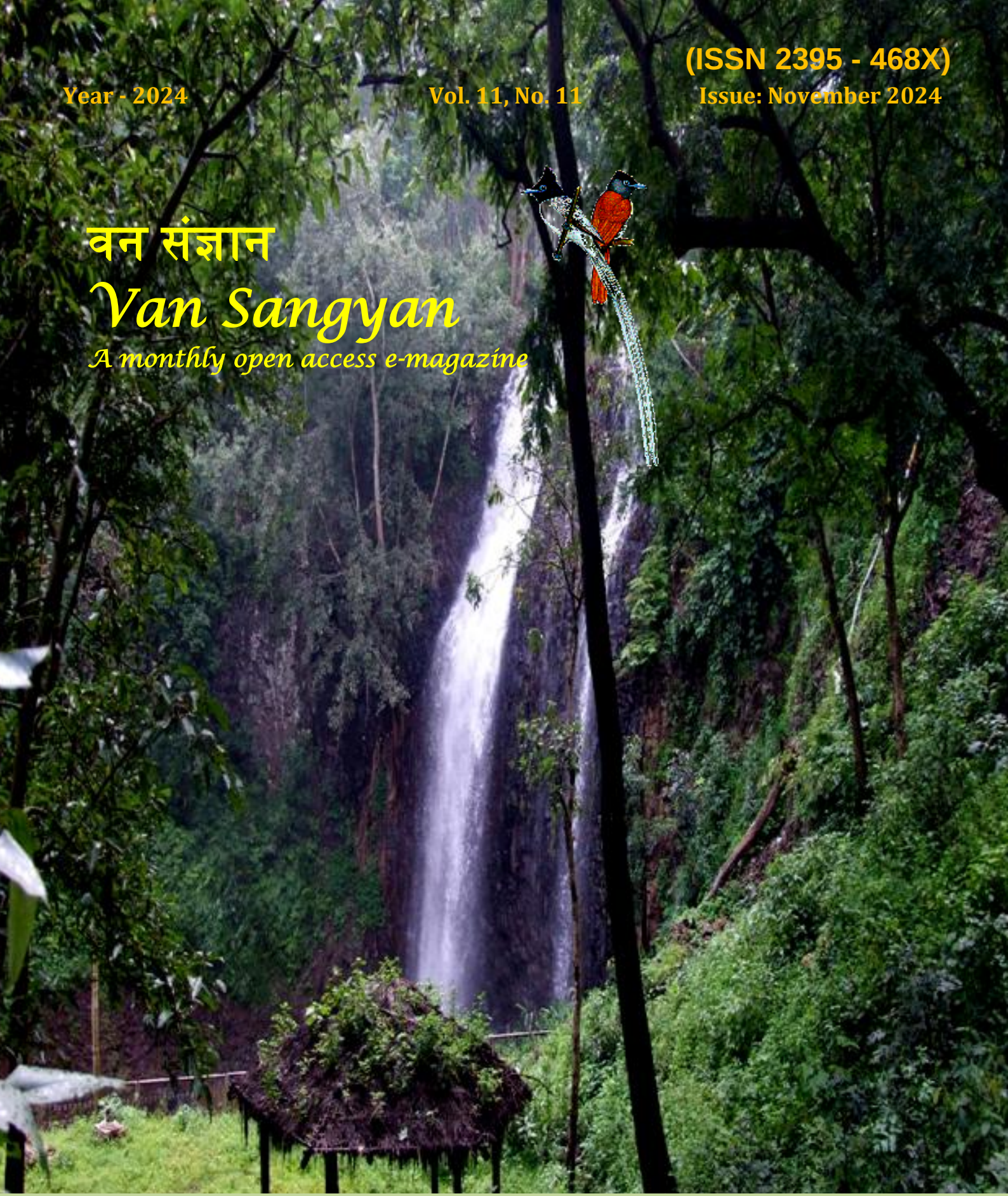
(ISSN 2395 - 468X)
Year - 2024 Vol. 11, No. 11 Issue: November 2024



वन संज्ञान
Van Sangyan
A monthly open access e-magazine

Indexed in:
COSMOS Foundation (Germany)
International Inst. of Org. Res. (Australia)
IIJIF

ICFRE-Tropical Forest Research Institute
(Indian Council of Forestry Research and Education)
Ministry of Environment, Forests and Climate Change (MoEFCC)
PO RFRC, Mandla Road, Jabalpur – 482021, India

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

© Published by ICFRE-Tropical Forest Research Institute, Jabalpur, MP, India

From the Editor's desk

Agroforestry is the integration of crops, trees, and livestock on the single plot of land, sustainable Agroforestry, a sustainable land-use system that integrates trees with agricultural crops or livestock, offers a multifaceted approach to natural resource management. By strategically incorporating trees into farming landscapes, agroforestry systems provide a range of environmental, economic, and social benefits. Trees act as natural windbreaks, reducing soil erosion and protecting crops from harsh weather conditions. Their deep roots improve soil structure and fertility by enhancing water infiltration and nutrient cycling. Moreover, trees provide shade and shelter for livestock, improving animal welfare and productivity. Beyond these direct benefits, agroforestry plays a crucial role in mitigating climate change. Trees absorb carbon dioxide from the atmosphere, sequestering carbon and reducing greenhouse gas emissions. They also help regulate local climates by moderating temperatures and increasing humidity. By enhancing biodiversity, agroforestry supports healthy ecosystems and promotes the conservation of vital plant and animal species. Furthermore, agroforestry can provide diverse income streams for farmers, such as timber production, fruit and nut harvesting, and the sale of non-timber forest products, thereby improving rural livelihoods and enhancing food security.

In line with the above this issue of Van Sangyan contains an article on Natural resource management through agroforestry. There are also useful articles viz. Combating wildlife crimes: Protecting biodiversity for future generations, The great green wall: A vision for sustainable environment, Essential oils: Extraction methods, significance and various applications, विलुप्ति की कगार पर सोन चिड़िया, Synergies in fruit-forage intercropped systems, Hill glory: The antifeedant property of plant extract against major insect pests of telangana, Ficus a Religious Genus: Versatility in Growth Forms and Wood Anatomy, Wood production in India and बंजर भूमि में ऑवले की बागवानी.

Looking forward to meet you all through forthcoming issues

Dr. Naseer Mohammad

Chief Editor

Disclaimer – Van Sangyan

Statement of Responsibility

Neither *Van Sangyan* (VS) nor its editors, publishers, owners or anyone else involved in creating, producing or delivering *Van Sangyan* (VS) or the materials contained therein, assumes any liability or responsibility for the accuracy, completeness, or usefulness of any information provided in *Van Sangyan* (VS), nor shall they be liable for any direct, indirect, incidental, special, consequential or punitive damages arising out of the use of *Van Sangyan* (VS) or its contents. While the advice and information in this e-magazine are believed to be true and accurate on the date of its publication, neither the editors, publisher, owners nor the authors can accept any legal responsibility for any errors or omissions that may be made or for the results obtained from the use of such material. The editors, publisher or owners, make no warranty, express or implied, with respect to the material contained herein.

Opinions, discussions, views and recommendations are solely those of the authors and not of *Van Sangyan* (VS) or its publishers. *Van Sangyan* and its editors, publishers or owners make no representations or warranties with respect to the information offered or provided within or through the *Van Sangyan. Van Sangyan* and its publishers will not be liable for any direct, indirect, consequential, special, exemplary, or other damages arising there from.

Van Sangyan (VS) reserves the right, at its sole discretion, to change the terms and conditions from time to time and your access of *Van Sangyan* (VS) or its website will be deemed to be your acceptance of an agreement to any changed terms and conditions.

Contents **Page**

© Published by ICFRE-Tropical Forest Research Institute, Jabalpur, MP, India

Natural resource management through agroforestry

Manish Kumar Mankur, Lalji Singh, Pratap Toppo

Department of Forestry
College of Agriculture, IGKV, Raipur, Chhattisgarh
E-Mail: manishmankur7@gmail.com

Introduction

There are interactions between the many components in agroforestry systems on both an economic and ecological level. Farmers can plant and maintain forests for whatever combination of advantages they might offer. They may prioritise a single result, like as biodiversity or timber output, or they may aim to balance a variety of advantages in a multipurpose planting. Their priorities may change over time and vary across the farm. A forest that was first planted or managed to protect the species or the land may later be exploited for timber or appreciated for its aesthetic appeal (amenity value). Farms with forests either increase or merely replace their agricultural output. They increase economic, social, and environmental capital and are sustainable. Agroforestry generates significant profits for the farmers.

Agroforestry

Agroforestry constructs integrated systems that bridge the gap between agriculture and forestry, fulfilling environmental and socioeconomic goals (Akoto *et al.* 2020). It increases agricultural system resilience, mitigates climate change effects (Mbow*et al.* 2014, Feliciano *et al.* 2018), prevents environmental degradation, boosts agricultural productivity, enhances carbon

Figure 1: Agroforestry system (Teak plantation on field bund)

sequestration, improves water quality, and supports healthy soil and ecosystems while providing stable incomes and other human welfare benefits (Brown *et al.* 2018). In summary, it creates a more integrated, diverse, productive, profitable, healthy and sustainable land use system compared to agriculture alone (Sharma *et al.* 2017). Furthermore, agroforestry can restore ecosystems by reclaiming degraded and wastelands, which is crucial for increasing forest area as recommended by the National Forest Policy (1988) to reach 33% from the current 24.39% (Patra 2022).

Area under agroforestry in India

The overall area under agroforestry for all 15 Agro-Climatic Zones (ACZs) of India was 28.427 M ha, which is about 8.65% of the total geographical area of the country (328.747 M ha). Among the 15 ACZs, seven (1, 3, 5, 7, 11, 12, and 13) had more than 10% of their area under agroforestry. ACZs 1, 5, 7, 10, 11, and 13 each had more than 2 M ha under agroforestry (Table 1). The Western Himalayan Region and the Eastern Plateau and Hilly Region recorded more than 4 M ha under agroforestry. Across the ACZs, the Upper Gangetic Plain Region had the greatest area (15.55%) under agroforestry, while the Western Dry Region (2.45%) and the Island Region (2.48%) had the lowest. According to the Global Forest Resources Assessment 2020 of FAO, Asia has the largest area under agroforestry, which is about 31.2 M ha. Comparing the agroforestry area in Asia as reported by FAO with the agroforestry area reported in this study, it can be presumed that more than 75% of the agroforestry area is in India. However, this is not a fact and should not be misinterpreted. Globally, only 71 countries report areas under agroforestry to FAO for the biannual Global Forest Resources Assessment, but no actual estimation is reported.

Table 1. Extent of agroforestry area in 15 agroclimatic zones (ACZs) of India

ACZ no.	ACZ	Geographical area (M ha)	Agroforestry area (M ha)	Agroforestry area (%)
1	Northern Himalayan Region	32.968	4.096	12.42
2	Eastern Himalayan Region	28.422	1.088	3.83
3	Lower Gangetic Plains Region	6.238	0.802	12.86
4	Middle Gangetic Plains Region	16.526	1.304	7.89
5	Upper Gangetic Plains Region	14.367	2.234	15.55
6	Trans Gangetic Plains Region	11.750	1.143	9.73
7	Eastern Plateau and Hill Region	40.525	4.292	10.59
8	Central Plateau and	37.435	1.924	5.14

	Hill Region			
9	Western Plateau and Hill Region	32.539	1.556	4.78
10	Southern Plateau and Hill Region	39.294	2.976	7.57
11	East Coast Plains and Hill Region	19.948	2.36	11.83
12	West Coast Plains and Hill Region	11.69	1.632	13.96
13	Gujarat Plains and Hill Region	18.673	2.57	13.76
14	Western Dry Region	17.587	0.431	2.45
15	The Island Region	0.785	0.019	2.42
Total/ percentage		328.747	28.427	8.65

Natural resource management through agroforestry techniques

Alley Cropping

Alley cropping is an agroforestry technique in which crops are planted between rows of controlled and spaced-apart trees and/or shrubs in cropland. This practice has attracted a lot of study attention and is seen as having potential for resolving issues with falling soil fertility, particularly in instances where farmers cannot afford to use inorganic fertilizers in the necessary amounts. The possibility of maintaining or enhancing soil fertility has been the focus of research. Other significant advantages include an enhanced microclimate, feed, and small-size wood. However, given the effort involved in managing hedgerows, labor has occasionally been seen as a limitation. Additionally, competition for moisture has been identified as a challenge for this technique, becoming more severe as conditions get drier.

Silvi-Patoral

Scattered trees on pastures, plantation crops mixed with pastures, live fences, fodder banks, windbreaks and shelterbelts, and hedgerow intercropping on pastures are all examples of silvi-pastoral practices. In the sylvi-pastoral system, trees provide protein-rich feed when grass is scarce or inedible. Reduced grazing pressure results in better vegetation coverage, which lessens erosion during critical periods.

Hortisilviculture

Horticulture trees and timber trees have been purposefully combined on a single plot of land to simultaneously gather fruits and timber. The windbreak provided by the timber trees planted on the orchard bunds shields the fruit from strong winds.

Hortisilvopastoral

This approach involves growing a variety of enhanced leguminous grasses in orchards to feed cattle. Trees are planted on the orchards' bunds, producing a variety of goods and serving as windbreaks that shield horticulture plants from strong winds.

Agroforestry in watershed management

The core of agroforestry in watershed management is applying appropriate land use planning to the entire catchment, focusing on water management and erosion control. Various agroforestry possibilities must be considered while allocating land according to the concept of land use planning.

Shillong, an Indian hill region in the northeast, provides a good example of land use planning. In a different land-use system, slopes are divided into three sections: the upper slope is left as a natural forest, the middle slope is used for pasture with fruit trees on individual semi-circular terraces (a horti-pastoral system), and the lower slope is terraced for arable land use.

In addition to assisting in the reduction of soil and water loss, the growth of hedgerows as vegetative measures along the contour or on a grade also serves as a source of off-season fodder. The soil particles that get deposited along hedgerows are trapped by raised hedges as a vegetative barrier, preventing the loss of finer soil particles and nutrients. These hedges have been shown to be quite effective for small fields.

According to a study from the Doon Valley, tree rows serve as barriers to surface runoff. Narain et al. (1988) found that planting *Leucaenaleucocephala* or *Eucalyptus tereticornis* in paired rows with a spacing of 4.5 meters by 1.5 meters reduces soil loss by more than 70%. When both trees were managed as a single tree, Eucalyptus tree rows performed better than Leucaena. Average decreases in runoff and soil loss over the fallow plot under grass cover were 73% and 94%, respectively. Compared to Leucaena tree-row barriers, Eucalyptus tree row barriers in the grass plot significantly limit runoff and soil loss. Sole plantations of Leucaena and Eucalyptus showed negligible runoff and soil loss, which were only 5.7% and 1.4% of the fallow plot. Although trees had an adverse effect on crop yields, the tree products compensated for the loss, making the system economically viable (Narain*et al.*, 1998).

