(ISSN 2395 - 468X)

Year - 2016 Vol. 3, No. 3 Issue: March 2016

# Van Sangyan

*A monthly open access e-magazine*

**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

## Editorial Board



## Note to Authors:

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

by e-mail to vansangyan_tfri@icfre.org

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

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number.

TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

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

# From the Editor's desk

*Humans should be concerned about saving biodiversity because of the benefits it provides us –biological resources and ecosystem services. However, nature provides social and spiritual benefits as well. Biodiversity is being depleted by the loss of habitat, fragmentation of habitat, over exploitation of resources, human sponsored ecosystems, climatic changes, pollution, invasive exotic species, diseases, shifting cultivation, poaching of wild life etc.*

*Since the human beings are enjoying all the benefits from biodiversity, they should take proper care for the preservation of biodiversity in all its form and good health for the future generation i.e., the human being should prevent the degradation and destruction of the habitats thereby maintain the biodiversity at its optimum level.*

*Conservation of biodiversity is protection, upliftment and scientific management of biodiversity so as to maintain it at its threshold level and derive sustainable benefits for the present and future generation. In other words, conservation of bio-diversity is the proper management of the biosphere by human beings in such a way that it gives maximum benefits for the present generation and also develops its potential so as to meet the needs of the future generations.*

*Biodiversity conservation is about saving life on earth in all its forms and keeping natural ecosystems functioning and healthy. Conservation biology as a scientific discipline has grown enormously over the past few decades and has increased our awareness and understanding of the great extent to which humans depend on natural ecosystems and biodiversity.*

*Conserving biodiversity means ensuring that natural landscapes, with their array of ecosystems, are maintained, and that species, populations, genes, and the complex interactions between them, persist into the future. Biodiversity conservation relies on a number of disciplines working together, including ecology and other biological sciences, physical sciences, mathematics, and the social sciences such as economics, law, public policy and psychology.*

*This issue of Van Sangyan contains an article on Biodiversity conservation. There are also useful articles on Anthocephalus cadamba: a promising tree for industrial agroforestry, Carbon benefits from forest activities, Management of poplar cotton menace in Kashmir valley, Lantana camara: an important medicinal plant, Wild edible fruits, their nutritional and medicinal properties, Wasteland development through forestry, Enhancing terrestrial carbon sink through energy plantations, Tree insurance in India and biodiversity of Sinopodophyllum hexandrum and Ursus thibetanus.*

*I hope that readers would find all information in this issue relevant and valuable. Van Sangyan welcomes articles, views and queries on various issues in the field of forest science.*

*Looking forward to meet you all through forthcoming issues.*

**Dr. N. Roychoudhary**
Scientist G & Chief Editor

# Contents



*© Published by Tropical Forest Research Institute, Jabalpur, MP, India*

# Biodiversity conservation

**Dr. P. K. Khatri and Dr. Sanjay Singh**
Biodiversity Conservation and Sustainable Management Division
Tropical Forest Research Institute
P.O. – RFRC, Mandla Road, Jabalpur (M.P.)

## Introduction

Biodiversity by definition refers to structural and functional variety of the life forms at generic, population, species, community and ecosystem level. The diversity of life form we see around us is result of 4.5 billion years of evolution. The diversity of life forms at different level of organization viz. (Species, population, community, ecosystem, biome, and biosphere) are part of the living system of the earth. This system is designed to function in sync with each other. In his book "Biodiversity II: understanding and protecting biodiversity our biological resources", Edward O Wilson (1997) definition of biodiversity underlines every component of biodiversity in its hierarchical order, he defines biodiversity as "all hereditarily based variations at all levels of organization, from the genes within a single local population or species to the species composing all or a part of a local community and finally to the communities themselves that compose the living parts of the multifarious ecosystems of the world". Biological diversity is dynamic characteristics of the earth; every component (species to ecosystem) of this system has a designated function and plays a vital role in providing efficacy to the system. Diversity at each level of organization provides resilience to system against disturbances. We are still not sure about the diversity of life form on earth. Approximately 1.75 million species have been described by science so far, estimates of total number of species range between 5 million to 30 million. There are habitats in rainforest, inaccessible mountain ranges and deep sea which are yet to be explored. These habitats and are known to harbor rich and unique diversity.

