leaves and fruit as well as shade, which may lessen heat stress and boost feed intake. Grazing pressure on forest areas is reduced by a variety of silvopastoral systems, which range from extensive nomadic silvopastoralism to extremely high intensity cut and carry fodder systems.

Korangadu - The traditional dry land Silvopastoral system in Tamil Nadu

The ancient silvopastoral model known as Korangadu is used in Tamil Nadu's semi-arid tracts in the Dharapuram, Kangeyam, Palladam, Kallimanthayam, and Moolanur parts of the rain shadow regions of the Western Ghats. Korangadu, a Tamil word, refers to unplanted, left-over, or uncultivated land. The region experiences 600–675 mm of yearly rainfall on average. Red laterite soil is the type of soil, and it has a low water-holding capacity and a gravelly texture. The crops will be harvested as grain or used in other ways as fodder if distribution of rainfall is uniform.

History of Korangadu

In the distant past, farmers in these areas worked these lands by ploughing them first, then cultivating dryland crops. The area or a section of these lands, were not covered by crop farming followed by

succession of natural vegetation for some seasons due to non-normality in rainfall and other seasonal fluctuations. Farmers are left with little choice but to let their livestock graze in those uncultivated areas. Farmers later discovered that these uncultivated lands were fruitful for efficient animal grazing. In the end, Korangadu evolved into a well-organized system with solid management that was built over years and a code to pick species that would be maintained to meet the soil, climate, and rainfall requirements of that region.

Species of Korangadu

In Korangadu, there are three levels of space-separated important flora species. The lowest tier is made up of grass species, the middle tier is made up of tree species, and the top layer is made up of live fences that farmers use to mark off their Korangadu. When season is preferable, hardy legumes such as *Phaseolus trilobus* (Narpayaru) or *Macrotyloma uniflorum* (Kollu) were raised for crop and when there is no rainfall fodder grasses such as Cenchrus sp.(Kolukattai grass) were raised. When there is no grasses the cattle feed on pods of *Acacia leucophloea.* The major species of Korangadu is listed in table below,

Grass species	Tree species	Legumes	Live fences
Cenchrus ciliaris **(Kolukattai grass)**	***Acacia leucophloea*** (Velvel)	***Phaseolus trilobus*** (Narpayaru)	***Commiphora berryii*** (Kiluvai)
Trachys muricata **(Vennampul)**	***Albizia amara*** (Usilai Wunja)	***Macrotyloma uniflorum*** (Kollu)	***Agave americana*** (Anaikaithai)
Cynodon dactylon **(Bermuda grass)**	***Azadirachta indica*** (Veppu maram)	***Trychosanthes tricuspidata*** (Kurattai)	
Seltaria Vericulata **(Ottanpul)**			
Chrysopogon montanus **(Cholapul)**			

Korangadu and Kangeyam cattle

The "Kangeyam" breed of cattle, recognised for its outstanding draught qualities, adaptability to dietary environments, and longevity, is bred in Korangadu. Although there are fewer agricultural activities, these breeds of Kangeyam cattle are in high demand in neighbouring states like Kerala, Karnataka, and Andhra Pradesh because of their greater flexibility The drought-tolerant "Kangeyam" breed of cattle developed in this area is a much coveted bull in annual bull fighting festival or 'Jallikattu' in Tamil Nadu

Threats and Challenges

The main reduction in land area was caused by the conversion of Korangadu lands into monocropping by installing deep bore wells and the construction of industrial facilities. The government's land ceiling severely hindered farmers from maintaining extensive tracts of grazing pasture. The creation of pastureland on privately owned farmland is essential for maintaining minimal input livestock production and preserving native animal breeds. Another factor posing a threat to Korangadu lands is the large-scale decline in the population of true-to-type "Kangeyam" cattle breeding bulls. Korangadu grazing land is essential for the survival of native animal breeds. The invasion of a parasite (Thangakodi) is another factor that prevents grass and leguminous plants from growing.

Conclusion

Korangadu, the traditional Tamil Nadu farming technique, is a great example of how to use marginal areas. The successful integration of the Korangadu system's components will enable farmers to take advantage of numerous advantages in terms of pasture, fodder, and fuel. In order to use indigenous farming practises like Korangadu as a model for sustainable land use, they need be elevated.

Kalmegh (*Andrographis paniculata)*

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Introduction

Kalmegh is commonly known plant of India and has been used in Indian system of medicine since time immemorial. It is also known of king as bitters' &chiretta. The fresh and dried leaves of this plant and juice extracted from herb are official drugs in Indian pharmacopoeia. Sometimes, it is substituted for swertiachirata for its bitter principles. The whole plant is the source of various diterpanoids, of which the bitter water soluble lactose Andrographolide is important and is distributed in all the plants parts in various proportions.

Vernacular names

Sanskrit: Bhunimbah, Kirta, Hindi: KalmeghGujrati:Kariyatu,Marathi:Olikiryata, Oriya: Bhuinimba, Bengali: Kalmegh,Telgu: Neelaveemu, Malyalam: Kiriyattu, Nelaveppu, Kannad: Nelaberuvayahullu, Tamil: Nilavemba, English: King of Bitters, Chiretta, Trade: Kalmegh

Botanical description

It is an annual errect herb with 1.0 meter height. The branches are sharply; quadrangular, often narrowly winged towards the apical region. The leaves are petolate; lanceolate; oblong alternate at both ends, globrous and acute. The flowers are small, soiltary, in panicles with a rose-coloured corolla which is hairy externally. The seeds are numerous, yellowish-brown and glabrous.

Varieties

AK-1 (AnandKalmegh -1), CIM-Megha, KI-5, IC-111286, IC-111287I, C-111289

Habit and habitats

The herb grows abundantly in wild as are under shrub in tropical moist, deciduous forest. It is distributed in the plains throught India and Srilanka. In India it is found in Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh and West Bengal.

Agro technology

Soil and climate

Kalmegh is a hardy plant and can easily be grown on a variety of soils form clay to sandy loam but sandy loam soil rich in organic matter is good for its growth, development and yield. It is a tropical and subtropical crop and prefers cooler

climates, moist, shady places with well distributed rainfall.