Soil fertility

Leguminous trees in agroforestry, in particular, enhance the soil by biologically fixing nitrogen, adding organic matter, and recycling nutrients. According to reports, some trees, including the Leucaena, Acacia, and Alnus species, may fix up to 400–500 kg, 270 kg, and 100–300 kg of nitrogen per hectare per year, respectively. The crops growing in association with the fixed nitrogen may benefit symbiotically from it, aiding in enhancing soil fertility.

Biological nitrogen fixing occurs through both symbiotic and non-symbiotic processes. Symbiotic fixation results from the interaction of plant roots with nitrogen-fixing bacteria. Many legumes form an association with the bacteria Rhizobium, while the symbionts of a few non-leguminous species belong to a genus of actinomycetes, Frankia. Non-symbiotic fixation is effected by free-living soil organisms and can be a significant factor in natural ecosystems, which have relatively modest nitrogen requirements from outside systems (Nair, 1993).

Carbon stock in agroforestry system in India

In many agroforestry systems, carbon is stored in standing biomass above ground as well as below ground through the improvement of soil carbon and root biomass. The sequestration potential for

carbon in agroforestry systems and other alternative land use systems in India was first estimated to be between 68 to 228 Mg C/ha, or 25 tC/ha across 96 Mha of land, in some of the earliest studies by Dixon et al. (1994). However, this value varies by location according to biomass production. Research by Jha et al. (2001) found that agroforestry can store 26% more carbon than farming in the Haryana plains, or about 83.6 tC/ha, up to a depth of 30 cm in the soil. However, the scale of the operation and the final use of the wood would determine the amount of carbon sequestration from forestry activities.

Conclusion

By using agroforestry-based techniques, soil and water conservation could be made more efficient and long-lasting. Reduced erosion and runoff losses have been achieved through an intercropping system of agroforestry that includes hedgerow intercropping (alley cropping), shelter belts and windbreaks, boundary planting of trees and woody hedges, living fences, and the corridor system of land use. The use of vegetative barriers has been crucial in lowering runoff and soil erosion. For the preservation of soil and water resources, crop residues must be kept on the soil's surface. Other potential methods of conserving soil and water resources include planting trees on erosion control structures, as windbreaks, and as shelterbelts in silvi-pastoral and horti-pastoral systems.

References

Ahmed, A. A., & Hazarika, D. N. (2007). Agroforestry systems and practices prevailing in Assam. *Agroforestry: systems and practices*, 347-355.

Akoto, D. S., Partey, S. T., Denich, M., Kwaku, M., Borgemeister, C., & Schmitt, C. B. (2020). Towards bamboo agroforestry development in Ghana: evaluation of crop performance, soil properties and economic benefit. *Agroforestry Systems*, *94*, 1759-1780.

Brown, S. E., Miller, D. C., Ordonez, P. J., & Baylis, K. (2018). Evidence for the impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in high-income countries: a systematic map protocol. *Environmental evidence*, *7*, 1-16.

Dhyani, S. K., & Handa, A. K. (2013). Area under agroforestry in India: An assessment for present status and future perspective. *Indian Journal of Agroforestry*, *15*(1), 1-11.

Dixon, R. K., Solomon, A. M., Brown, S., Houghton, R. A., Trexier, M. C. & Wisniewski, J. (1994). Carbon pools and flux of global forest ecosystems. *Science*, *263*(5144), 185-190.

FAO, Global Forest Resources Assessment 2020, Food and Agriculture Organization of the United Nations, Rome, Italy, 2020.

FSI, India State Forest Report 2019, Forest Survey of India, Dehradun, 2019.

Gupta, J. P., Rao, G. G. S. N., Gupta, G. N., & Rao, B. R. (1983). Soil drying and wind erosion as affected by different types of shelterbelts planted in the desert region of Western Rajasthan, India. *Journal of arid environments*, *6*(1), 53-58.

Gupta, V. P. (2020). Role of agroforestry in soil conservation and soil health management: A review. *Journal of Pharmacognosy and Phytochemistry*, *9*(4S), 555-558.

Jha, M. N., Gupta, M. K., & Raina, A. K. (2001). Carbon sequestration: Forest soil and land use management. *Annals of Forestry*, *9*(2), 249-256.

Kataria, N., &Bassi, K. (1997). Effect of organic mulch and nitrogen on early-sown wheat (Triticumaestivum) under rainfed conditions. *Indian Journal of Agronomy*, *42*(1), 94-97.

Mbow, C., Smith, P., Skole, D., Duguma, L., & Bustamante, M. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current opinion in Environmental sustainability*, *6*, 8-14.

Nair, PK Ramachandran. An introduction to agroforestry. Springer Science & Business Media, 1993.

Narain, P., Singh, R. K., Sindhwal, N. S., &Joshie, P. (1998). Water balance and water use efficiency of different land uses in western Himalayan valley region. *Agricultural Water Management*, *37*(3), 225-240.

Pathak P.S. and Newaj Raam, 2003. Agroforestry: Potentials and Opportunities. Agrobios (India) & Indian Society of Agroforestry First published, 2003.

Patra, A.K. (2022). Introductory agroforestry. CRC Press.12

Sathaye, J. A., &Ravindranath, N. H. (1998). Climate change mitigation in the energy and forestry sectors of developing countries. *Annual Review of Energy and the Environment*, *23*(1), 387-437.

Sharma, H., Thakur, C. L., Bhardwaj, D. R., &Prabhakar, M. (2017). Growth and yield performance of maize (Zea mays) and tomato (Solanumlycopersicum) under Grewiaoptiva Drummond based agroforestry system. *Indian Journal of Ecology*, *44*(6), 771-776.

Young Anothony, 1989. Agroforestry for soil conservation, pp.276, CAB International , Wallingford, (U.K.).

Combating wildlife crimes: Protecting biodiversity for future generations

Yadavalli Baby Aparanjani and Perala Nikitha

Department of Forest Resource Management
Forest College and Research Institute
Hyderabad, Telangana.
E-mail: y.babyaparanjani@gmail.com

Introduction

India is one of the most biodiverse regions and is home to a large variety of wildlife. It is one of the 17 megadiverse countries and includes three of the world's 36 biodiversity hotspots – the Western Ghats, the Eastern Himalayas, and the Indo-Burma hotspot. About 24.6% of the total land area is covered by forests. It has various ecosystems ranging from the high-altitude Himalayas, tropical evergreen forests along the Western Ghats, desert in the north-west, coastal plains and mangroves along the peninsular region. India lies within the Indo-Malayan realm and is home to about 7.6% of mammal, 14.7% of amphibian, 6% of bird, 6.2% of reptilianand 6.2% of flowering plant species. India has an estimated 92,873 species of fauna (ZSI,2021) roughly about 7.5% of the species available worldwide and about 29,015 species of plants (BSI,2021) including 17,926 species of flowering plants. This is about 9.1% of the total plant species identified worldwide and 6,842 species are endemic to India. According to IUCN Red list data there are 622Vulnerable species, 521 Endangered species and249 Critically Endangered species in India.Habitat destruction, poaching and trafficking these wildlife crimes are the significant challenges that threaten the existence of certain fauna and flora and pushing them towards extinction. Hence combating wildlife crimes play a significant role in protecting biodiversity for future generations.

Combating wildlife crimes

Combatting wildlife crimes involves a collaborative effort among various stakeholders, including:

Law enforcement and government agencies

Police, Forest departments, wildlife authorities, Ministry of Environment, Forest and Climate Change play a central role in enforcing wildlife protection laws, formulating policies, investigating crimes, provide resources, and coordinate efforts to combat wildlife crimes.

International organizations

Organizations like INTERPOL and the United Nations Office on Drugs and Crime (UNODC),Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) collaborate with national authorities to address transnational wildlife crime networksand ensure effective regulation of international wildlife trade.

Non-Governmental Organizations (NGOs)

Several NGOs play crucial roles in combatting wildlife crimes, like Wildlife Conservation Society (WCS),World Wildlife Fund (WWF),TRAFFIC-The

Wildlife Trade Monitoring Network, International Fund for Animal Welfare (IFAW). These NGOscontribute expertise, resources, and support to combat wildlife crimes and protect endangered species globally.

Research Institutions and Universities

Wildlife Institute of India (WII), National Centre for Biological Sciences (NCBS) and Advanced Institute for Wildlife Conservation (AIWC) are few research institutions in India. Researchers and scientists from these institutes play a crucial role in generating knowledge, developing tools and technologies, informing policy decisions, and building capacity to combat wildlife crimes effectively.

Communities

Local communities living near wildlife habitats can act as watchdogs, providing valuable information and support for law enforcement efforts.

Initiatives taken by different organizations to combat wildlife crimes

Operation THUNDER 2023

In Operation Thunder 2023, which took place in June, there were 2,114 seizures of endangered animals and timber. The operation involved the coordination of intelligence sharing, investigations, and resources between INTERPOL and the WCO. The joint efforts of frontline police and customs officers led to the identification and arrest of traffickers attempting to smuggle animals or timber across borders

Operation Save Kurma

Conducted by the Wildlife Crime Control Bureau (WCCB) in India, this operation focuses on combating the illegal trade of turtles and tortoises. It aims to disrupt smuggling networks and rescue endangered turtle species from poachers.Under Operation Save Kurma, which was conducted from December 15, 2016 to January 30, 2017, approximately 16,000 live turtles/tortoises were seized and released back into the wild. Fifty-five suspects involved in the illegal trade were also arrested.

HAWK (Hostile Activity Watch Kernel)

The development of HAWK started in 2017 in the state of Kerala by a joint team of the Kerala Forest Department & Wildlife Trust of India. The system was officially launched in 2019 in Kerala and since then it has been the official system of the state forest department.The implementation of a customized version of HAWK was initiated in 2022 in Karnataka in partnership with the ICT cell of the Karnataka Forest Department and the

system is being implemented across the state.

Not all animals migrate by choice

Campaign launched by Wildlife Crime Control Bureau (WCCB) of India and UN Environment in the year 2019, aimed at airports across India. Tiger, Pangolin, Star Tortoise and Tokay Gecko featured in the campaign.

Wild for Life

The "Wild for Life" campaign is an initiative led by the United Nations Environment Programme (UNEP) started in the year 2016 to combat illegal wildlife trade and raise awareness about the importance of protecting endangered species. The campaign aims to mobilize individuals, governments, and organizations around the world to take the action to stop wildlife crime and preserve biodiversity.

Catch the Trap

The Telangana forest department launched an intensive 'Catch the Trap' drive in Dec 2023 to rid forest areas of snares and traps laid by poachers to catch wild animals and birds. The wildlife wing of the department, which said, "Killing and hunting of wild animals using snares, traps, nets, live wire, poison and explosives is a big challenge," also announced rewards for informants with a promise of keeping their identities a secret. The 'Catch The Trap' drive was implemented to prevent poaching of wild animals in the forests.

Approaches to combat wildlife crime

Monitoring of wildlife through Artificial Intelligence (AI)

AI has transformed wildlife monitoring and crime prevention, with India's IT prowess making it a crucial player in deploying AI-based systems. These technologies include GPS, microchips, drones, infrared cameras, acoustic sensors, and tools like SMART, enabling real-time tracking and swift resolution of wildlife crimes, similar to how cell phones aid in personal crime cases.

Strengthening and modernization of wildlife laboratories

Establishing modern wildlife labs in every state and enhancing forensic facility is crucial for crime investigation. Standard tests like morphometry should be supplemented with advanced genetic methods like multiplex PCR. Routine e-DNA examination is essential for monitoring elusive wildlife. Expanding wildlife health facilities and funding schemes for conservation and staff training are imperative for governments.

Amendment of existing wildlife laws

The Wildlife (Protection) Act, 1972 requires urgent amendments to include alien species and enforce penalties for their trade. The Wildlife (Protection)

Amendment Bill, 2022, introduces penalties for exotic species trade but lacks provisions for human-wildlife conflict and coastal wildlife crimes. Amendments to address these gaps are essential, possibly through changes to the Custom Act of 1962.

Monitoring of Wildlife trade

Foresters and police must closely monitor wildlife trade using advanced technology to combat illegal activities. Addressing socio-economic inequalities through community engagement is crucial. Achieving zero rhino poaching in Assam involved coordinated efforts and technological advancements with regard to monitoring of wildlife trade. Vigilance against exotic species consumption is essential, exemplified by the government's amnesty offer to improve compliance with CITES.

Conservation of wildlife and their habitats

The Union environmental ministry has launched various wildlife conservation projects, like 'Project Tiger,' showing success in increasing tiger populations. Efforts should extend to other threatened species. Recommendations to limit tourism in wildlife areas and discourage zoos within reserves aim to mitigate human-wildlife conflict. Individual actions, like planting native trees and supporting conservation organizations, are also crucial.

Successful cases

A succinct view of wildlife crimes in West Bengal and their conservation practices by Debaditya Roy, Vinod Kumar, 2023.

In the above study they have identified the Causes for wildlife crimes in West Bengal. They are mentioned below:

- Traversed rivers and their branches passing through the forests of West Bengal.
- Transnational boundary with Bangladesh.
- Human-Wildlife conflicts.
- Pollution.

Conservation practices are framed accordingly:

- Wildlife sniffer dogs- 6 young German shepherd dogs (6-9mo) seven-months training at Basic Training Centre, the Indo-Tibetan Border Police Force (BTC-ITBP) camp in Haryana.
- Government in collaboration with wildlife organizations, experts, and lovers- wildlife, grasslands, wetlands and forests, tigers as it exceeded 100, other wildlife animals like Chital and Blackbuck.
- Areas where frequent collisions occurred are identified, construction of Underpass, overpass and realignment of railway lines near the curves where ever possible.
- The government of Bengal decided to form a special squad for a forest to prevent the wildlife crime and trafficking- “Forest squad”.

Case 2

The Telangana forest department’s ‘Catch The Trap’ drive to locate and remove snares and traps laid in the forests to catch wildlife for poaching is yielding shocking results that are indicating the true extent of attempts to poach wild animals and birds in different parts of the state.

Pictures of the recoveries show a truck load of wire snares found in Gudur forest division alone weigh some 400 kg.

Conclusion

- Wildlife crimes represent a significant threat to biodiversity and ecosystems.
- Combating wildlife crimes requires collaborative efforts, legislative actions, community engagement, and technological innovations.
- Together, we can protect our planet's precious wildlife and ensure a sustainable future for generations to come.