## Biodiversity and mankind

Human society at different places has always resorted on native biological diversity for their existence. And this is often reflected in our tradition, culture and lifestyle. We are dependent on the biological resources for food, most of which comes from plants (Chopra 2000). Fodder for our livestock also come from the plant kingdom. Today about 80% of the population in developing countries use plants as primary source of medicine. Most

of our medicines have biological origin. We have been traditionally been dependent on plants to meet our demand for fibers and building material, things have not changed much, we still prefer plant derived fibers and building material. Recognizing our dependence on plants Dr. Panchanan Maheshwari once remarked that "We live on this earth as guest of plants". With the advent of agriculture, we started cultivation of plants of economic importance on large scale to meet our demands. However, of the quarter of millions of plants known to the mankind, 5000 have been extensively studied and 3000 are being cultivated throughout the world to meet the human demands. Most of the cultivated crops are derived from the wild races. Conservation wild population of cultivated varieties ensure maintenance of a broad genetic pool, genetic diversity is critical for developing new strains and breeds that suit a particular environment or are resistant to pests or disease and as a source of new crops in the becomes critical. The plants growing in wild conditions also provide food and shelter to the magnificently diverse fauna, which play a significant role in structure and function of the ecosystem. Apart from meeting the demands for sustenance, biological resources have contributed to the economy of nations since ancient times. Trade of Silk from China and Spices from India and South East Asia are known to have contributed to the economy of these nations since ancient times. In modern times, Tea, Coffee, Smoking Tobacco, Rubber, Cotton etc. are some of the major traded items contributing to the economy of the nation.

Biodiversity is the treasure throve which provide mankind with various possibilities, bio-prospecting has emerged as one of the major discipline which looks to nature for inspiration and as a resource for betterment of human life. Time and again the humanity has turned to biological diversity for finding solutions to different problems that have threatened the mankind. There are many such incidence where in the solutions derived from nature has turned the tables. Penicillin for example; the drug first extracted by Alexander Fleming in 1928, have earned him place among the Times 100 people of the century, it described his discovery, as "It was a discovery that changed the course of history. The active ingredient in that mold, which Fleming named penicillin, turned out to be an infection-fighting agent of enormous potency. When it was finally recognized for what it is—the most efficacious life-saving drug in the world—penicillin altered forever the treatment of bacterial infections". Of the 150 most prescribed drugs 57% have biological origin. Penicillin is only one among the long list of life saving drugs having biological origin. The tangible benefits of the biodiversity are well known, and together they provide a strong ground, to advocate conservation of biological diversity. There are many intangible benefits/ecosystem services provided by the biodiversity, each component of the biological diversity play its role in (i) Regulating global processes, such as atmosphere and climate (ii) Soil and water conservation (iii) Nutrient cycling (iv) Pollination and seed dispersal (v) Control of agricultural pests (vi) Scientific and educational value (vii) Recreational value (viii) Cultural, spiritual, and aesthetic value (ix) Structural and functional resilience in the community/ecosystem. Enumerating the ecosystem services of the biological

diversity make us realize that our existence depends on the biological diversity, as we are just one part of it, and we need to protect and conserve it for our own survival.

**Threats to biological diversity**

The loss of earth's biodiversity is one of the most critical environmental and developmental issues. As an estimate, less than 20% of original forests are intact and fully functional (Kurtz et al, 2008) Through years we have lost our natural forest to agricultural land, plantations and other land-uses (Chopra *et al*. 2000). In the last 400 year 1,100 species has gone extinct, this amount only to the species that were known to science there are many more unknown species which may have gone extinct unnoticed. Extinction is a natural process. On average one species goes extinct naturally every 500–1,000 years—this is the background rate of extinction. Earth has faced five mass extinction in the course of history, in which over half of its species got extinct suddenly; marked as Ordovician extinction, Devonian extinction, Permo-Triassic extinction, End-Triassic extinction, and Cretaceous Tertiary extinction. All this extinction occurred due to natural catastrophe (as predicted by Archeologists). Currently the earth is facing sixth mass extinction, and this time the chief cause is rise in human population. There are many species that are facing the threat of extinction due to various reasons. The UN Millenium Assessment found losses in biodiversity in the past 50 years' was more rapid than ever before in human history'(Staff writers, 2012). The IUCN Red List of Threatened Species maintains a comprehensive inventory of the global conservation status of biological species. IUCN released the Red List of 2012 in Rio+20 Summit on 19th July 2012, a total of 63,837 species were assessed of which 19,817 were found to be threatened with extinction. With 3,947 described as "critically endangered" and 5,766 as "endangered", while more than 10,000 species were listed as "vulnerable". Of the known species to science, 41% of amphibian species, 33% of reef-building corals, 30% of conifers, 25% of mammals, and 13% of birds are under various degree of threat. The IUCN Red List has listed 132 species of plants and animals from India as "Critically Endangered" (Sidhi 2012; Knight, 2012; Phelan, 2012). The pressing need for food fiber shelter and fuel and fodder combined with compelling need for economic development exert pressure on natural resources. the major causes identified for Biodiversity loss are (i) Habitat fragmentation (ii) Shrinking genetic diversity (iii) Deforestation & Urbanization (iv) Invasive alien species (v) Climate change and desertification (vi) Anthropogenic pressure (vii) Developmental project (viii) Pollution. To sustain the life-support services of planet earth for food security, resilience to natural disasters, and access to clean water and raw materials, we need to revisit our policy for improvements addressing biodiversity losses and changes (extinctions, changes in population sizes, distribution, species composition, genetic diversity).