Soil preparation

The soil is prepared by repeated ploughing and planking and brought to a fine tith. The soil is mixed with FYM @ 25 t/ha at the time of last ploughing. The field is laid out in plots of convenient size along with irrigation channels for easy management.

Mode of propagation

Kalmegh can be propagated by seeds

Direct sowing: In the well prepared field the furrows are mode at a distance of 30 cm and about 3-4 seed are sown in each spot maintaining a distance of 15 cm between two plants. 3-4 kg seed are required for direct sowing in a hectare field.

Nursery raising

The seed are sown on nursery beds of 3×1.5×0.15m size filled with a mixture of soil, sand and farm yard manure in equal proportion. The best season for sowing is during the month,May and June. About 400-500 g seeds are required for raising nursery to Transplant in one hectare field area. The seeds germinate in about 8-10 days and the seedling will ready for transplanting in 45-50 days.

Transplanting

The seedlings are transplanted at a spacing of 30×30 and 30×45 cm in the main field. The 15th June to 15th July is the best time for transplanting.

Manures and fertilizers

The FYM@ 25t/ha shall be mixed well in to the soil at the time of last ploughing is recommended. A fertilizers dose of 20:30:20 kg N: P_2O_5:K_2O is required for a crop of one hectare. Of this 50% nitrogen and the entire dose of phosphorus and potash is given as basal dose and remaining 50% nitrogen is applied as topdressing 30 days after sowing /transplanting.

Irrigation

Kalmegh grows as a kharif crop and needs no irrigation in the areas with well distributed rainfall however, in case of long dry spells the crop is irrigated initially at 3-4 days interval and later on it is increased to one week depending as the local weather conditions.

Interculture operations

It is a small herbaceous herb. The field should keep weed free during initial crop growth stages. The first weeding is done after about one month of planting. After this one or two weeding are recommended after 60 days of sowing or transplanting to keep the weeds under control.

Pest and diseases

Being a hardy crop no attack of pest and disease are reported.

Harvesting

The Kalmegh crop is ready for harvest after about 3 to 4 months after sowing when the plants start flowering, At this stage the plants are harvested by cutting the plants at the base ; leaving about 10-15 cm of the stem for regeneration. The regenerated plants are ready for harvest in about 60 days of the previous harvest 2 to 3 harvest can be made in a years. At the flower initiation, active principle andrographilide is high in the leaves. After harvesting the plants are dried in shade for, 3-4 days before storages.

Chemical constituents

The Kalmegh leaves contain diterpene lactose Andrographolide (about 2.5%) and stem (2.0%) In addition; the plants is also important source of flavonoids, Sesquiterpene, Phenylepropanoids. The

roots contain the flavonoids, andrographin, panicotin, aplegenin-4', 7- dimethylether, mono-o-methyl wightin and hydroxy-7, 8, 2, 3, - trimethoxy flavone and betasitosterol.

Medicinal uses

The Kalmegh forms the principle ingredient of household medicine called 'Alui', extensively used in west Bengal for general debility and for certain forms of dyspepsia amongst adults and infants. The expressed juice of the leaves as prescribed with cardamon; cloves and cinnamon in the form of globules to infants for relief from bowl complaints, irregular stools and loss of appetite. Kalmegh is also considered as highly efficacious against malaria, snake bite; the hot water extract of the whole plant is used for acute jaundice, fever, dysentery, and stomach worm. The fresh leaf juice along with leaf juice of *Azadiracta indica* and *Tinospora cordifolia* are used to cure cholera. The roots are used as antipyretic, alternative and cholagogue agents. The common ayurvedic drugs are 'Kalmeghasava' and Kalmegh anamayas Haub' the main constituents of which are *Andrographis paniculata* besides Trikatu (Viz. Piper longum, P. nigrum and Zingiber officinalis) *Cyperus scariosus*, *Triphala*, *Embelliaribes*, Plumbago Zelynica and lauh Bhasm (organometallic salt of iron).

अल्पाईन चारागाहें

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ब्रह्मांड में व्याप्त अनगिनत आकाश- गंगाओं , तारामँडलों, ग्रहों, उप-ग्रहों में से केवल पृथ्वी ही एक ऐसा ग्रह है, जहां पर प्रकृति ने अपने विविध रूपों-रंगों को स्थापित किया है। इस धरा पर वनस्पतियों एवं जीव-जंतुओं की असंख्य प्रजातियाँ, विविध प्रकार के पारिस्थितिक–तंत्र तथा अनेकों सुरम्य एवं मनभावन स्थल विद्यमान है। पर्वतीय क्षेत्रों में समुद्र तल से 2800 मीटर से 3500 मीटर तक की ऊंचाई पर वृक्ष रेखा से उपर पायी जाने वाली अल्पाईन चारागाहें भी प्रकृति के इन्हीं इंद्रधनुषी रूपों-रंगों में से एक है। ग्रीष्म ऋतु में , बर्फ पिघलने के बाद भांति-भांति के पुष्पों से सुसज्जित हरित कालीनो की तरह दिखने वाले घास के ये मैदान अपनी उत्कृष्ट सुंदरता से अद्भुत नजारा प्रस्तुत करते है। इसलिए अल्पाईन पादप पारिस्थितिकी क्षेत्र के वैज्ञानिक और प्रसिद्ध वनस्पतिशास्त्री क्रिश्चियन

आकर्षक नेसर्गिक सौन्दर्य

कोर्नर के कथनानुसार अल्पाईन चारागाहें प्रकृति के एक सुंदर बगीचे की तरह है जिसमे विविध प्रकार की वानस्पतिक संरचनाएँ प्रकृति-प्रेमियो, वैज्ञानिकों और पारिस्थितिकविदों को अनायास ही अपने ओर आकर्षित करती है।