References

Carter, N.H., López-Bao, J.V., Bruskotter, J.T., Gore, M., Chapron, G., Johnson, A., Epstein, Y., Shrestha, M., Frank, J., Ohrens, O. and Treves, A., 2017. A conceptual framework for understanding illegal killing of large carnivores. *Ambio*, *46*, pp.251-264.

Doody, J.S., Reid, J.A., Bilali, K., Diaz, J. and Mattheus, N., 2021. In the post-COVID-19 era, is the illegal wildlife trade the most serious form of trafficking? *Crime Science*, *10*, pp.1-12.

Gaubert, P., Antunes, A., Meng, H., Miao, L., Peigné, S., Justy, F., Njiokou, F., Dufour, S., Danquah, E., Alahakoon, J. and Verheyen, E., 2018. The complete phylogeny of pangolins: scaling up resources for the molecular tracing of the most trafficked mammals on earth. *Journal of Heredity*, *109*(4), pp.347-359.

Gore, M.L., Lute, M.L., Ratsimbazafy, J.H. and Rajaonson, A., 2016. Local perspectives on environmental insecurity and its influence on illegal biodiversity exploitation. *PloS One*, *11*(4), p. e0150337.

Gomez, L., Joseph, T., Heinrich, S., Wright, B. and D'Cruze, N., 2023. Illegal trade of pangolins in India with international trade links: an analysis of seizures from 1991 to 2022. European Journal of Wildlife Research, 69(4), p.85.

Naveen, A., Sahu, M.R., Maharik, S.S., Mohanty, M.K. and Padhi, K.S., 2022. Ball of death: a fatal case report on Accidental Death of a child after crude bomb explosion. *The American Journal of Forensic Medicine and Pathology*, *43*(2), pp.199-203.

Patel, N.G., Rorres, C., Joly, D.O., Brownstein, J.S., Boston, R., Levy, M.Z. and Smith, G., 2015.

Quantitative methods of identifying the key nodes in the illegal wildlife trade network. *Proceedings of the National Academy of Sciences*, *112*(26), pp.7948-7953.

Radhakrishnan, S., 2018. A note on wildlife poisoning cases from Kerala, South India. European journal of wildlife research, 64(5), p.58.

Roy, D. and Kumar, V., 2023. A succinct view of wildlife crimes in West Bengal and their conservation practices. Journal of Wildlife and Biodiversity, 7(supplementary issue), pp.14-29.

Xue-Hong, Z.H.O.U., Xiao-Tong, W.A.N., Yu-Hui, J.I.N. and Zhang, W., 2016. Concept of scientific wildlife conservation and its dissemination. *Zoological research*, *37*(5), p.270.

The great green wall: A vision for sustainable environment

Visha Jain and Shivam

Department of Forestry
Chaudhary Charan Singh Haryana Agricultural University, Hisar-125004
E-mail: vishajain3027@gmail.com

Introduction

According to Indian Union Minister for Environment, Forests, and Climate Change, Shri BhupenderYadav, the "Aravalli Green Wall Project" was newly initiated under Prime Minister Shri Narendra Modi. The 2007 implementation of Africa's "Great Green Wall" project, which stretches from Senegal in the west to Djibouti in the east, served as the model for the design.A massive initiative spanning four states aims to green a 5-kilometer buffer zone surrounding the Aravalli Hill Range. During the function, ShriYadav presented the Indian Council of Forestry Research and Education's FAQ on agro-forestry as well as the National Action Plan to Combat Desertification and Land Degradation through Forestry Interventions. The Aravallis are to be revived through a range of initiatives, including as the banning of single-use plastics, conservation efforts with regard to water, and the protection of natural resources. The Aravalli Range is a product of the Proterozoic era which is possibly the oldest geological feature on Earth. It is India's oldest range of Fold Mountains.

It will enhance the region's soil fertility, water availability, and climate resilience in addition to increasing the Aravalli's green cover and biodiversity through afforestation, reforestation, and water body restoration.

According to him, the initiative will help the surrounding community by generating revenue, creating jobs, and supplying ecological services. Rejuvenating the local streams catchment and water bodies will contribute to increased productivity, drought resistance, and overall soil moisture regime. In order to ensure that both conservation and development can be accomplished, he emphasized the significance of creating synergy between restoration, socioeconomic variables, and development activities.He re-affirmed the GOIcommitment to achieving the national objective of generating an additional 2.5 billion tonnes of carbon sink by 2030 and expressed gratitude to the Haryana Forest Department and other stakeholders for their collaboration and support in putting the project into action.

Distribution of Aravalli range for green wall project

It covers around 670 kilometers across the northwest of India, originating near Delhi, heading through southern Haryana, Rajasthan, and Ahmedabad, Gujarat. Guru Shikhar, at 1,722 meters (5,650 feet) on Mount Abu, is the highest summit. Its delicate and old water channels have been overexploited, mining, and deforestation over the past four decadeshave all contributed to its destruction.

- The Aravalli-Delhi Orogen, a Precambrian event, caused the range to rise.

- One of the world's oldest mountain ranges, it predates the emergence of the Himalayan Mountains and was created by the orogenic process of folding.
- Convergent plate boundaries move, leading to folding, forming the Fold Mountains.
- With an overall length of roughly 560 km, the mountains are split into two main ranges: the SambharSirohi Range and the Sambhar Khetri Range in Rajasthan.
- In addition, many of the endemic flora, mushrooms, spiders, frogs, toads, snakes, and other animals that are unique to the Aravalli are understudied and their population size is uncertain.

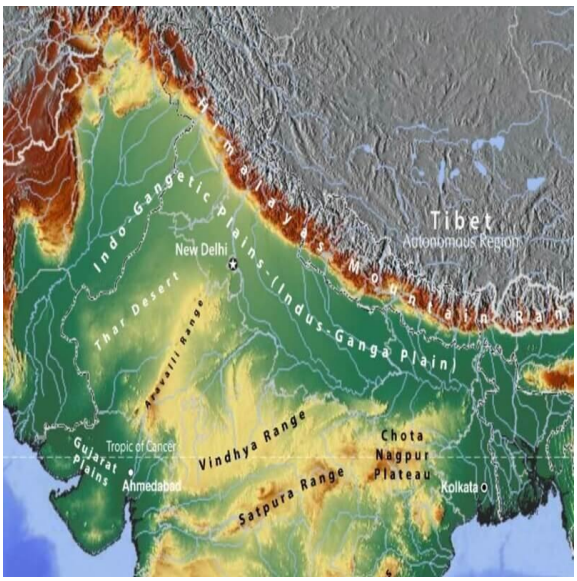


Fig.1 The range of Aravalli green wall project

The following are the goals of the Aravalli Green Wall project:

- Improving the ecological health of the Aravalli range.
- To stop the Thar Desert from spreading eastward and to lessen land degradation by building green barriers that will stop dust storms, desertification, and soil erosion.
- By planting native tree species in the Aravalli region, creating habitat for wildlife, and enhancing the quality and quantity of the water, this green wall will contribute to carbon sequestration and climate change mitigation, enhancing the biodiversity and ecosystem services of the Aravalli range.
- Involve local populations in afforestation, agroforestry, and water conservation projects that will produce revenue, jobs, food security, and social benefits in order to promote sustainable development and livelihood prospects.
- Numerous parties, including the federal and state governments, forest agencies, research facilities, civil society organizations, businesses, and local communities, will work together to carry out the project. To guarantee the project's success, sufficient financing, technical know-how, policy coordination, and public awareness will be needed.
- Participate in India's commitments under the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD), and the United Nations Framework Convention on Climate Change (UNFCCC).

- Enhancing India's standing as a global pioneer in green growth and environmental preservation.

Significance of Green wall project

Alongside the project was the unveiling of a National Action Plan to Combat Desertification and Land Degradation through Forestry Interventions. This also highlights the importance of starting the Aravalli green wall project.

- Its sensitive and traditional water channels have been overexploited, mining, and deforestation over the last forty years have all contributed to its destruction.
- It has become a serious risk that desertification will extend east of the Aravalli.
- According to a study released by the Wildlife Institute of India, anthropogenic topographical changes in Haryana have resulted in at least 12 locations where groundwater levels have been depleted and the Aravalli range has been breached.
- One of the major degraded zones to be targeted for greening is the Aravali, in keeping with India's goal of rehabilitating 26 million hectares (mha) of its land.
- An ISRO assessment from 2016 found that more over 50% of the land in Delhi, Gujarat, and Rajasthan had deteriorated.

Way forward

Northwest India's past and future will be greatly influenced by the Aravalli mountain range because of its distinctive topography, geology, forests, soils, and water sources. But the area's fragile ecology is in jeopardy due to operations like mining, clearing land for development, deforestation, and altering river courses. Protecting the Aravallis is the goal of government projects like the Great Green Wall, but their success depends on resolving problems like illicit mining. To protect the Aravallis and make sure that conservation initiatives like the Great Green Wall are successful, a comprehensive strategy that includes the end of additional exploitation for commercial or industrial uses is required.

References

https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1910745

https://moef.gov.in/wp-content/uploads/2018/03/Green-India-Mission.pdf

https://timesofindia.indiatimes.com/city/mumbai

https://www.hindustantimes.com/cities/gurugram-news/afforestation-project-green-wall-launched-to-revive-the-aravallis-101679766619488.html

Essential oils: Extraction methods, significance and various applications

Monica Avadoota[1] and Kiranmai Jaligapu[1]

[1]Department of Forest Products and Utilization
Forest College and research institute, Mulugu, Telangana
Email - monicaavadoota@gmail.com

Introduction

Essential oils (EOs), also known as ethereal or volatile oils, these are odoriferous liquids having pleasant taste. Found in over 60 families of Indian plants.An essential oil may contain up to several hundred chemical compounds. This complex mixture of compounds gives the oil its characteristic fragrance and flavor. They are aromatic oily liquids collected from various parts of the plant, such as leaves, seeds, fruits, buds, flowers, wood, herbs, barks, and roots and have wide-ranging applications in the pharmaceutical, medicinal, and perfume sectors.

The name Essential oils (EOs) refer to their combustible properties. EOs is aromatic oily liquids with low water solubility, but they are soluble in alcohols, organic solvents, lipids, and other hydrophobic substances. (They are usually liquid at room temperature). Essential oils make up only a small portion of plant material's wet weight, often 1% or less. Essential oil quality, amount, and composition vary according to geographical conditions, soil composition, and specific plant portions, and plant age. The International Standard Organization on EOs (ISO 9235:2013) and European Pharmacopoeia (Council of Europe, 2004) both define an essential oil as a product that is obtained from plant raw materials by hydro distillation, steam distillation, dry distillation, or by a suitable mechanical process. Essential oils are distinct from other aromatic or volatile products that are derived using various extraction methods such as solvent extraction, supercritical fluid extraction, and microwave-assisted extraction. Additionally, essential oils are different from fixed or fatty oils in terms of their chemical and physical characteristics.

In nature, EOs are crucial for plant defense and signaling (Harborne 1993; Bowsher *et al.*, 2008) They help protect plants from microorganisms, insects, and herbivores, attract pollinators and animals that disperse seeds, regulate water, and facilitate allelopathic interactions. Additionally, they are valuable natural products used as raw materials in various industries, including pharmaceuticals, agronomy, food, sanitation, cosmetics, and perfumery.Essential oils are complex mixtures of volatile compounds (approximately 100 u) to semi-volatile compounds (around 300 u). They typically have a strong odor, are rarely colored, are soluble in organic solvents, and are insoluble in water. These oils include volatile compounds of both terpenoid and non-terpenoid origins, synthesized through various biosynthetic pathways with different primary metabolic precursors.

Classification of essential oils

The oil may be found in the internal glandular tissues of flowers, fruits, seeds, leaves, bark, root and wood. On the basis of their occurrence, they are classified asWood oil, Leaf oil, Seed oil, Root /rhizome oil, Flower oil, Grass oil, etc.

S. No.	Type of essential oils	Example
1.	Flower oils	Keora oil (*Pandanus tectorius*)
		Champ oil (*Michelia champaca*)
		Jasmin oil (*Jasminum grandiflorum*)
		Rose oil (*Rosa damascena)*
2.	Seed oil	Muskdana (*Abelmoschus moschatus*)
3.		Lemon grass oil (*Cymbopogon flexuous*)
		Palmarosa oil (*Cymbopogon martinii*)

	Grass oils	Ginger grass oil (*Cymbopogon martinii*)
4.	Leaf oil	Eucalyptus oil (*Eucalyptus globulus*)
		Camphor oil (*Cinnamomum camphora*)
		Cinnamon oil (*Cinnamomum zeylanicum*)
		Mint oil (*Mentha piperita*)
		Winter green oil (*Gaultheria fragrantissima*)
5.	Wood oil	Sandal wood oil (*Santalum album*)
		Agar wood oil (*Aquilaria malaccensis*)
		Deodar wood oil (*Citrus deodara*)
		Pine wood oil/Turpentine (*Pinus* species)
6.	Root oil	Costus/Kuth (*Saussuria lappa*)
		Valerian oil (*Valeriana jatamansii*)

How essential oil extraction methods are important?

Choosing the appropriate extraction procedure is critical for producing high-quality essential oils. It influences the oil's quality, purity, safety, energy efficiency, cost-effectiveness, compatibility for the plant material, consistency and reproducibility, and regulatory compliance. Different extraction procedures produce oils of different quality, while others, like as steam distillation, and maintain delicate aromatic components better. Energy efficiency is critical for economic and environmental reasons, and cost-effectiveness is an important consideration. Matching the extraction procedure to the plant material ensures the highest yield and quality. Regulatory compliance is also important for legal marketability.

Extraction methods

There are numerous techniques of extraction operations for essential oils; depending on the use, different methods are selected. Some of them are Maceration, Cold Pressing, Solvent Extraction, and supercritical carbon dioxide, hydro distillation, Turbo Distillation Extraction, Steam Distillation etc.

Maceration

Maceration is a method for creating infused oils or herbal oils by soaking plant material in carrier oil for extended periods. These oils absorb the plant's aromatic and therapeutic properties, but are not essential oils. They are used in skincare, massage therapy, and aromatherapy.

Solvent extraction

Solvent extraction involves extracting essential oils from plant materials using a suitable solvent. Hydrocarbons are commonly used as a solvent to extract essential oils from plant materials. After adding a solvent to the plant material, the resulting solution is filtered and concentrated using distillation. Oil is extracted from the concentrate by adding pure alcohol, which is subsequently evaporated, leaving behind the oil. The biggest disadvantage of employing this procedure is that solvent residue might induce allergies and damage the immune system.

Enfleurage

Enfleurage is the traditional and thorough method of extracting essential oils from flowers. This procedure involves layering fat on flower petals to extract them. After fat absorbs essential oils from flower petals, alcohol is used to extract and separate them. The essential oil is extracted by evaporating the alcohol solvent residue, which may induce allergies and impair the immune system.

Hydrodistillation

Hydro distillation is a method for extracting essential oils from plant material, particularly aromatic plants. It involves heating the material, adding water, steam distillation, separation, and collection. The volatile aromatic chemicals are released, which are then condensed into liquid form. The essential oil layer is collected and processed, while the residual water, called hydrosol, can be used for various purposes. This method is suitable for various plant materials but may not be as efficient or yield-boosting as other extraction methods. Hydro distillation has been replaced by other methods due to its potential for producing burnt essential oils.

Steam Distillation

The primary method widely employed for extracting essential oils from plant material is distillation. In this process, the plant material, typically flowers or plants, is arranged on a screen, and steam is introduced through the material. Subsequently, the steam is condensed to yield a mixture of water and essential oil. Finally, this combination of essential oil and water is separated (Cassel *et al.*, 2009).

Importance and use of essential oil

Essential oils are commonly used in aromatherapy, interacting with the body through skin application and inhalation. They stimulate the limbic system, affecting emotions, behaviours, and physiological functions. While their physical effects are under-researched, they're popular for home fragrance, cosmetics, and as potential eco-friendly mosquito repellents. Studies suggest certain oils like citronella may deter mosquitoes, with industrial potential in food preservation. Essential oils have potential therapeutic benefits in treating various health conditions, but their efficacy remains limited. Aromatherapy has shown promise for stress and anxiety, but blinded studies due to scent biases have led to inconclusive reviews. Peppermint and lavender oil use have shown relief for headaches and migraines, while lavender oil has shown positive effects for sleep improvement.

Test-tube and animal studies suggest essential oils have potential anti-inflammatory properties, but human research is limited. Further research is needed to determine their clinical applicability. Essential oils, often considered safe due to their natural origin, can pose health risks, especially for vulnerable populations like pregnant women, children, and pets. Common side effects include skin rashes, asthma attacks, headaches, and allergic reactions. High-phenol essential oils like cinnamon can cause skin irritation and can increase skin sensitivity to sunlight. Ingesting essential oils is not recommended due to potential harm.Selecting the right essential oils can be challenging due to lack of universal standards and regulation. To ensure high-quality oils, consider purity, minimal extraction process, and reputable brands. Choose oils with botanical names, minimal alteration, and a track record of producing high-quality products to maintain their integrity.

References

Aziz, Z. A., Ahmad, A., Setapar, S. H. M., Karakucuk, A., Azim, M. M., Lokhat, D., ... & Ashraf, G. M. (2018). Essential oils: extraction techniques, pharmaceutical and therapeutic potential-a review. *Current drug metabolism*, 19(13), 1100-1110.

Bakkali, F., Averbeck, S., Averbeck, D., & Idaomar, M. (2008). Biological effects of essential oils–a review. *Food and chemical toxicology*, *46*(2), 446-475.

Bhardwaj, K., Islam, M. T., Jayasena, V., Sharma, B., Sharma, S., Sharma, P., ... & Bhardwaj, P. (2020). Review on essential oils, chemical composition, extraction, and utilization of some conifers in Northwestern Himalayas. *Phytotherapy Research*, 34(11), 2889-2910.

Başer, K. H. C., & Demirci, F. (2000). Essential oils. Kirk-Othmer *Encyclopaedia of Chemical Technology*, 1-37.

El Kharraf, S., Farah, A., Miguel, M. G., El-Guendouz, S., & El

Hadrami, E. M. (2020). Two extraction methods of essential oils: Conventional and non-conventional hydrodistillation. *Journal of Essential Oil-Bearing Plants*, 23(5), 870-889.

Hanif, M. A., Nisar, S., Khan, G. S., Mushtaq, Z., & Zubair, M. (2019). Essential oils. Essential oil research: trends in biosynthesis, analytics, industrial applications and biotechnological production, 3-17.

Ríos, J. L. (2016). Essential oils: What they are and how the terms are used and defined. In *Essential oils in food preservation, flavor and safety* (pp. 3-10). Academic Press.

Silori, G. K., Kushwaha, N., & Kumar, V. (2019). Essential oils from pines: Chemistry and applications. *Essential oil research: Trends in biosynthesis, analytics, industrial applications and biotechnological production*, 275-297.

Stratakos, A. C., & Koidis, A. (2016). Methods for extracting essential oils. In Essential oils in food preservation, flavor and safety (pp. 31-38). Academic Press.

Zuzarte, M., & Salgueiro, L. (2015). Essential oils chemistry. Bioactive essential oils and cancer, 19-61.

Zhang, X. H., da Silva, J. A. T., Jia, Y. X., Zhao, J. T., & Ma, G. H. (2012). Chemical composition of volatile oils from the pericarps of Indian sandalwood (Santalum album) by different extraction methods. Natural product communications, 7(1), 1934578X1200700132.

विलुप्ति की कगार पर सोन चिडिया

सौरभ दुबे, अविरल असैया एवं दर्शन के.

वन सुरक्षा प्रभाग

उष्ण कटिबंधीय वन अनुसंधान संस्थान, जबलपुर, (म. प्र.)

ग्रेट इंडियन बस्टर्ड या सोन चिडिया, भारत तथा सीमावर्ती पाकिस्तान में पाया जाने वाला एक शानदार पक्षी हैं। इसका वैज्ञानिक नाम *आर्डीऔटिस निग्रिसेप्स* (*Ardeotis nigriceps*) हैं। भारत में इसे अलग – अलग नामों जैसे - सोन या सोहन चिडिया, सोन चिरैया, बड़ा तिलोर, मल्धोक, हुकना तथा घोराड आदि से जाना जाता हैं। गुर्राने जैसी ध्वनि निकालने के कारण इसे गुरायन या गुरायिन भी कहाँ जाता हैं। राजस्थान में इसे गोडावण कहते हैं, तथा इसे राजस्थान के राज्य पक्षी होने का दर्जा प्राप्त हैं।

देश में सोन चिडिया राजस्थान, गुजरात, मध्य प्रदेश, महाराष्ट्र, हरियाणा, कर्नाटक, आन्ध्र प्रदेश, उडीसा आदि राज्यों के शुष्क तथा अर्धशुष्क भागों के घास के मैदानों मे विचरण करती थी, लेकिन आज यह केवल मुख्य रुप से राजस्थान राज्य के अलावा गुजरात, महाराष्ट्र, आंध्रप्रदेश, तथा कर्नाटक में कुछ एक की आबादी के साथ शेष बची हुई हैं। भारतीय वन्यजीव संरक्षण अधिनियम 1972 के अनुसूची 1 के तहत यह संरक्षित प्रजाति है तथा IUCN की रेड डेटा बुक में इसे गंभीर संकटग्रस्थ प्रजाति के रुप दर्ज किया गया हैं। ग्रेट इंडियन बस्टर्ड कभी भारत के राष्ट्रीय पक्षी बनने की दौड मे थी, पर आज अपने अस्तित्व की लड़ाई लड़ रही हैं। इनके रहवास के इलाकों में हो रहे मानवीकृत बदलाव व अत्यधिक दखल के चलते आज यह प्रजाति अपने अस्तित्व के लिये संघर्ष कर रही हैं।

शारीरिक संरचना

स्वभाव से शर्मीली परंतु सतर्क, सोन चिडिया सामान्य तौर पर यह घास के मैदानों व शुष्क एकांत इलाको मे विचरण करती है। इसकी सुनने की क्षमता अच्छी होती हैं, जो इन्हें घास के मैदानों के संभावित खतरे से बचने में सहायता करती हैं । सुंदर शारीरिक बनावट वाले इन पक्षियों के सिर तथा माथे पर काले रंग का निशान होता हैं । लम्बी गर्दन पर पंख हल्के सफेदी लिये हुये होते हैं और सीने पर काली पट्टीनुमा रेखा होती हैं। नरों की अपेक्षा मादाओं के सीने पर यह काली पट्टी बिखरी हुई अथवा नही होती हैं तथा गर्दन का रंग भी नरो की तुलना में गहरा होता हैं। सोन चिडिया का शरीर गहरे भूरे रंग का तथा पंख काले, स्लेटी रंग के व उनमें सफेद रंग के निशान होते हैं। इनके पैर लम्बे होते हैं, जिससे ये मैदानों में अच्छी तरह से चल तथा दौड सकते हैं। इसकी ऊचाई लगभग 1 मीटर तथा वजन 10 से 15 किलोग्राम तक होता हैं। यह उड़ने वाले पक्षियों में यह सबसे भारी पक्षियों मे से एक

होता है। नर, मादा पक्षियों के मुकाबले अधिक वजनी तथा लम्बें होते हैं।

आहार

सोन चिडिया सर्वाहारी होती है तथा यह भोजन के रुप मे अनाज, जंगली फल, घास के बीज, कीट - पतंगे, छिपकली, चूहे और टिड्डे जैसे छोटे जंतुओं को खाते हैं। इनके निवास स्थलों के आस – पास के खेतों में बुवाई के समय ये उनसे विभिन्न प्रकार का अनाज जैसें – गेहुँ, ज्वार, मूँगफली व फलियाँ आदि को खाते हैं। शुष्क क्षेत्रों मे रहने के कारण ये पानी की कमी होने पर भी आसानी से निर्वाह कर लेते हैं।

प्रजनन संबंधी व्यवहार

सोन चिडिया मार्च से सितम्बर माह में प्रजनन करती हैं। प्रजनन काल में मादाओं को रिझानें नर पक्षी अपने सिर पर काले निशान वाले पंखो को फैलाकर तथा गले की थैली को फुलाकर गूंजती हुई तेज आवाज करते हैं। यह आवाज मादाओं को नरों के प्रणय प्रदर्शन की सूचना देने के लिये होती हैं। नर इस प्रर्दशन के दौरान नर अपनी गर्दन को पीठ की तरफ झुकाकर, पूँछ को ऊपर की ओर उठाकर आवाजें निकालता हैं।

यह प्रर्दशन कुछ घंटो तक चल सकता हैं। अपने प्रतिद्वंदी अन्य नरों को मादाओं के लिये मुकाबला होने पर ये उनसे झगडा करने से भी पीछे नही हटते। मादा द्वारा नर का चुनाव कर लेने व उससे जोडा बनाकर मिलन कर लेने के बाद वह अण्डा देती हैं, जिसको सेने से लेकर चूजे को पालने का काम वह अकेले ही करती हैं। नर मिलन के बाद अन्य मादाओं से भी मिलन करते हैं। सामान्य तौर पर नर अपना इलाका तय कर लेते हैं तथा प्रजनन के मौसम मे वही रहते हैं, तथा मादायें एक नर के इलाके से दूसरे नर के इलाके में घूमती रहती हैं।

विलुप्ति के कारण

आज भी अक्सर भारत के हिन्दीभाषी राज्यों में माता – पिता व परिवार के बडे – बुजुर्ग घर की

लडकियों को प्यार से सोन चिरैया कहकर दुलारते हैं, पर जहाँ सोन चिडिया ने अपने नाम के कारण प्यार - दुलार में अपनी जगह बनाई वही यह शानदार पक्षी अपने नाम के ही चलते संकट में भी आया। नाम मे सोन (स्वर्ण) शब्द आ जाने के कारण विभिन्न प्रकार के अंधविश्वासो के चलते कई बार ग्रामीण इसके अण्डे मिलने पर उसे अपने साथ ले आते थे और अण्डे से पक्षी बनने का कभी मौका नही मिल पाता था। माँस के लिये किया जाने वाला अवैध शिकार भी इनकी जनसंख्या में आयी भारी कमी का एक कारण हैं।

घास के मैदान जिन पर कभी यह शानदार पक्षी रहा करता था, वे मैदान अब मानव आबादी के बढ़ते दवाब के चलते सिकुडने लगे हैं। इन मैदानों कि तरफ बढ़ते गाँव, खेत, सडकें तथा व्यापारिक वृक्षारोपण धीरे – धीरे इनकी जगह लेते जा रहे हैं, जिससे परिआवास में अवांक्षित बदलाव हो रहा हैं तथा इन्हें आहार व रहवास आदि की समस्या हो रही हैं।

सोन चिडिया जमीन पर घोंसला बनाती हैं तथा मादा वर्ष में एक बार में केवल एक ही अण्डा देती हैं और यदि वह किसी कारण से नष्ट हो जाये तो वह अगले प्रजनन काल तक अण्डा नही देती हैं। जमीन पर अण्डे देने के कारण पशु चराई के समय मवेशियों के पैरों से कुचलकर इसके अण्डे फूट

जाते हैं या कभी – कभी आवारा कुत्ते इनके अण्डे और चूजों का शिकार कर लेते हैं।

जिन शुष्क खुले हुये घास के मैदानी भाग व मरुस्थल इनके आवास हैं, वही क्षेत्र पवन व सौर ऊर्जा से बिजली बनाने के लिये भी उपयुक्त हैं। इन इलाको में ही सौर व पवन ऊर्जा से बिजली बनाने के सोलर पैनल तथा विद्युत सप्लाई के लिये तारो

को लगाया गया हैं। तारों की चपेट में आ जाने के कारण यह शानदार और विलुप्त होता पक्षी अपनी जान गवा बैठता हैं और मरते हुये हर पक्षी के साथ उसकी आबादी को बचाने में लगे लोगो व संस्थाओं के प्रयासो को न केवल जोरदार झटका लगता हैं, बल्कि उनको आबादी को विलुप्ति की कगार से बाहर लाने उम्मीद भी कम होने लगती हैं।