विश्व के हर महाद्वीप में, पर्वतीय वातावरण का अपना ही सम्मोहन होता है। परंतु, भारतीय उपमहाद्वीप में विराजमान पर्वताधिराज हिमालय का अपनी विशालता, भव्यता, दूर-दूर तक फैली शृंखलाओं, ऊंचे- ऊंचे पर्वत- शिखरों और समृद्ध जैव- विविधता के कारण दुनिया भर में एक अलग एवं अनूठा स्थान है। हिमालय के ऐसे विशाल साम्राज्य के अंतर्गत ही अल्पाईन चारागाहें मुख्यतया पूर्वी- हिमालय के कुछ राज्यो और उत्तर- पश्चिम हिमालय में जम्मू व कश्मीर, उत्तराखंड और हिमाचल प्रदेश में पायी जाती है। ऊंचाई पर स्थित, घास के इन सुंदर मैदानों को अलग- अलग राज्यों में भिन्न- भिन्न नामों से जाना जाता है, जैसे जम्मू व कश्मीर में अल्पाईन चारागाहें को मर्ग, उत्तराखंड में 'बुग्याल' तथा हिमाचल प्रदेश में 'कांडा' या 'थाच' कहा जाता है।

वास्तव में, अल्पाईन शब्द लैटिन भाषा के 'एल्बस' शब्द से संबन्धित है जिसका अभिप्राय है - 'सफेद' या 'बर्फ से ढका हुआ'। यहाँ पर, विविध जलवायु कारकों जैसे तापमान, प्रकाश, विकिरण और मृदा के भौतिक, रसायनिक अभिलक्षणों में व्यापक विषमता पायी जाती है। ऐसे ही विषम वातावरण में प्राकृतिक वृक्ष रेखा के ऊपर अल्पाईन पारिस्थितिक तंत्र बहुवर्षीय शाकीय पौधों और अन्य जीवों के लिए अद्भुत आवासीय स्थल है। इन क्षेत्रों में ज्यादातर समय तक बर्फ रहने तथा लंबी सर्दियों के कारण पौधों की वृद्धि बहुत कम होती है , तथा अधिकांश पौधे छोटे आकार के होते है। विषम और प्रतिकूल वातावरण में रहने के लिए इन पौधों में खास संरचनात्मक विशेषताएँ और रूपात्मक अनुकूलन पाये जाते है। अल्पाईन क्षेत्रों के समीप पायी जाने वाली वानस्पतिक संरचनाओं को 'क्रुमहोल्ज़' कहते है। इस श्रेणी में, प्रमुखतया जमीन से कुशन की तरह सट्टी हुई बौने आकार की झाड़ियों जैसी गॉलथेरिया ट्राइकोफिला, कोटोनेयस्टर और कैसिओप फास्टिगियाटा का प्रभुत्व होता है।

कोटोनेयस्टर

गॉलथेरिया

शरद ऋतु में, अल्पाईन चारागाहें ज़्यादातर बर्फ से आच्छादित रहती है। परंतु, वसंत के मौसम में विविध प्रकार की खूबसूरत अल्पाइन वनस्पतियों से जीवंत हो उठती है । ऊंचाई पर स्थित घास के ये मैदान अर्थात अल्पाइन पारिस्थितिक तंत्र न केवल नेसर्गिक सौंदर्य से सुसज्जित है, अपितु जैव-विविधता का भी भंडार है। इन जगहों पर मुख्य

(कैप्राआइबेक्स सिबिरिका) , मार्खोर (कैप्राफाल्कोनेरी) जैसी महत्वपूर्ण प्रजातियाँ शामिल है । जीवों की यह प्रजातियाँ दुर्लभ व संकटग्रस्त श्रेणी में आती है । एंटीऑक्सीडेंट से भरपूर और कीमती हिमालयी कैटरपिलर कवक अर्थात कीड़ा-जड़ी भी हिमालय के ऐसे ही अल्पाईन वातावरण में मिलती है।

अल्पाईन पुष्पों की विविधता

रूप से रोजेसी , लैगूमिनेसी, ऐस्ट्रैसी और स्क्रोफूलेरियसी वानस्पतिक कुलों से संबन्धित पुष्पीय जड़ी-बूटियाँ मिलती है । इनमें से बहुत सारे शाकीय पौधे जैसे - आतीश (*एकोनिटम हेटरोफिलम*), सलामपंजा (*डैक्टिलोरिज़ा हैटेजीरिया*), कड्डु (पिक्रोरयीजा करूया), वन-ककड़ी (पोडोफिलम हेक्सेंड्रम) इत्यादि उच्च औषधीय गुणों से युक्त होते है।

इसके अतिरिक्त , अल्पाईन क्षेत्र कई प्रकार के वन्यजीवों के लिए एक उत्कृष्ट आवास प्रदान करते हैं। इन जगहो पर पाये जाने वाले जंतुओं में हिम तेंदुआ (पेंथेरा अनसिया), हिमालयी कस्तूरी मृग (मोस्कस क्राइसोगास्टर) , सीरो (नेमोरहेडस सुमात्राएंसिस), हिमालयन आइबेक्स

वैज्ञानिकों के मतानुसार , हिमालय में लगभग 33% हिस्से पर अल्पाईन क्षेत्र आच्छादित है और हिमाचल प्रदेश में कुल भौगोलिक क्षेत्र का लगभग 15% भाग अल्पाईन चरागाह भूमि में शामिल है। हिमाचल प्रदेश मेंबहुत सी आकर्षक अल्पाईन चरागाहें है, जहां पर अत्यधिक मूल्यवान औषधीय , सुगंधित पौधों एवं जड़ी बूटियों के प्राकृतिक भंडार पायी जाती है । ये अल्पाईन चरागाहें जिला चंबा , शिमला, कुल्लू, कांगड़ा, मंडी, किन्नौर और लाहौल- स्पीति में स्थित है। इनमें से चांसल , मुराल डंडा, तालरा, ढेल थाच आदि कुछ प्रमुख नाम है।

वर्तमान में, विविध मानवजनित कारणों जैसे कि खानाबदोश प्रवासी चरवाहों के मवेशियों द्वारा