संरक्षण के प्रयास

हम यदि चाहते हैं, कि जिस प्रकार भारतीय चीता विलुप्त हो गया, कहीं उसी प्रकार सोन चिडिया भी केवल किस्से कहानियों में सिमटकर न रह जाये तो हम सबको मिलकर इनके संरक्षण के लिये सार्थक प्रयास करने होंगे। सोन चिडिया के संरक्षण को लेकर विभिन्न सरकारी तथा गैर सरकारी संस्थायें, पर्यावरणविद्, ग्राम समूह आदि कार्य कर रहे हैं। नेशनल बस्टर्ड रिकवरी प्लान तथा प्रजाति कार्यक्रम के तहत इनको विलुप्ति से बचाने का प्रयास हो रहा हैं। इनके संरक्षण के लिये विभिन्न राज्यों में इनके रहवास वाले भागों को वन्यजीव अभ्यारण्य व राष्ट्रीय उद्यान के रुप में आरक्षित किया गया हैं। राजस्थान राज्य की मरूभूमि में स्थित डेजर्ट नेशनल पार्क, जो इनकी छोटी सी प्रजनन योग्य आबादी को संजोये हुये हैं। यह 3162 वर्ग किलोमीटर के क्षेत्र में फैला हैं। सोन चिडिया इस नेशनल पार्क में विलुप्त होते गिद्धों की प्रजातियों और मेकक्वीन बस्टर्ड (प्रवास के समय पर) आदि दुर्लभ जीवों के साथ अपना इलाका साझा करती हैं, परंतु बढ़ती जनसंख्या, पशु चराई, सोलर ऊर्जा संयत्र, बिजली के तार तथा अन्य विकास के कार्यो का विपरीत प्रभाव का स्पष्ट असर इनकी आबादी पर दिखाई पड रहा हैं। राज्य में शुरु किया गया प्रोजेक्ट ग्रेट इंडियन बस्टर्ड भी इनके संरक्षण की तरफ उठाया एक महत्त्वपूर्ण कदम हैं। इसी क्रम में मध्य प्रदेश का करेरा वन्यजीव अभ्यारण्य इनके संरक्षण के लिये बनाया गया था परंतु अब वहाँ वर्षो से किसी सोनचिडिया को नही देखा गया हैं। राज्य का ही एक अन्य वन्यजीव अभ्यारण्य जिसे घाटीगाँव के नाम से जानते हैं, उसमें सोन चिडिया की आबादी को बढ़ाने के लिये प्रयास किये जा रहे हैं। महाराष्ट्र में नन्नाज घास मैदान, गुजरात में नलिया तथा गागा वन्यजीव अभयारण्य, आन्ध्रप्रदेश में रोलापडू, आदि अभ्यारण्य बनाये गये हैं।

वाइल्ड लाइफ इंस्टीट्यूट ऑफ इंडिया के वैज्ञानिको द्वारा इनके अण्डो को लेकर प्रयोगशाला में ले जाया गया तथा उनसे सफलतापूर्वक चूजे निकले, ये चूजे भविष्य के प्रजनन कार्यक्रम में महत्तवपूर्ण योगदान निभायेंगे। इनके रहवास स्थलों पर हाई वोल्टेज बिजली सप्लाई के लिये ऊँचे – ऊँचे तार लगे हुये हैं, जिनसे रात के समय यदि यह पक्षी उडान भरता हैं, तो वह उन तारो को अंधेरे में न देख पाने के

कारण उनसे टकराकर मारा जाता हैं। इस समस्या को रोकने के उपाय के प्रयोग के तौर पर जैसलमेर में बिजली के तारों पर बर्ड डायवर्टर लगाये गये हैं, जो रात मे चमकते है। आशा यह की जाती है, कि जब पक्षी इन चमकदार डायवर्टर को देखेंगा, तो वह इनसे बचकर उडान भरेगा तथा बिजली के तारों से टकराकर होने वाली सोन चिडिया की मृत्यु को काफी हद तक टाला जा सकेगा । हाई वोल्टेज बिजली के तारों को अंडरग्राउंड करने की योजना पर टास्कफोर्स का गठन किया गया हैं।

संदर्भ

छायाचित्र – श्री राधेश्याम विशनोई, (वन्यजीव फोटोग्राफर एवं संरक्षणकर्ता), जैसलमेर, राजस्थान

Threatened Birds of India, The Conservation Requirements by Asad R. Rahmani

Downtoearth.org.in/hindistory/wildlife-biodiversity/wildlife/efforts-tosave-great-indian-bustard-birds-are-carry-on-66839

https://www.britannica.com/animal/great-Indian-bustard

https://animalia.bio/great-indian-bustard

Synergies in fruit-forage intercropped systems: Maximizing forage and environmental benefits

Suheel Ahmad*, Nazim Hamid Mir, Sheeraz Saleem Bhat, Regu Atufa and Aamir Nazir Lone

ICAR-Indian Grassland and Fodder Research Institute, Regional Research Station, K D Farm, CITH Campus, Rangreth, Srinagar-191132 (Jammu and Kashmir)-INDIA
Email: suhail114@gmail.com

Introduction

In the quest for sustainable agricultural practices, fruit-forage intercropped systems (hortipastoral systems) are emerging as a promising solution. By integrating horticulture and pastoral activities, these systems offer a unique opportunity to enhance forage availability while providing a host of environmental benefits. Hortipastoral systems combine the cultivation of fruit trees with livestock grazing on the same land. The significance of horticulture in enhancing land productivity, generating employment, improving the economic conditions of farmers and entrepreneurs, boosting exports, and providing nutritional security cannot be overstated. The production potential of Indian livestock, particularly in the Himalayan regions, is significantly below global averages, often 50-60% less. The primary factor limiting livestock productivity is the inadequate availability of quality feed. High-yielding and nutritious fodder is crucial for the scientific and economic management of livestock, especially crossbred animals. However, fodder cultivation has remained stagnant, with only about 4% of arable land dedicated to fodder production. There is a severe shortage of fodder, particularly green and nutritious fodder, which is a major cause of low livestock productivity, especially in hilly areas. In animal husbandry, 65-75% of expenditure is on feeds and fodder. The deficit in fodder availability varies across different regions. For example, green fodder availability in the Western Himalayan, Upper Gangetic Plains, and Eastern Plateau and Hilly Zones is more than 60% of the actual requirement. In the Trans-Gangetic Plains, feed availability ranges from 40% to 60%, while in other regions, it is below 40%. For dry fodder, availability is over 60% in the Eastern Himalayan, Middle Gangetic Plains, Upper Gangetic Plains, East Coast Plains, and Hilly Zones. In the Trans-Gangetic Plains, Eastern Plateau and Hills, and Central Plateau and Hills, availability ranges from 40% to 60%, whereas it is below 40% in the remaining zones.

With the increasing human population, arable land is primarily used for food and cash crops, leaving little room for quality fodder production. Among fruit tree-based agroforestry systems, hortipastoral systems have been recognized as a sustainable land use option due to their high productivity and environmental benefits, even in fragile agro-ecosystems. This integrated approach leverages the strengths of both horticulture and pastoral farming, creating a mutually beneficial relationship that enhances productivity and sustainability.

Enhancing fodder production through hortipastoral systems

Integrating fodder grasses and legumes into agroforestry systems is a crucial strategy for boosting fodder production. Intercropping perennial forage grasses and legumes with fruit crops significantly enhances both forage and fruit yields. Hortipastoral systems, which combine orchards, pastures, and livestock, utilize the interspaces between fruit trees for cultivating grasses and grass-legume mixtures. This approach is particularly vital due to population growth, poor grassland productivity, and a forage supply deficit, alongside farmers' inability to allocate cultivated land solely for forage production.

The initial slow growth of fruit trees leaves interspaces underutilized and prone to weeds, complicating orchard management. Incorporating pastures in these spaces not only boosts profitability but also improves orchard floor management. Annual crops in the alleys can decrease soil organic matter and increase erosion, especially on slopes. In contrast, perennial crops maintain continuous soil cover, enhance water infiltration, reduce erosion, and improve soil quality. Thus, planting perennial forage species in alleys protects soil resources and provides income during orchard establishment.

Grass-legume intercropping in hortipastoral systems increases biomass production and provides high-quality, protein-rich forage, improving milk production and animal health. Legumes, which retain quality better than grasses even at maturity, enrich forage value and add necessary nitrogen to the soil. Utilizing interspaces in horticultural tree plantations is a key strategy for augmenting forage resource availability in response to population pressure, grassland productivity challenges, and forage supply deficits.

Phalaris grass + Almond hortipastoral system (Green fodder yield: 40-45 t/ha)

Orchard grass + Red clover in an apple orchard (Green fodder yield: 30-35 t/ha)

Table 1. Suitable fruit and fodder crops for different rainfall regimes (tropical and subtropical regions) Source: Khan et al., 2009

Rainfall (mm) Zones	Fruit crops (cultivars)	Forage crops
< 350	*Zizyphus mauritiana* (Seb, Gola, Mundia), *Capparis decidua*, *Salvoda oleides*, *Cordia myxa*	*Cenchrus ciliaris*, *Cenchrus setigerus*, *Sehima nervosum*, *Stylosanthus scabra*, *Clitorea ternatea*
350-500	*Zizyphus mauritiana* (Seb, Gola, Mundia, Bagwadi, Katha), *Emblica officinalis* (Banarsi, Chakaiya, Hathijhool), *Morus alba*, *Syzigium cuminii*, *Manilkara hexandra*	*Panicum antidotale*, *Dicanthium annulatum*, *Stylosanthus hamata*, *Pennisetum pedicellatum*
500-700	*Aegle marmelos* (Faizabad selection), *Emblica officinalis*, *Mangifera indica* (Chausa, local cultivars, Safeda, Bombay green), *Citrus aurantifolia*, *Annona squamosa* (Balanagar, Washington, Mammoth)	*Chloris gayana*, *Chrysopogon fulvus*, *Stylosanthus hamata*, *Panicum maximum*
>700	*Mangifera indica*, *Punica granatum* (Jodhpur red, Jailor seedless), *Psidium guajava* (Allahabad safeda, L-49),	*Dicanthium annulatum*, *Panicum maximum*, BN hybrid

	Tamarindus indica, *Emblica officinalis* (NA-6., NA-7)	

Table 2. Suitable fruit and forage crops for different zones in North western Himalayan region (Ahmad *et al.*, 2017)

Zone	Fruit crops	Forage grasses	Forage legumes
Temperate zone	Apple, Almond, Pear, Cherry, Walnut and Apricot	*Dactylis glomerata, Festuca arundinacea, Lolium perenne, Phleum pratense, Bromus unioloides, Phalaris spp., Poa pratensis, Lolium multiflorum*	*Trifolium pratense, T. repens, Onobrychis viciifolia, Medicago sativa, Trifolium alexandrinum, Lotus corniculatus,*
Intermediate zone	Peach, Plum, Apricot, Olive and pomegranate	*Dactylis glomerata, Festuca arundinacea, Lolium perenne, Dicanthium annulatum, Chloris gayana, Chrysopogon fulvus, Heteropogon contortus, Setaria spp., Avena sativa*	*Trifolium alexandrinum, Stylosanthus hamata, Macroptelium atropurpreum, Trifolium resupinatum, Medicago sativa, Onobrychis viciifolia*
Sub-tropical zone	Mango, Citrus, Ber, Aonla	*Dicanthium annulatum, Chloris gayana, Chrysopogon fulvus, Heteropogon contortus, Cenchrus ciliaris, C. setigerus, Paspalum notatum, Avena sativa*	*Trifolium alexandrinum, Stylosanthus hamata, Trifolium resupinatum, Medicago sativa*
Cold arid zone	Apricot, Apple	*Festuca arundinacea, Avena sativa, Phalaris spp., Dactylis glomerata,*	*Medicago sativa, Medicago falcata, Astragalus spp., Caragana spp., Melilotus officinalis, Cicer microphyllum*

Environmental benefits from hortipastoral systems

Ecosystem services are the benefits provided to humans by transforming natural resources—such as land, water, vegetation, and the atmosphere—into essential goods and services like clean air, water, and food. The Millennium Ecosystem Assessment framework categorizes these services into four types: provisioning services (e.g., food and water), regulating services (e.g., flood and disease control), supporting services (e.g., nutrient cycling), and cultural services (e.g., spiritual and recreational benefits). Hortipastoral systems, which combine horticulture and pasture, offer a range of these ecosystem services. They provide not only provisioning services but also regulating and cultural benefits. For

example, agricultural regulating services include flood control, water quality control, carbon storage, climate regulation, disease regulation, and waste treatment. A significant benefit of hortipastoral systems is sustainable orchard floor management, which is crucial for tree health, yield, and fruit quality. Despite its importance, the orchard floor has traditionally received less attention than tree horticulture and pest management. Standard orchard floor management practices typically involve a vegetation-free tree row and a grass-covered alleyway, which effectively limits competition from undesirable vegetation and creates a favorable environment for fruit trees. Orchard cultivation aims to maintain soil in a condition that meets the needs of the trees with minimal expense. Incorporating grasses and legumes in hortipastoral systems helps maintain soil tilth and fertility, reduce weed competition, moderate soil temperature and moisture, provide habitat for beneficial arthropods, and minimize soil erosion. Apple trees, with their low root density, are particularly poor competitors with other vegetation, making low weed competition essential for high productivity. The best management practice is to integrate perennial forage grasses (tall fescue, orchard grass, guinea grass, *Setaria*, *Chrysopogon* etc) with legumes such as red and white clover, sainfoin, alfalfa, berseem, cowpea, pea, winter vetch, crown vetch, *Stylosanthus*, soyabean etc. Legumes provide additional nitrogen in the orchard. Mowing and discharging the nitrogen rich plant material in the tree row effectively bands the nitrogen next to the tree roots. These act as living mulches and stabilize the soil against erosion and compaction, and reduce dust and mud. Forage crops in fruit orchards act as cover crops and thus have substantial effects on several components of agro-ecosystem. They can be used to suppress weeds, enhance nutrient availability, increase soil organic matter and improve soil structure and aggregate stability.

Challenges and opportunities

Yield and quality of forage in hortipastoral systems can be improved by introducing high yielding forage grass and legume species in suitable mixtures. Managing these systems involves selecting the appropriate species and maintaining an optimal balance between them. To fully leverage the synergies of fruit tree-pasture associations, various plant species must be evaluated under specific soil and climatic conditions. Optimizing hortipastoral systems by determining the right density and spatial arrangement of trees and understory species is a complex, long-term process that requires practical and economic feasibility studies before major investments are made. However, challenges such as selecting grass-legume mixtures that minimize competition, avoiding rodent problems, and managing vegetation growth without negatively affecting fruit yield, quality and storability must be addressed. These challenges are heightened by climate change, but recent advances in estimating the value of ecosystem services related to agriculture and analysing potential trade-offs and synergies offer promising solutions. Future research should tackle these challenges in spatially and temporally explicit frameworks. Developing guidelines for managing animal, forage, and tree crops

requires a deeper understanding of the interactions between these components. Since the design and management of these systems will vary by location, regional testing is crucial before making widespread recommendations to farmers. Identifying, measuring, and valuing ecosystem services, and acknowledging their benefits even if they cannot be precisely quantified, is vital for the advancement of hortipastoral systems.

Conclusions

Hortipastoral systems offer a potential solution to the increasing demand for both fruit and fodder, while also improving the overall productivity and sustainability of the system. These systems provide essential provisioning ecosystem services and also support and regulate various other ecosystem services. Although maximizing provisioning services from agroecosystems can lead to trade-offs with other ecosystem services, careful management can significantly reduce or even eliminate this trade-offs. The integration of horticulture and pastoral practices holds significant promise for the future of sustainable agriculture. By maximizing forage availability and environmental benefits, hortipastoral systems can contribute to food security, environmental conservation, and rural livelihoods. Embracing the synergies in hortipastoral systems could well be a transformative step towards a more resilient and sustainable agricultural landscape.