हो रही अनियंत्रित चराई , पर्यटन गतिविधियों, औषधीय जड़ी बूटियों के अनियमित दोहन से प्रकृति की अद्वितीय देन- 'अल्पाईन चारागाहों' का निरंतर नुकसान और ह्रास हुआ है । जिस कारण से, परिस्थितिकीय रूप से अति महत्वपूर्ण और जैव-विविधता संपन्न ये स्थल अपना मूल स्वरूप खो चुके है।

बहुत जरूरी है कि इन संवेदनशील पारिस्थितिकी तंत्रों की संरचना व कार्यप्रणालियों को गंभीरतापूर्वक समझा जाए और अवक्रमित अल्पाइन घास के मैदानों के संरक्षण और पुनर्स्थापना के लिए उपयुक्त नीतियां और उचित हस्तक्षेप किए जाए, जिससे चिरकाल तक इनकी स्थिरता और समग्रता अक्षुण्ण बनी रहे।

अल्पाइन क्षेत्रों पर बढ़ता अवक्रमण

किसानों की खेती में लागत को कम करने के लिए शून्य लागत प्राकृतिक खेती

ब्रजकिशोर प्रजापति[1], जया प्रजापति[2] एवं अविकल कुमार[3]

[1]शस्य विज्ञान प्रभाग

कृषि विज्ञान केन्द्र, शहडोल (म.प्र.)

[2]मृदा विज्ञान एवं कृषि रसायन शास्त्र प्रभाग

राजमाता विजयाराजे सिंधिया

कृषि विश्वविद्यालय, ग्वालियर (म.प्र.)

[3]शस्य विज्ञान प्रभाग

कृषि विज्ञान केन्द्र, रुद्रप्रयाग (उत्तराखंड)

पिछले एक दशक में भले ही खाद्यान्न उत्पादन में वृद्धि हुई है लेकिन इस अवधि में देश के किसानों की स्थिति में सुधार नहीं हुआ है। यह एक गंभीर चिंता का विषय है । रसायन जैसे उर्वरक या कीटनाशक का उपयोग फसल की वृद्धि को बढ़ाने के लिए अधिक मात्रा में किया जाता है, ताकि ये राजस्व में वृद्धि कर सकें । निर्जीवकृत बीज, निवेश और बाजार किसानों के लिए दुर्गम और महंगें हैं । उच्च उत्पादन लागत ऋण के लिए उच्च ब्याजदर, फसलों की बाजार कीमतें, जीवांष्म ईंधन आधारित निवेशों की बढ़ती लागत और निजी बीजों के कारण भारतीय किसान तेजी से कर्ज में फंसते जा रहे हैं । जैविक खेती, नवप्रर्वतनों में शून्य लागत प्राकृतिक खेती (जेड.बी.एन.एफ.), किसानों की समस्या के समाधान के रूप में लोकप्रियता हासिल कर रही हैं । वर्तमान में 50 लाख से अधिक किसान खेती की इस प्रणाली का प्रयोग कर बंजर भूमि को उपजाऊ भूमि में परिवर्तित कर रहे हैं ।

जीवामृत

यह गाय के गोबर (20 किलो), गोमूत्र (5-10 लीटर), गुड़ (20 कि.ग्रा.) और द्विपत्रियों के आटे (2 किलोग्राम) से बना है । प्रत्येक सिंचाई चक्र के साथ फसलों पर यह प्रयुक्त होता है । यह पोषक तत्व प्रदान करता है । सबसे महत्वपूर्ण यह है कि एक उत्प्रेरक घटक के रूप में भी कार्य करता है, जो मिट्टी में सूक्ष्मजीवों की गतिविधियों को भी बढ़ाते है । जीवामृत, पौधों में कवक और जीवाणुजनित रोगों को रोकने में भी मदद करता है । इसके लिए जीवामृत केवल अवस्थातंर के पहले 3 वर्षो के लिए आवश्यक है, उसके बाद यह प्रणाली आत्मनिर्भर हो जाती है ।

बीजामृत

यह मूलरूप से पानी (20 लीटर), गोबर (5 किलोग्राम), मूत्र (20 लीटर), चूना (50 ग्राम),

और सिर्फ एक मुट्ठी मिट्टी से बना है । बीजामृत एक बीज उपचार है, जो तरूण जड़ों को कवक के साथ-साथ मृदाजनित और बीज जनित रोगों से बचाने में प्रभावी है ।

आच्छादन पलवार

यह मृदा पलवार, पुआल या जीवित पलवार द्वारा किया जा सकता है। यह वाश्पीकरण को कम करके, मिट्टी की नमी को संरक्षित करता है। जैविक पुआल में मृदा अधिक समय तक नमी बनाये रखती है तथा उसमें लाभदायक जीवाणु उपलब्ध हो जाते है जो मृदाकी उर्वरता को बनाने में सहायक होते है। यह लाभकारी किसान मित्र केंचुए की वृद्धि में सहायक होती है ।

व्हापासा

सिंचाई को कम किया जाना चाहिए और केवल दोपहर के समय ही सिंचाई का अभ्यास करना चाहिए। पौधों की जड़ों को बहुत अधिक पानी की आवश्यकता होती है, वास्तव में जड़ों को जल वाष्प की आवष्यकता होती है । और इसलिए व्हापासा वह स्थिति है, जहां मिट्टी में हवा के अणु और जल के अणु दोनों मौजूद होते हैं ।

कीट प्रबंधन की संरचना और नियंत्रण

अग्निआस्त्रा

स्थानीय गाय का 10 लीटर मूत्र और एक किलोग्राम तम्बाकू, 500 ग्राम हरी मिर्च, 500 ग्राम स्थानीय लहसुन, 5 कि.ग्रा नीम के पत्तो के गूदे (मूत्र में संदलित) से बना है । छिड़काव के लिए, 100 लीटर पानी में 2 लीटर ब्रह्मस्त्र लिया जाता है । यह पर्ण लपेट (लीफ रोलर), तनाभेदक (स्टेम बोरर), फलभेदक (फ्रूट बोरर), फलीबेदक (पोड बोरर) जैसे कीटों के प्रति प्रभावी होता है ।

नीमास्त्रा

नीमास्त्रा टिड्डियों एवं मीली बग्स (कीटाणु) को मारने में असरदार होता है। नीमास्त्रा के मुख्य घटक हैं : 100 लीटर पानी, 5 लीटर देसी गाय का गोमूत्र, 5 लीटर देसी गाय का गोबर, 5 किलो कुचले नीम पत्ते।गोमूत्र को 100 लीटर पानी में मिलाएं।इस तरल मिश्रण में 5 किलो गाय का गोबर एवं कुचले नीम पत्ते और उसकी गूदा मिलाएं । इस घोल को 24 घंटे तक सड़ने दें । एक डंडे से एक दिन में दो बार इस घोल को घुमाएं । एक कपड़े से इस मिश्रण को छानें । इस मिश्रण की 2 लीटर नीमास्त्रा 100 लीटर पानी में मिलाएं और उसका फसलों पर छिड़काव करें ।

ब्रह्मास्त्रा

10 लीटर गोमूत्र, 3 किलो नीम पत्ते, नीम पत्तों की गुदा का 3 लीटर घोल, सीताफल की 2 किलो गूदा, पपीते के पत्तों की 2 किलो गूदा, अनार के पत्तों की 2 किलो गूदा, अमरूद के पत्तों की 2 किलो गूदा, लेन्टाना कामिल्ला (राई मुनिया) की 2 किलो गूदा और सफेद धतूरा के पत्तों की 2 किलो गूदा । गोमूत्र और नीम के पत्तों की गूदा एक साथ मिलाए । इसमें सीताफल, पपीता, अनार, अमरूद, लेन्टाना कामिल्ला (राई मुनिया) एवं सफेद धतूरा के पत्तों की गूदा मिलाएं और उसे 5 मिनट तक उबलने दें। इसे एक कपड़े में

छानें और इस घोल को 24 घंटे तक सड़ने दें। ब्रह्मास्त्राघोल (एक भाग ब्रह्मास्त्रा का घोल 50 भाग पानी में) का चूसक टिड्डियों, फली छेदक और फल छेदक कीटों पर नियंत्रण के लिए इस्तेमाल करें।

शून्य लागत कृषि प्रणाली के मुख्य घटक

- केवल स्थानीय व्यक्तियों द्वारा सस्ती उपयोगी वस्तुएं काम में ली जाती है। जिसका खर्चा शून्य होता है क्योंकि गांव में उपलब्ध वस्तुओं का प्रयोग करके मचान, बिजुला, झटका मषीन, कांटेदार बा आदि को उपयोग में लिया जाता है।
- भारतीय गाय का गोबर और मूत्र चमत्कारी माना जाता है, लेकिन किसी भी देसी गाय का गोबर और मूत्र भी अच्छा रहता है।
- गोबर और मूत्र का अधिकतम उपयोग करने के लिए, यह सुनिश्चित करें कि गोबर जितना संभव हो उतना ताजा हो और मूत्र उतना ही जीर्ण।
- मूत्र, गुड़ और द्विपत्रियों के आटे को योजक के रूप में इस्तेमाल किया जा सकता है।
- खेत के चारों ओर वृक्ष लगाने के लिए खेजड़ी, देषी बबूल, कूमट, लहसोरा, नीम, करोंदा, पारकिन सोनिया, अगेव, पीलू, आदि वृक्षों को मेड़ों पर लगाकर फसलों व फल वृक्षों को लू और शीत लहर से बचा सकते हैं।
- स्थानीय स्तर पर उपलब्ध सामान को सही समय पर उपयोग किया जाता है। जो फसल सुरक्षा के लिए काम आते हैं।

फसलों को जंगली जानवरों और पक्षियों से सुरक्षा

फसल सुरक्षा के अभाव में किसानों की लगभग 15-20 प्रतिशत फसल खराब हो जाती है, तथा यह नुकसान और भी बढ़ सकता है। समय पर सही तरीके से फसल सुरक्षा न करने पर किसान की आय बढ़ाने के बजाय घटने लगती है। हमारे देश में फसल सुरक्षा के लिए प्राचीन समय से परंपरागत विधियों को अपनाकर किसान फसलों की सुरक्षा करते हैं जिसमें शून्य खर्चा आता है। आज के आधुनिक युग में फसलों की सुरक्षा के लिए कृत्रिम तकनीकों का प्रयोग किया जाता है जो मंहगी होने के साथ-साथ पर्यावरण के लिए घातक होती है। जैसे रासायनिक दवाओं का प्रयोग, एल.ई.डी लाईट, पटाखे, बंदूक, बिजली के तार, काटेंदार तार द्वारा फेंसिंग, ट्रैक्टर से आवाज करना, डीजल इंजन द्वारा आवाज करा कर जंगली जानवरों और पक्षियों को खड़ी फसल से भगाना आदि। इसी प्रकार फसलों में कीड़ों व रोग के लिए रासायनिक दवाओं का प्रयोग करने से भूमि की उर्वराशक्ति कम हुई है और इसके साथ ही फसल की गुणवत्ता भी प्रभावित हुई है और मानव स्वास्थ्य पर भी गलत प्रभाव पड़ा है। इन सब तरीकों में वातावरण को प्रभावित करने

के साथ लाभकारी जानवर और पक्षियों का भी विनाश हुआ है जिससे प्रकृति को हानि पंहुची है। इससे खेती की लागत भी ज्यादा आती है और किसान को हानि होती है । प्राचीन समय में इस समस्या को दूर करने के लिए किसान परंपरागत वस्तुओं का उपयोग करके जंगली जानवरों और पक्षियों से फसलों का बचाव करते थे, जो लाभकारी और शून्य लागत पर तैयार की जाती थी जिससे किसानों की आय भी बढ़ते वातावरण भी शून्य रहता तथा पर्यावरण भी प्रभावित नहीं होता था । प्राचीनकाल में फसलों और फलों को जानवरों के प्रकोप से बचाने के लिए किसान कम लागत वाले प्रभावी तरीके अपनाने से फसल सुरक्षा के लिए लाभकारी सिद्ध हुए हैं । किसान खेती की लागत को कम करने के लिए आज भी परंपरागत तकनीकों को अपनाकर फसलों को जंगली जानवरों से बचाते हैं । परंपरागत तकनीकों को निम्न प्रकार किसान उपयोग में लेते हैं ।