Hill glory (*Clerodendrum viscosum*): The antifeedant property of plant extract against major insect pests of telangana

Deepa M and Yuvaraj Praveen

ICFRE-Intitute of Forest Biodiversity
Dulapally Hyderabad, Telangana

Abstract

Botanicals act not only as insecticides but also function as antifeedants, oviposition deterrents and ovicides. The antifeedant property of plant extract *Clerodendrum viscosum*, against four test insects (*Hyblea purea, Tinolius eburneigutta, Eutectona machearalis, and Atteva fabricella*) at different concentrations was done. All insect cultures were maintained in a growth chamber in the laboratory at a temperature of 27 ± 2° C, 12: 12 L:D and with 70 ± 5 % RH during the experiments and the antifeedant activity observed in the

plant extract based on the feeding behavior of the test insect and arranged in the descending order is 1.0%>0.8%>0.6%>0.4%>0.2%>0.1% concentrations and uncontrol. At 1.0 per cent concentration found to be the most effective and potent antifeedant against these leaves's feeding insect pest. Efficacy of Bee sting bush in bringing down the population of test insects was studied in the laboratory.

Introduction

Insect pests are one of the major limiting factors in crop production. Synthetic organic insecticides have emerged as major tools of pest management. However, due to indiscriminate use of synthetic chemicals, insect pests have developed resistance to insecticides. Resurgence of secondary pests, reduction in the population of natural enemies and harmful residues in food, feed and fodder are some of the aftermaths of the use of pesticides. These concerns have led to the surge of alternative pest control technologies by which relatively environmentally safe pesticides/insecticides solely of biological origin are intended to develop. The pesticide formulations based on extractives from organisms have attracted particular attention because of their specificity to insect pests, biodegradable nature and a potential for commercialization. Over 2,000 plant species out of about 2,50,000 have been reported to possess insecticidal activity in which only a fraction of them are analysed for biocidal properties and many more insecticidal plants awaits discovery. Tropical forests are rich in biodiversity. Native people use various plant products for different and specific purposes. Many workers recorded use of certain plant species by the native people for insect repellent, attractant, antifeedant and insecticidal activity. On the other hand, world over intense efforts is on to

identity newer compounds of insecticidal properties with novel modes of action. So, ICFRE-IFB Hyderabad has studied the antifeedant properties of Beesting bush against certain leaf feeding insects.

Methodology

The extraction was carried out in the Soxhlets extraction apparatus. The samples containing leaves of the selected plant materials were air-dried for 6-7 days. After complete drying the plant parts were pulverized into powder with the help of mixer grinder. The plant material was extracted by Soxhlet extraction method (Fractional distillation method).

Table 1: List of plant species used in the laboratory evaluation

Sl. No	Botanical name	Vernacular name	Telugu name	Family	Plant part used
1	*Clerodendrum viscosum*	Hill glory	Gurrapu	Lamiaceae	Leaf

Table 2: Test insects selected for the study

Sl. No.	Common name	Scientific name	Family	Order
1	Teak defoliator	*Hyblaea puera*	Lepidoptera	Hyblaeidae
2	Teak skeletonizer	*Eutectona macheralis*	Lepidoptera	Pyalidae
3	Alianthus web worm	*Atteva fabriciella*	Lepidoptera	Attevidae
4	Soapnut semilooper	*Tinolius eburneigutta*	Lepidoptera	Noctuidae

Table 3: Solvent used and concentration of stock solutions

Sl. No.	Plant extract	Solvent used	Amount of extract dissolved (gms)	Volume of solvents (ml)	Concentration of stock solution
1	*Clerodendrum viscosum*	Acetone	2	100	20,000 ppm

Table 4: Preparation of different concentrations of different plant extracts from stock solutions of two percent concentration (20,000 ppm) V/V.

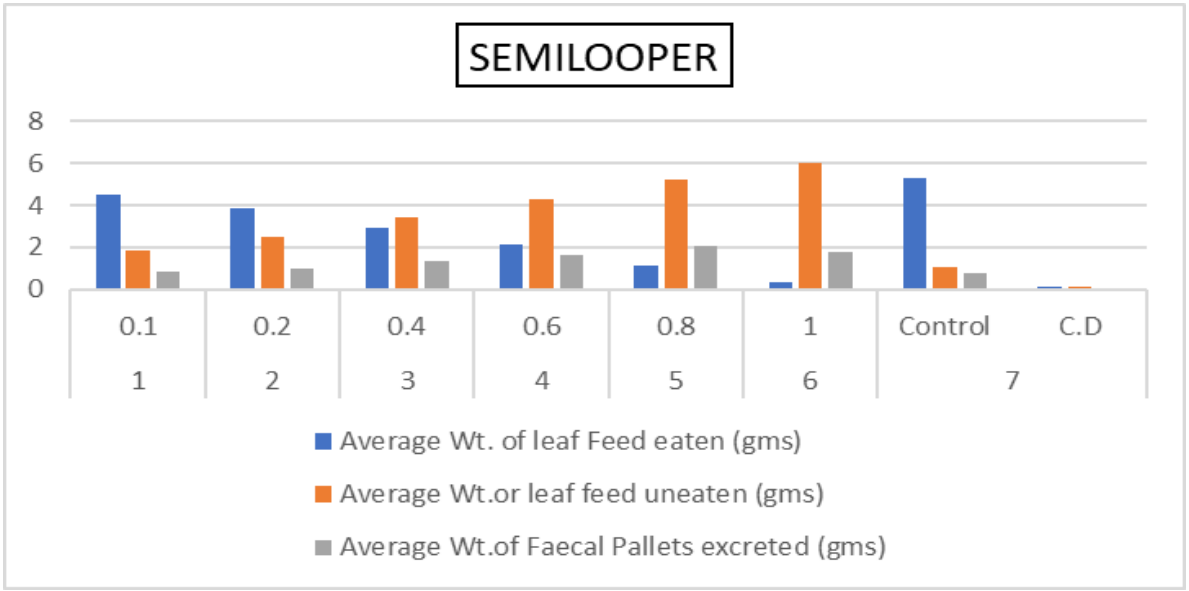
Sl. No	Required concentration in ppm	Volume of stock solution taken in ml	Volume of Acetone used for dilution (ml)	Total volume of solution obtained (ml)
1.	1,000	1.25	23.75	25

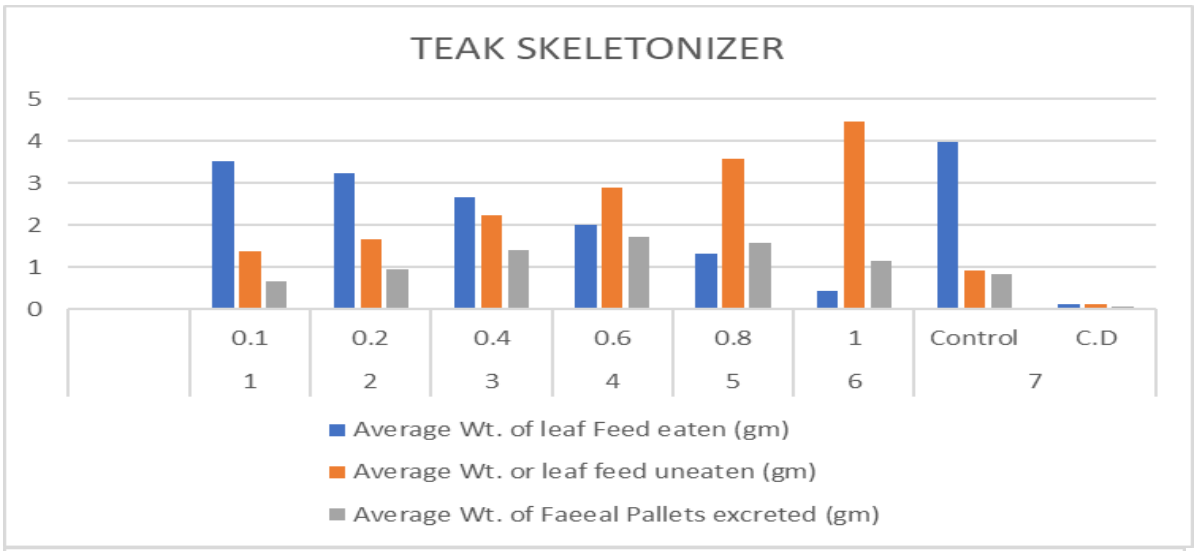
2.	2,000	2.50	22.50	25
3.	4,000	5.00	20.00	25
4.	6,000	7.50	17.50	25
5.	8,000	10.00	15.00	25
6.	10,000	12.50	12.50	25
7.	12,000	15.00	10.00	25

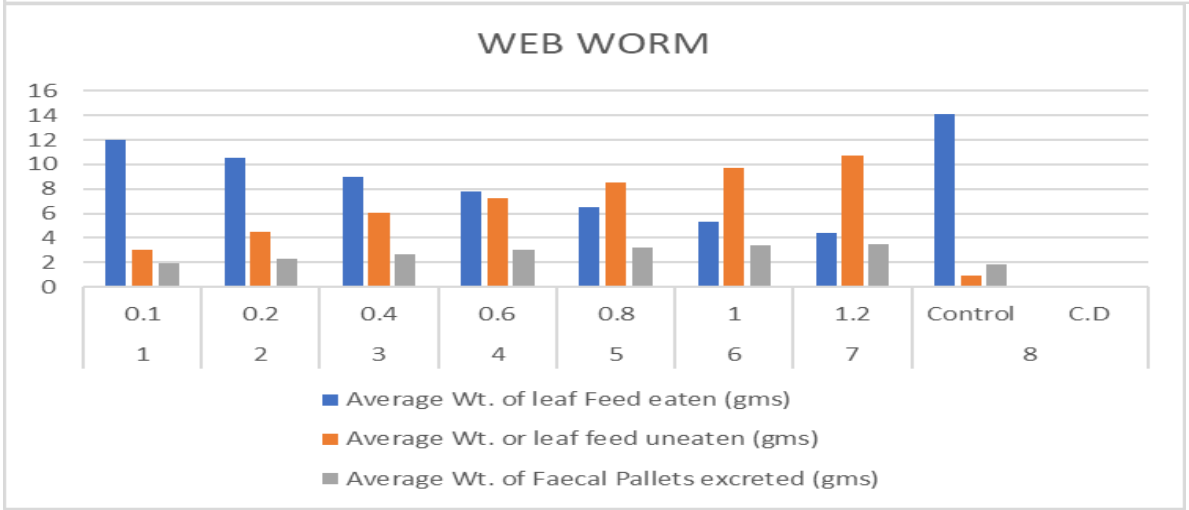
Fig: Plant processing for extraction

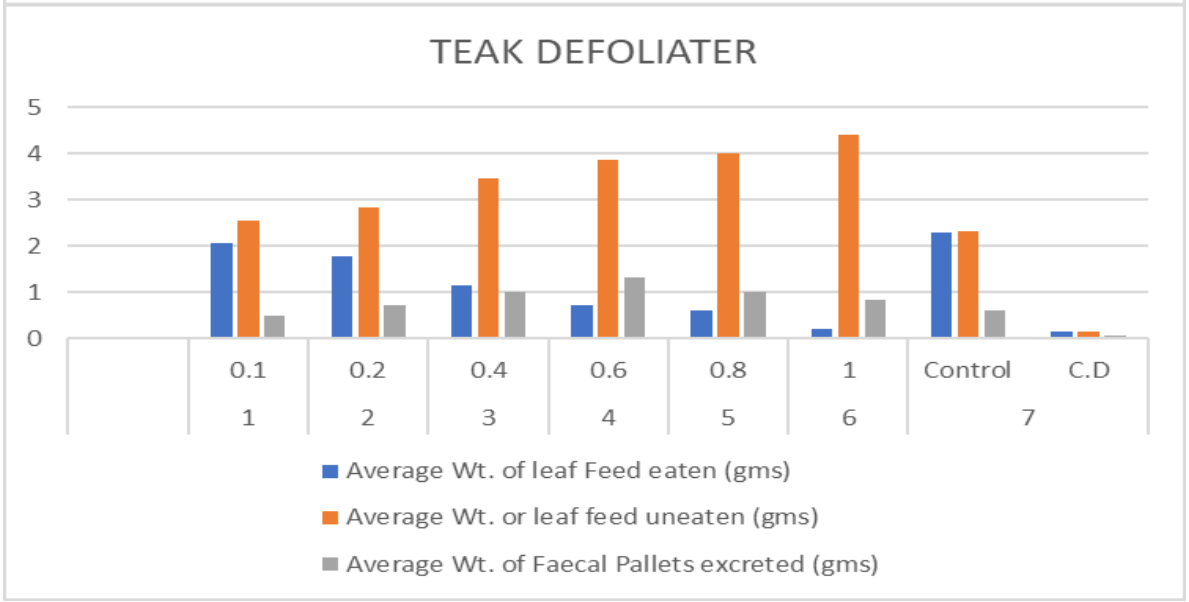
Results

Regarding the unconsumed treated leaf feed, there exist significant differences between the treatments and the untreated control and also between the treatments. Highest leaf feed was left over in the *Clerodendrum viscosum* treatment of 1.0 percent, while lowest quantity of leaf feed was left over in the untreated control followed by treatment of 0.1 percent concentration.




TEAK SKELETONIZER
5
4
3
2
1
0
0.1
1
0.2
2
0.4
3
0.6
4
0.8
5
1
6
Control
7
C.D
Average Wt. of leaf Feed eaten (gm)
Average Wt. or leaf feed uneaten (gm)
Average Wt. of Faeeal Pallets excreted (gm)


WEB WORM
16
14
12
10
8
6
4
2
0
0.1
1
0.2
2
0.4
3
0.6
4
0.8
5
1
6
1.2
7
Control
8
C.D
Average Wt. of leaf Feed eaten (gms)
Average Wt. or leaf feed uneaten (gms)
Average Wt. of Faecal Pallets excreted (gms)


TEAK DEFOLIATER
5
4
3
2
1
0
0.1
1
0.2
2
0.4
3
0.6
4
0.8
5
1
6
Control
7
C.D
Average Wt. of leaf Feed eaten (gms)
Average Wt. or leaf feed uneaten (gms)
Average Wt. of Faecal Pallets excreted (gms)

Conclusion

Among the plant extracts tested against *H. purea* larvae, 1.0 percent *Clerodendrum viscosum* showed highest antifeedant activity. Thus it is concluded that the degree of antifeedant activity of different plant extracts varied from insect to insect, hence depending upon the pest problem and a particular type of extract has to be applied for effective control of the pest.