बिजूका या बिजकना

बिजूका द्वारा जंगली जानवरों और पक्षियों को भगाने का यह एक परंपरागत लोकप्रिय तरीका है जो प्राचीन समय से ही प्रचलित है तथा फसल सुरक्षा के लिए कारगर भी माना जाता है । बिजूका को कृषक अपने घर पर बेकार फटे-पुराने कपड़ों से तैयार करते हैं जिसमें अलग-अलग चेहरा बनाया जाता है और सिर बनाने के लिए मिट्टी की मटकी का उपयोग करते हैं। इसे फसल में इस प्रकार लगाते हैं कि जानवरों व पक्षियों को खड़ा हुआ किसान दिखे तथा इसके गले और हाथों में बजने वाली घंटी या खाली बोतल, लटका देते हैं जो हवा के वेग से बजती रहती है । जिससे जंगली जानवर और पक्षी दूर भाग जाते हैं तथा फसल को नुकसान नहीं होता है । जंगली जानवर जैसे सुअर, नीलगाय, आवारा पशु, हिरण, चिंकारा आदि जंगली जानवरों को फसल से भगाने में 85 प्रतिशत तक लाभकारी होता है । बिजूका खेत के मध्य में लगाते है तथा जहां से जंगली जानवरों की खेत में आने की सम्भावना हो वहां पर किसान बिजूका को लगाते हैं जिससे फसलों को बचाया जा सके और यह उपाय भी किसान की आय वृद्धि करने में महत्वपूर्ण होता है।

बोल्टबोटल मॉडल द्वारा फसल सुरक्षा

कृषकों की आज फसल उत्पादन में सबसे बड़ी समस्या जंगली जानवरों और आवारा पषुओं की होती है। आजकल किसान पैदावार का अधिक खर्च फसल सुरक्षा पर करता है क्योंकि फसलों को ज्यादा हानि नीलगाय, सुअर, हिरण और आवारा पषु से होता है जिसका मुख्य कारण जंगलों की कटाई व वनों का सिकुड़ता आकार है। अब जंगली

जानवर जंगल से चारे और पानी की तलाश में खड़ी फसल को नुकसान पहुंचाते हैं। इनसे बचने के लिए किसान अपने खेत के मेड़ोंपर खड़े वृक्षों की शाखाओं पर एक रस्सी की सहायता से कांच की बोतल के साथ एक नट बोल्ट और एक प्लास्टिक बोर्ड, या हार्ड गत्ता बोतल के सहारे पेड़ की शाखा से लटका देते हैं। एक हेक्टेयर में लगभग 5 बोल्टबोटल मॉडल लगा देते हैं। यह एक बहुत प्रभावी तकनीक है जो जंगली जानरों के साथ-साथ पक्षियों का भगाने में लाभकरी विधि है। जब हवा चलती है तो नट-बोल्ट बोतल से आकर टकराकर आवाज करता है व ध्वनि निकलती है जिससे आस-पास जानवर और पंक्षी दूर भाग जाते हैं यह ध्वनि रात में एक से दो किलोमीटर तक ध्वनि सुनाई देती है और फसल को बचाया जाता है। इसे बनाने में शून्य लागत आती है तथा इसका उपयोग बहुत लाभकारी होता है।

प्लास्टिक पट्टियां या चमकीला कपड़ा खेत की मेड़ों पर लगाना

किसान इस तकनीक को भी बहुत अपनाते हैं जिससे जंगली जानवर दूर भाग जाते हैं। प्लास्टिक पट्टी या कपड़ें की पट्टी हवा से हिलती रहती है जो जानवरों की आंखों में रिफलेक्टस और कम्पन से ध्वनि करती है जिससे नीलगाय व जंगली सुअर दूर भाग जाते हैं। इसमें प्रति 100 मीटर पर लगाने से 150 रूपये तक का खर्च आता है। यह विधि बड़े आकार के खेतों के लिए लाभकारी है। इसमें बाजार से प्लास्टिक पट्टी या चमकीले कपड़े की पट्टी फसल के चारों ओर मेड़ों पर लकड़ी के खंभो से बांध देते हैं जिससे फसल को सुरक्षा मिलती है।

मचान द्वारा फसल सुरक्षा

जहां पर जंगली जानवर और पक्षियों की अधिक संख्या हो व पहाड़ी क्षेत्रों में किसान फसलों, सब्जियों, फल वृक्षों को बचाने के लिए खेत में एक लकड़ी के डंडों व घास-फूस से 10 से 15 फिट ऊंचाई वाला मचान बनाते हैं जिससे जानवर और पक्षी इसे देख कर दूर भाग जाते हैं। मचान दो प्रकार के होते हैं। एक जिसमें किसान एक चारपाई ऊपर खंभों से बांधकर बनाते हैं जिसमें एक आदमी रातभर रहकर फसलों की सुरक्षा करता है तथा इसमें वर्षा का पानी और हवा का प्रवेश नहीं होता, जो किसान की सुरक्षा के लिए उपयोगी होता है। दूसरा छोटा मचान होता है जिसे घास-फूस द्वारा बनाया जाता है इसमें बैठने की जगह नहीं होती तथा इसमें बजने वाले यंत्र जैसे लोहे का पीपा, प्लास्टिक पीपी भी काम में लिया जाता है जिससे हवा द्वारा आवाज आती रहती है । और फसलों को जानवरों से सुरक्षा मिलती रहती है ।

Application of nanotechnology in insect pest management

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Introduction

Nanotechnology is a new and innovative science that attracts researchers and scientists from various fields like agriculture, pesticides, pharmaceuticals, electronics etc. Nanotechnology can make available green and eco-friendly alternatives for insect pest management without damage the nature. The word "Nanotechnology" derived by Norio Taniguchi in 1974. The term 'nanotechnology' is based on the prefix 'nano' which is from the Greek word meaning 'dwarf'. More precisely, the word 'nano' means 10^{-9} or one billionth part of a meter. Nanotechnology used in insect pest management predominantly through Nanopesticide formulations, Nanobiosensors for pesticide detection in insect system and Nanoparticle-mediated gene transfer.