Ficus a Religious Genus: Versatility in Growth Forms and Wood Anatomy

Ronak yadav, Sangeeta Gupta and Chander Shekhar

ICFRE-Forest Research Institute
Dehradun-248006
Email- yadavronak2380@gmail.com

It has been shown in TV serials that Lord 'Shri Krishna' ate curd from the bowl-shaped leaves of a tree in his childhood. To honor Lord Krishna who's one of the most powerful incarnations of Vishnu, this tree is known as *Ficus krishnae*. Also in the famous epic "Bhagavad Gita" Krishna says "*I am the Peepal tree among trees*" which emphasizes the importance of the genus *Ficus* in religious countries like India. Undoubtedly, India is a country rich in

animal and plant biodiversity. It is the variety and variations among different plants and animals that is responsible for the beauty of the natural world. It should be noted, however, that these variations are not just interesting among animals, but also for plants as well. Although it is not surprising for everyone to have variations across different plant genera, the differences within genera are quite striking.

One day a friend of mine and I went for a morning walk and he asked me in the same manner whether there is any plant genus in which there is tremendous diversity, such as herbs, shrubs, climbers and trees.

As part of my Ph.D. work, I remembered the name *Ficus*, a genus in the Moraceae family. While walking with him in the campus of Forest Research Institute, Dehradun, I showed him variations within the genus *'Ficus*.' There is an amazing diversity in growth forms of plants which includes shrub (*Ficus squamosa*), climbers/lianas (*Ficus pumila* and *Ficus hederacea*), small trees (*Ficus carica, Ficus arnottiana*) and very large trees (*Ficus virens, Ficus drupacea, Ficus pomifera* etc.). It's surprising that some of these large plants are free-living and others grow epiphytically on other trees.

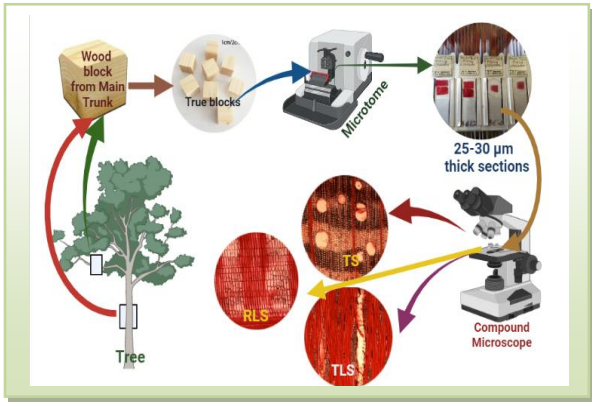
It was a pleasure to talk to him about the beauty of plants and the versatile genus *Ficus*. Plants are truly a gift by God to humanity. *Ficus* (or Figs) is the genus of those plants, which have a social, cultural, ethno-medicinal and religious significance in all three major religions of the world viz. Hinduism, Buddhism, and Jainism originated on the Indian subcontinent. In addition to the religious significance of

various species of the genus *Ficus*, ethno-medicinal importance is also well known in India. Owing to the above facts, the fig species can be seen in the vicinity of almost all major temples and is regularly worshiped and regarded as the trees of life.

After listening about the beauty of *Ficus*, he said to me; yes, I know about the Peepal (*F. religiosa*) and the banyan (*F. benghalensis*) plants of genus *Ficus*. As you are pursuing your work in wood anatomy of family Moraceae, I just want to know about whether the wood microstructure of this genus varies or whether the anatomy of the plants remains conserved. I was also curious to know if this is a true statement or if the wood anatomy changes with the changes in plant habits. After the sun had come up, I told him that I would answer the question you asked. Now it would be time to go to the hostel.

As I returned, I kept thinking about how to collect the wood from these different growth forms of *Ficus* for study of their microstructure. These distinct growth forms within the same genus make it unique among all the genera in the family Moraceae.

To evaluate the effect of varying degree of diversification of habits on wood microstructure within the same genus of ten species of genus *Ficus* were collected from the Forest Research Institute campus and nearby area of district Dehradun, Uttarakhand, India. The prominent goal in collection of these ten species was to cover all the growth forms of *Ficus*. Among ten collected species, two are climbers (*Ficus pumila* and *Ficus hederacea*), one shrub (*Ficus squamosa*), three small trees (*Ficus carica*, *Ficus arnottiana* and *Ficus sarmentosa*) and 4 large trees (*Ficus virens*, *Ficus pomifera*, *Ficus krishnae* and *Ficus drupacea*). In order to authenticate the collected wood samples, the dried plant specimens of the same tree were submitted to the Dehradun Herbarium.



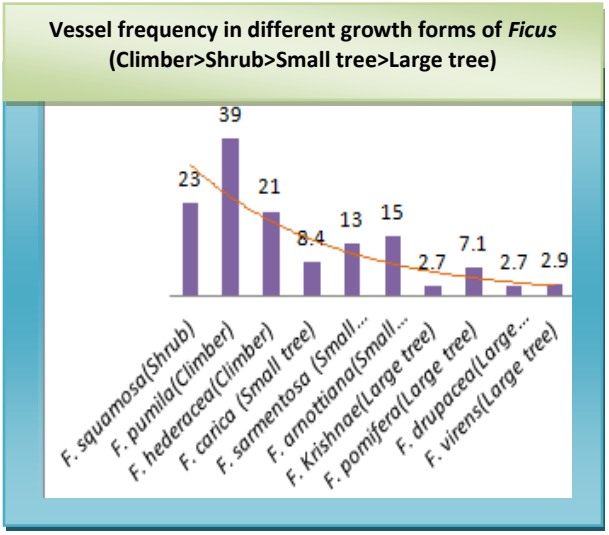
The diagrammatic illustrations show the complete process from collection of wood samples, section cutting with the help of a microtome to observing characteristics from three sections; transverse, radial longitudinal and tangential longitudinal sections under microscope. To record the quantitative and qualitative wood microstructure, the terminology given by the International Association of Wood Anatomists (IAWA, 1989) for hardwood identification was followed and descriptions were followed accordingly.

After making permanent slides, we have recognized the wood anatomical variations among the different growth forms of genus *Ficus*. Anatomically, this genus is also unique; among its all growth forms some of its anatomical characters are similar which include axial parenchyma in bands, prismatic crystals, rays multiseriate 4-10

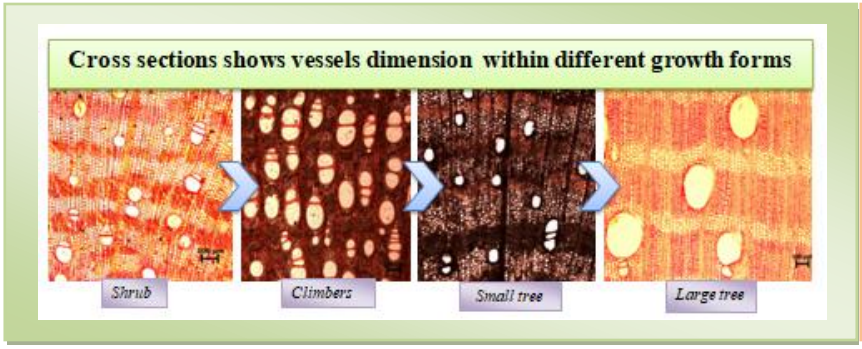
seriate with few numbers of 1-3 seriate with some striking characters.

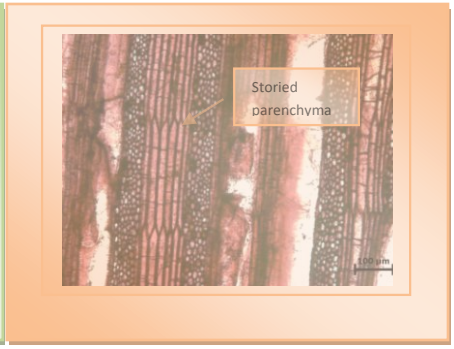
As for the anatomy of climbers, I remember my childhood memories; my grandfather always said that if someone gets all the success without doing anything, then why would they work hard? The same inference was drawn from present study and the saying words of '*dadaji'* holds true in wood microstructures of 'climbers' habit of genus *Ficus* which grow in support with other plants, and do not need to develop their fibre tissues for mechanical support. Climbers invest more in their conductive tissues. Climbers have relatively large-diameter vessels and a high proportion of the cross section devoted to vessel lumen and parenchyma compared to self-supporters. As a result, climbers have a less developed fibre component, but they require some other tissue for mechanical support. As climbers grow with support of other trees over long distances, their storied axial parenchyma provides strength.

multiples that cover a wide area, more than 60 % of the cross section of the wood.



Axial parenchyma has bands more than four cells wide in shrubs, small trees, and large trees, but in climbers there are narrow bands due to high vessel components. Additionally, climbers have a much longer ray than other habits which may help in lateral food translocation within stem.





From shrubs to large trees, vessel tissue proportion decreases, as shown in the cross sections (10x) of different habits and graphs of different fig species; however, in climbers (*F. pumila* and *F. hederacea*), the vessel's frequency is extremely higher with radial

As I arrived at some interesting conclusions, I discussed all the findings with my Supervisor. As I am working on wood anatomy and systematics of family Moraceae it is fortunate for me to add this

effect of habits on the wood anatomy of trees in my final Ph.D. thesis.

My supervisor added her vision of experience and stated that "to increase vessel dimensions the climbers also increases fibre lumen" and also within climber species, mechanical development is less developed because they grow with support of other trees but long distance water transport requires more hydraulic development. My study also proves this statement.

After some time I met my Friend, told him about the interesting findings of the wood anatomical variations due to different growth forms. Although in previous literatures the genus *Ficus* is homogenous in their wood anatomy. But this is the pioneer work on the anatomical variations among different habits within a genus *Ficus*.

Conclusion

This study concluded that "In climbers, mechanical development is less developed because they growing with support of other trees but long distance water transport require more hydraulic development as compare to free-living" trees.

Future prospect

The present research concludes that wood microstructure is a conservative science that is susceptible to quantitative variations caused by habits, climate, and environmental factors. Finally the genus *Ficus* shows versatility not only in their habits but also in their wood microstructure. It would be interesting for me if further works on the other aspects such as in shrubs, climbers and trees what anatomical features/characteristics make it shrub, climber or trees?

References

IAWA Committee. (1989). IAWA list of microscopic featuresfor hardwood identification. IAWA Bull. N.S. 10:219-332.

Wood production in India

Shivani and Rajneesh Kumar

Department of Forest products
Dr.Yashwant Singh Parmar University of Horticulture and Forestry, Nauni,
Solan (Himachal Pradesh) - 173230.
E-mail address- bhardwajshivani1110@gmail.com

Introduction

Wood is an important natural resource. In a developing country like India, on the one end of the spectrum, fuelwood continues to be the primary source of energy for millions of (mostly rural) citizens, while on other end of the spectrum, a healthy GDP growth rate ensures that a bourgeoning middle class craved for the most modern of wooden utilities, from modular kitchens to the latest designs in furniture.Indian forests cannot douse this hunger for wood.To cater to the rising demand, India requires making sustainable use of its vast and underutilized land resources, available in the form of cultivable wastelands, fallow lands and much of the agricultural land available with the farmers for farm forestry. The productivity of Indian forests is already much lower than the world average, owing to deterioration of forest lands over the decades due to myriad anthropogenic factors. The potential of TOF (Tree outside forestry) is also severely underutilized in terms of timber production.

Production in India

The growing stock of TOF has remained almost static across recent decades, so it can be assumed that timber production from TOF has also remained static or grown marginally—considering a marginal growth of 25 million cum in the 2019 assessment over the 2015 assessment (TOF growing stock in 2015 was 1,573 million cum)[1].

Timber production from TOF is almost 14 times that from forests nearly two-thirds of which come from Forest Development Corporations (FDCs). In addition, we have 5.38 million cum of annual bamboo production, which is also used as a substitute for timber and in the cottage industry.

According to the FAO's 2020 report on Global Forest Assessment, the total wood extracted in India in 2017 was 434.77 million cum, out of which the fuelwood volume was 385.25 million cum or 231.15 million tonnes.

Annual estimated wood production in India (in million cum)

Annual estimated wood products	Million cum
Estimated production of timber from forests (excluding FDCs)	1.205
Timber production from Forest Development Corporations (FDCs)	1.97
Annual production of timber from TOF	44.34
Bamboo production in India	5.38
Imports (All timber and allied products in 2015)	18.01

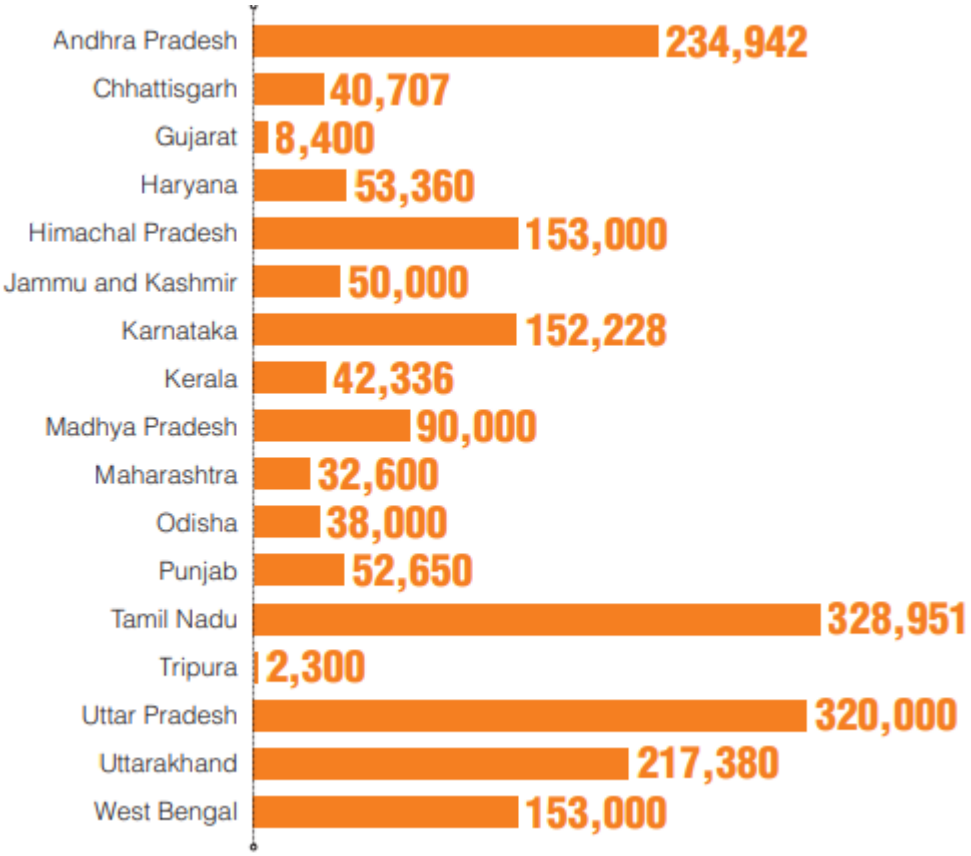
Fuelwood production	385.25
Total timber production (excluding fuelwood)	456.15

Timber production from forests

Indian forests are vulnerable to fires, illegal grazing and overexploitation. Changing land use patterns are nibbling away at their already fragile edges. A 1996 Supreme Court judgment banning felling may have been necessary, but led to further decline in forest productivity. At only 0.045 cum per hectare a year, the productivity of Indian forests is paltry compared to the world average of 2.1 cum per year. To make matters worse, India only has 0.06 ha per capita forest area, while the world average is 0.6 ha. The average annual production of timber by Forest Development Corporations (FDCs) is 1.97 million cum, and makes up a significant part of the total from forests (3.175 million cum). FDCs have not been able to fulfil the dream of raising the productivity of Indian forests. At 0.77 cum per ha, their annual productivity does not compare with that of TOF (3.06 cum per ha).