Nanopesticide formulation

The 90% of the applied pesticides are lost to the air during application and affecting both the environment and farmers cost. To overcome this nanoformulations are developed for increase in pesticide efficiency. The plans of nanoformulations are generally common to other pesticide formulations and consist of:

a. Increasing the obvious solubility of poorly soluble active ingredient.
b. Releasing the active ingredient in a slow/targeted manner or protecting manner the active ingredient against premature degradation.

Different nanoformulations of nanopesticides are:

Nanoemulsion

Nanoemulsions are prepared to increase the solubility, wettability and spreading capacity of pesticides. They consist of lipid or polymeric particles, size ranges from 20-200 nm and have better pesticide delivery system and prevent the formation of precipitation. Eg: Nanoemulsion of Citronella oil

Nanosuspension

Nanosuspensions are submicron colloidal dispersions of pure active compounds range from 50–500 nm. These are produced by homogenization or milling - mechanical forces and solvent diffusion methods. Development of effectiveness due to higher surface area and higher solubility. Eg: Novaluron nanosuspension.

Nanoencapsulation

Nanoencapsulation of pesticides are used to minimize the doses and get maximum effect with more target-oriented action of the pesticides. Nanoencapsulation also reduces the contact of active ingredients with agricultural workers, Environmental safe - reducing run-off rates. Eg: Lambda Cyhalothrin

Nanoparticles

Nanoparticles are useful because they provide new insecticides and insect

repellent. Nanoparticles can also hold DNA and other desired chemicals into plant tissues for management of host plants against various insect pests. Nanoparticles associated with pesticides increased their activity to many folds by providing more weight capacity and controlled release patterns. Nano-silica particles, absorbs the lipids of insect cuticle and causing insect death by physical ways.

Eg: Porous hollow silica nanoparticles of avermectin.

Nanocapsules

Nanocapsules have shown slow release and slow degradation properties of active component for controlling plant diseases and insect-pests.

Eg: Temephos and imidacloprid containing PEG (poly ethylene glycol) encapsulated nanopesticides are more active against larva of *Culex quinquefasciatus* (Southern house mosquito). PEG nanoparticles with essential oil extracted with *Citrus reticulata* and Geranium are effective against *Blatella germanica.*

Nanogels

Nanogels have been prepared for long term residual activity and favourable safety profiles. Eg: Nano-gelled pheromone formulation for efficient management of Fruit flies (*Bactrocera dorsalis*).

Nanobiosensors for pesticide detection

The widespread use of various pesticides and their mixtures in the agricultural fields causes the multi residue retention problem in the environment. Bio sensors are used as analytical tool for mobility s

Nanoparticle-mediated gene transfer

This new technology is useful for the development of new insect resistant varieties. Therefore, it can also be concluded that nanotechnology can provide green and eco-friendly alternatives for insect pest management without harming the nature.

Future line of work in insect science

1. Development of devices to understand the complete physiology and behaviour of insects.
2. Development of target specific nanopesticides.
3. Tools of nanotechnology – to address urgent issues of environmental protection & pollution.

Conclusion

The nanotechnology has great potential in various areas of science. In near future the pest control to be done by the application of nanotechnology that is an ecofriendly way and is to be need of the research of the day Nanopesticide-based formulations have a potential and bright future for the development of more effective and safer pesticide/biopesticides.

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Natural variation as a basis for tree improvement; emphasis on wood properties

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Introduction

Trees and forests constitute one of the most vital natural resources and contribute substantially to the socio-cultural and economic development of a country by providing goods and services to the people. In recent decades, wood has become one of the important raw materials for forest-based industries such as sawmills, composite and plywood, pulp and paper, and other industries.

With the rapid increase in raw material requirements for wood-based industries, a considerable amount of timber was extracted from the natural forest unscientifically (Whitmore, 1997). This overexploitation of timber has caused irreversible damage to the natural forest. National Forest Policy, 1988, brought in a policy shift towards using forests for conservation, which included preservation, maintenance, sustainable utilization, restoration, and enhancement of forest cover. Presently, the productivity of the Indian forest is at 1.36 m^3 ha^{-1} $year^{-1}$ (FSI, 2019), and the per capita forest of India is 0.064 ha. The low productivity of natural forests coupled with an increasing area under conservation network has eventually led to the failure to meet the demand for industrial wood. This scenario caused an enhanced focus on plantations and trees on private land to fulfill different wood-based purposes such as timber, fuelwood, food, etc.

The evaluation of variation in phenotypic and wood traits is necessary to delineate better provenances and conceptualize advanced breeding strategies (Yang, 2009). For initiation of any breeding program knowing the variation or variability is essential. Variability studies of wood properties are most important in selecting wood for good quality pulp and paper production (Zobel, 1981). When the exception is more, there is scope for selection. Parentage as well as the environment influences variation. Considerable anatomical, physiological, morphological, and genetic variability may be exhibited by trees in an extensive range of spreading and little influence by anthropological activities for surviving under varying environmental conditions. The differences between populations in different traits are influenced by the latitude and total site factors and the ecotype of the stand (Varghese *et al*., 2000).

Variation in wood characters

The wood characteristics are the essential features in the selection of trees for the improvement program for industrial utility, which shows Intra and inter-specific

variation with change in the growing environment. Wood properties such as basic wood density, specific gravity, fibre length, fibre width, fibre lumen width, fibre wall thickness, vessel length, vessel width, vessel lumen width, vessel wall thickness, and anatomical ratios are indicators of wood quality in hardwoods (Parthiban, 2019).The study of wood parameters is often considered a helpful step in understanding the variability, which will provide ample opportunities for selecting superior genotypes and further tree improvement programs. The earlier studies on different tree species have demonstrated that wood traits across the population and radial portions show substantial variability. Hence these variations could be reliably used in further selection and tree improvement programs (Sahoo et al., 2017).

Wood physical parameters

Wood quality, strength, and durability of timber are mainly influenced by physical characteristics like density, moisture content, and specific gravity. The bark thickness is the most considered physical feature after the density of the wood. Waste material generated by the bark is a considerable loss to the industry and the farmers unless the bark has some other utility view. Site-to-sitevariations in bark thickness are commonly found in the tropical tree species in relation to the growing condition (Prasad and Sagheer, 2012; Chauhan and Kumar, 2014)

The change in wood density is mainly governed by the moisture content or rainfall of the region along with the various site factors such as altitudeand edaphic factors (Chauhan *et al.*, 2019; Saravana *et al.*, 2014). The basic wood density varies along the radial direction. Wood density increases from pith to periphery. The vessel and fibre parameters chiefly affect the density of the wood (Anoop *et al.*, 2014). Specific gravity is an essential factor that influences the strength and stiffness of the wood. As specific gravity increases, strength increases (Niklas, 1993). The radial variation in wood species may be because of changes in vessel parameters,*viz*, vessel frequency, vessel area, etc. Anoop *et al.* (2014) reported significant variation in specific gravity in the radial portion with an increasing pattern from pith to periphery due to its lesser vessel diameter and vessel area besides high vessel frequency.

Inter-clonal, Intra-clonal, and within tree variations are governed by clonal and site factors. The site factors have a significant effect on inter-clonal changes of wood parameters. Thus, the environment has more impact on wood quality than the inherited nature of clones.The interspecific variation reflects vertical niche differentiation (Osunkoya ***et al.,*** 2007). The density of the stem is lower than the density of branch wood. The density of the stem shows higher variability between the growing sites than the density of the branch (Gryc ***et al.,*** 2011).

Srilakshmi and Rao (2017) evaluated the specific gravity of two and four-year-old ***Eucalyptus tereticornis*** clones grown in two different conditions of Karnataka, ***viz.,*** irrigated (Mandya) and rainfed (Kolar). The clones raised under rainfed conditions showed higher specific gravity than in irrigated conditions. As age increased, specific gravity increased, and specific gravity increased from pith to bark.

The wood-specific gravity of different tree species associated with ***Myristica*** swamps in five swampy sites of Karnataka was investigated by Tambat ***et al.*** (2018). The study revealed that the specific gravity of the marshy species and co-occurring non-swampy species varied across the sites. They concluded that the non-swampy species subjected to the drier environment tend to increase their wood-specific gravity as an adaptive strategy.

Wood fibre and vessel parameter

Wood formation is chiefly controlled by genetic factors and environmental factors in which trees grow (Savidge, 2003). The anatomical features mainly affect the quality and strength of timber; it also reveals timber's suitability for end-use. Most wood fibre and vessel parameters vary with rainfall, temperature, edaphic factors, and interaction between the genotype and environment.

The wood anatomical structures were highly influenced by the sites' longitude, latitude, and precipitation. Annual rainfall in the region affects the vessel percentage and diameter, fibre length, and lumen of fibre (Moya and Fo**,** 2008; Ashwath et al., 2021). The 7-year-old 14 ***Eucalyptus globulus*** clones showed variations in vessel frequency, area, coverage, fibre wall thickness, and lumen diameter. From pith to bark vessel and fibre parameters increased except for fibre wall thickness (Ramirez ***et al.,*** 2009).

Pande (2011) studied the intra and inter-clonal variation in wood properties like density, fibre, and vessel parameters of 10 different clones of ***Populusdeltoides*** in Rudrapur. All clones showed a significant variation for diameter at breast height. Wood traits showed considerable variation in inter and intra-clonal ramets. Fibre length and specific gravity were significantly higher in female, while male clones showed high significance in wall thickness and vessel parameters. In all ramets, fibre and specific gravity were significant in increasing trends from pith to periphery. Wood structure variation of ***Acacia senegal*** grown under different rainfall zones of Western Sudan was investigated by Elamin ***et al.*** (2015). Wood characters were examined to study the effect of rainfall on wood traits in different rainfall zones (low, medium, and high). Fibre, vessel, and parenchyma diameters have not shown any difference under varying rainfall zones in sandy soil. The study revealed that the species was well adapted to its environment without any changes in the anatomical structure.

Vessel morphology variation of Anjily (***Artocarpushirsutus)*** wood grown in three different agro-climatic zones of Thrissur, Kerala, was studied by Sahoo ***et al.*** (2017). The vessel length showed a significant difference between girth classes across three agro-climatic zones. Vessel frequency, vessel area, and vessel diameter did not significantly differ across the three agro-climatic zones.

The variation of wood property in ***Meliadubia*** with an increase in age in Gujarat was evaluated by Sinha ***et al.*** (2019). Wood properties such as basic density, fibre dimensions, cellulose, and lignin content of ***M. dubia*** of five age gradations were tested to determine the harvesting age for pulp and paper production. All the traits considered differed with tree age. Fibre length and cell wall thickness increased while fibre width and lumen width slightly decreased

with an increase in age. Studied wood properties showed significant variation from one to fifth-year.The study showed that the species is suitable for making pulp and paper at the age of 4 and 5, compared to other ages with higher fibre and derived dimensions.

Conclusions

Understanding the variation of all tree species provides information about adapting to changing environmental conditions. Understanding geographic variation within a species is essential for developing effective tree improvement programs. It gives an idea about the species range, the amount of diversity encountered within the species in its natural range, and its variation pattern. In anatomical properties, the variation is related to age and locality factors. Further selection will be made to identify superior genotypes for mass multiplication and future breeding programs based on the variation studied.

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