Wood production from state FDCs

Average volume of wood produced/harvested (in cum per year)



TOTAL PRODUCTION= 1,969,854cum

Timber production from TOF

In India, TOF are defined as 'all trees growing outside recorded forest areas'. TOF provide the meat of India's timber needs, and agroforestry and farm forestry are the backbone of TOF. In 2010, 44.34 million cum of wood was available from TOF in India.

State-wise annual production of timber from forests and TOF

A. States/UT	B. Recorded Forest Area (Sq Km)	C. Volume of Growing Stock (million cum)			D. Annual Production of timber from Forests (thousand cum)	E. Annual production of timber from TOF (thousand cum)	F. Total Annual Timber production (thousand cum) (D + E)
		In Forests	In TOF	Total			
Andhra Pradesh + Telangana	64,162	206	102	307	138	2,360	2,498
Arunachal Pradesh	51,407	413	89	502	64	810	874
Assam	26,832	144	33	177	25	810	835
Bihar	6,493	29	37	67	7	2,180	2,187
Chhattisgarh	59,772	363	82	445	397	2,060	2,457
Delhi	102	-	-	-	-	0	0
Goa	1,225	9	4	13	-	20	20
Gujarat	21,647	52	113	165	99	4,920	5,019
Haryana	1,559	5	15	21	108	1,900	2,008
Himachal Pradesh	37,033	318	21	339	231	670	901
Jammu and Kashmir	20,230	237	147	384	55	840	895
Jharkhand	23,605	123	61	184	13	1,510	1,523
Karnataka	38,284	297	87	384	49	2,090	2,139
Kerala	11,309	155	49	204	68	1,010	1,078
Madhya Pradesh	94,689	277	92	369	397	2,680	3,077
Maharashtra	61,579	227	156	383	203	3,530	3,733

Agroforestry and farm forestry

- As per a 2019 estimate by FSI, the total tree cover under agroforestry systems is 111,554 km^2 i.e., 3.39 per cent of the TGA of India. In terms of volume, the major species under agroforestry systems in India are *Mangiferaindica*, followed by *Azadirachtaindica*, *Borassusflabelliformis*, *Madhucalatifolia* and *Cocosnucifera*. In terms of geographical spread, the major species of trees are Teak and Eucalyptus, Poplar, Casuarina and *Leucaenaleucocephala*.
- The agroforestry sector has been fulfilling most of the wood as well as fuelwood demands in

India (Plywood: 80 per cent, Paper: 60 per cent). [2]

- Over the decades, market saturation, farmers not being paid remunerative prices by the paper mills, and legal restrictions on the transport and sale of wood have doused the initial enthusiasm. If farm forestry is to be revived to feed the growing timber hunger of Indian industry, dishonest middlemen need to be weeded out and the legal processes involved in the growing, sale and transport of wood need to be smoothened.

Species-wise volume of trees and number of stems under agroforestry systems in India

Species-wise volume of trees under agro-forestry systems in India			Species-wise number of stems under agroforestry system in India (number in thousand)				
Species	Total volume (in million cum)	Percentage	Diameter class (cm)				Percentage
			10–30	30–50	50 +	Total	
Mangifera indica	149	13.3	255,815	60,917	28,323	345,055	9.2
Azadirachta indica	76	6.8	176,671	27,952	3,844	208,467	5.6
Borassus flabelliformis	64	5.7	18,551	74,411	1,276	94,238	2.5
Madhuca longifolia	64	5.7	6,573	6,467	11,546	24,586	0.7
Cocos nucifera	60	5.3	168,423	43,238	101	211,762	5.7
Rest of the species	711	63.2	2,526,692	267,703	52,867	2,847,262	76
Total	**1,124**	**100**	**3,152,725**	**480,688**	**97,957**	**3,731,370**	**100**

Source: India State of Forest Report, FSI, 2013

Bamboo

Bamboo is a valuable forest resource with immense potential as it grows fast and supports local economies. India has great potential to bend it like bamboo, but is held back by problems, including those in its value chains, regulatory and legislative barriers to cultivation and harvesting of bamboo, difficulties in its procurement, lack of technical knowledge among the primary users of bamboo, and insufficient market linkages. In addition, different regulatory bodies do not seem to have a unified view on whether bamboo is a 'tree' or a 'minor forest produce'. Better definitions, and smoother laws, can help India spread a prosperous canvas over its flourishing tall bamboo. Production of bamboo in india is given below.

- Number of culms in India = 23,297
- Green sound = 79%
- Bamboo growing on private lands = 15.4%
- Dry sound = 16%
- Decayed = 5%
- Annual production = 3.23MT

Imports (Timber and allied products)

India is a net importer of timber and allied products. In 2019, India imported an estimated 18.01 million cum of timber, pulpwood and allied products worth US $6,701.3 million, which included wood logs, panel and plywood, pulpwood, paper, furniture and other wooden products. Under all categories of timber, wood logs and paper constitute the major part of Indian wood imports[3].

Wood consumption

In its 2019 assessment, FSI has provided the estimates of consumption of timber in only three sectors (in non-fuelwood categories)—housing, furniture and agricultural implements.

Adding all categories, the total estimated wood consumption (excluding fuelwood) in India comes to about 69 million cum per year. This may be a gross underestimation, considering that a large share of wood markets, especially panel and plywood, and furniture markets, are fairly unorganized, and no official estimates are available for the same.

Fuel wood alone amounts to approximately 90 percent total wood production in India. It is still the dominant energy source in rural India, which indicates the paucity of alternatives in the countryside.

Annual estimated wood consumption in India (in million cum)

Annual estimated consumption	million cum
Construction, furniture and agricultural implements (RWE)	48
Plywood and panel	8.47
Paper, paperboard and newsprint	12.52
Fuel wood	33.33
Total annual wood consumption	402
Total annual timber consumption	69

Exports (Timber and allied products)

Paper and paperboard, and furniture are the categories in which India exports most of its timber products. Indian exports of wood logs from 2001 to 2015 have been extremely low in comparison with its imports under the same category, except in 2015, when India imported over two million cum of confiscated Red Sanders wood worth $80 million.

Projections of future growth

From 2001 to 2015, the total imports of timber by India has steadily increased by an average of 0.9 million cum. If the imports increase at the same rate for the next 15 years, India's imports in 2020, 2025 and 2030 are projected to be 22.51, 27.01 and 31.5 million cum, respectively.[4]

Indian exports of timber have also increased marginally by an average of just 0.11 million cum per year from 2001 to 2014. Exports in 2015 have been discounted from the calculation of the average because of the large scale exports of the confiscated Red Sanders in the same year, which doesn't give a true picture of Indian exports.

Therefore, considering the average Indian exports of timber under all categories at 0.11 million cum per annum, Indian timber exports are projected to reach 2.35, 2.9 and 3.45 million cum in 2020, 2025 and 2030 respectively.

References

FAO, 2009.India Forestry Outlook Study, Ministry of Environment and Forests, Government of India, Working Paper No.APFSOS II/WP/2009/06.

S. B. Chavan, A. Keerthika, S. K. Dhyani, A. K. Handa, R. Newaj, & K. Rajarajan, 2015. National Agroforestry Policy in India: a low hanging fruit. Current Science, 108(10), 1826.

FSI (Forest Survey of India), 2013.India State of Forest Report 2013.

ManmohanYadav, 2016. Handbook on Forest Certification.The Energy and Resources

बंजर भूमि में ऑवले की बागवानी

ऋषिकेश तिवारी एवं भूमिका तिवारी
जवाहरलाल नेहरु कृषि विश्वविद्यालय
जबलपुर (मध्य प्रदेश)
ई-मेलः rishikeshtiwarijnkvv@gmail.com

ऑवला गर्म जलवायु का वृक्ष है जो कि प्रतिकूल परिस्थितियों में भी सफलतापूर्वक उगाया जा सकता है। इसके लिए अधिक उपजाऊ जमीन की आवश्यकता नही पड़ती है। पौधों में वानस्पतिक वृद्धि अधिक व फलत कम होती है। इस पर लू व पाले का अधिक प्रभाव नहीं होता है। इसकी खेती बारानी एवं बंजर भूमि पर भी की जा सकती है। खेत में जल विकास की समुचित व्यवस्था करनी चाहिए।

किस्में

नरेन्द्र ऑवला-4 : फल छोटा व रेशामुक्त, अचार, चटनी, त्रिफला के लिए उपयुक्त।

नरेन्द्र ऑवला-6 : रेशा रहित फल कैण्डी व मुरब्बा के लिए उपयुक्त।

नरेन्द्र ऑवला-7 : फल रेशा रहित विभिन्न उत्पादों के लिए उपयुक्त फलन रोपाई के तीसरे साल प्रारम्भ।

नरेन्द्र ऑवला-10 : अगेती किस्म, फल रेशा रहित।

प्रवर्धन

ऑवले के बीज को 24 घण्टे भिगोने के बाद अप्रैल-जुलाई तक बोते है। 4-6 माह बाद पेन्सिल की मोटाई के बराबर होने पर मूलवृन्त पर कलिका चढ़ाकर पौध करके कम समय में अच्छे साइज का फल प्राप्त कर सकते है।

पौधे रोपण

सूखे क्षेंत्रो में पेडों को लगाने के लिए 8-10 मी0 दूरी ठीक रहती है। बाग को तेज धूप व हवा से बचाने के लिए दक्षिण-पश्चिम दिशा में वायुरोधक वृक्ष जामुन, शीशम, बबूल या कभी-कभी बांस भी लगाते है। अप्रैल-मई में 1 X 1 X 1 मी. के गड्ढे बनाते है और 15-20 दिन के लिए खुला छोड़ देते है। इसके बाद हर गड्ढे में 40-60 किग्रा0 सड़ी गोबर की खाद व 200 ग्राम सुपर फास्फेट मिला कर 20-25 सेमी. ऊँचाई तक भरते है। सिंचाई देने पर जब मिट्टी बैठ जाये तब पौध लगाते हैं व तुरन्त पानी लगाते है।

खाद एवं उर्वरक

10 कि0ग्रा0 गोबर की खाद, 100 ग्राम नाइट्रोजन, 60 ग्राम फास्फोरस 75 ग्राम पोटाश प्रति वर्ष डालते है। अगले दस साल इसी अनुपात में बढ़ाते जाते है। इस प्रकार दसवें वर्ष से 100 किग्रा0 गोबर की खाद 1000 ग्राम नाइट्रोजन, 600 ग्राम फास्फोरस तथा 750 ग्राम पोटाश प्रति वर्ष प्रति पौधा खाद दें। सभी खाद एवं उर्वरक (आंधी नाइट्रोजन) फरवरी में डालते है तथा आधी जुलाई-अगस्त में फल वृद्धि शुरू होने पर देते है।

सिंचाई

गर्मियों में सिचाई की व्यवस्था नियमित करें। पौधे के चारों तरफ थाले में पत्ती या काली पॉलीथीन बिछाने से पानी कम उड़ता है व घास नियंन्त्रित रहती है। मार्च में कोपल निकलने के साथ 15 दिन के अन्तर पर जून तक पानी देने की आवश्यकता होती है।

कीट एवं रोग

माहू व पत्ती खाने वाला कीट

इसके रोकथाम के लिए मानोक्रोटोफास (2 मिली0/ली0 पानी) का एक या दो छिड़काव करें।

छाल खाने वाला कीट

कीट रात के समय शाखा विशेष कर जोड़ के स्थान में खाते है तथा गोलमल पदार्थ निकालते है। रोकथाम के लिए डाइक्लोरवास (2 मिली0/ली0 पानी) दवा का छिड़काव करें व सुराखों में मिट्टी की तेल, पेट्रोल डाल कर चिकनी मिट्टी से बन्द कर दें।

शूट गाल कीट

रोगग्रस्त भाग फूला हुआ दिखता है यह शाखा के अगले सिरे पर होता है गॉठो को तोड़कर जमीन में गाड़ दें रोकथाम माहू की तरह करें।

गेरूई

पत्ती पर गोल लाल धब्बे बनते है, जिसकी रोकथाम सल्फेक्स से करें।

फल विगलन

फलों पर जल सिक्त चोट बनती है जो बढ़ती जाती है। इस रोग से बचने के लिए तोड़ते समय सावधानी बरतें व फलों पर बोरेक्स या सोडियम क्लोराइड का छिड़काव करें।

फलों का आन्तरिक ऊतक क्षय

फल के गूदे में काले-काले धब्बे बन जाते है, जिसकी रोकथाम के लिए 6 प्रतिशत बोरेक्स सितम्बर से प्रति पखवाड़ा करें।

उपज

दस वर्ष की आयु में 100-150 तथा 15 वर्ष में 150-200 कि0ग्रा0 फल प्रति वृक्ष प्राप्त हो जाते है। जिससे प्रति हेक्टेयर 15-20 टन उत्पादन होता है व 30,000 रू0 तक की आमदानी हो सकती है।

Published by:

Impact Factor

SJIF: 2022-6.071

ICFRE-Tropical Forest Research Institute
(Indian Council of Forestry Research & Education)
(An autonomous council under Ministry of Environmnet, Forests and Climate Change)
P.O. RFRC, Mandla Road
Jabalpur – 482021, M.P. India
Phone: 91-761-2840484
Fax: 91-761-2840484
E-mail: vansangyan_tfri@icfre.gov.in, vansangyan@gmail.com
Visit us at: http://tfri.icfre.org or http://tfri.icfre.gov.in