**India in biodiversity context**

India is rich in biodiversity and is one of the 17 mega biodiversity centers of the world. With only 2.4% of the global land area, and 1.8% of global forest area, India is home to 11.8% of flora and 7.46 % fauna recorded by science. There are about 91, 000 species of animal and 45, 500

species of plants. It is one of the 8 Vavilovian centers of origin of crop plants; A total 902 wild ancestors of the cultivated plants found in our forest (Mathur *et al*. 2014). There are four Biodiversity hotspot in Inda out of the total 34 biodiversity hotspots identified globally, namely (i) Himalaya (ii) Western Ghats (iii) North-east Himalaya (iv) Nicobar Islands. UNESCO has incorporated Western Ghats in the World Heritage List owing to the high level of endemism. About 4,045 species of flowering plants are endemic to India, 69 species of birds, 156 species of reptiles and 110 species of amphibians are endemic to India (Mathur *et al.*, 2014). Owing to the climatic and geographical variations there are 15 identified agro-climatic zones India, choice of species and traditional farming system contributes to a huge spectrum of 811 cultivated plants. Livestock rearing is also one of the traditional practice in India, representing a broad spectrum of native breeds of cattle (34), buffaloes (12), Goat (21), Sheep (39) and Chicken (15). The diverse farming systems throughout the country contribute to the food security of the nation. The biodiversity of country faces threats, from habitat fragmentation, proliferation of invasive species, pollution, anthropogenic pressure and over exploitation.

**Biodiversity conservation**

India's cultural diversity and biological diversity is closely linked with its bio-geographical features, with ethical values of respect for nature as integral part of culture and religion. Conservation formed article of faith and was enshrined in religious practices, myths folklores and out tradition medicinal systems. Network of 8,024 sacred groves distributed throughout country, depicts our traditional conservation values. India strategy for conservation of biodiversity focuses on according special status and protection of biodiversity rich areas for their in-situ conservation (Kumar *et al.*, 2000; Somnathan *et al.* 2005). There is a network of 102 National Parks, 527 Wildlife sanctuaries, 57 Conservation Reserves and four Community Reserves, covering an area of 166,851 $km^2$ comprising 5.07% of country geographical area, additionally India has also establish 18 Marine Protected Areas (Mathur *et al* 2014). Apart from this India have 9 biosphere reserve of the total 621 Biosphere reserve spread throughout the world.

Indian constitution also provide guidelines for environment protection under article 48-and 51-A (g) of directives principles of state says that "the state shall endeavor to protect and improve the environment and safeguard the forest and wildlife in the country " and it is duty of every citizen to protect and improve national environment including forest, lakes, rivers and wildlife and to have compassion for living creatures." India was one of the first nations to recognize the source of value of the biodiversity, which is reflected in its policies to conserve biodiversity in India. These have taken the form of legislations such as Wildlife Protection Act of 1972, and its amendments, Forest Conservation act of 1980, that extended the colonial Forest Act of 1878 and 1927(Saberwal *et al.* 2001; Vasan 2005), Environment Protection Act 1986 and Biological Diversity Act 2002, Protection of Plant Varieties and Farmer's Rights Act, 2001, Forest Rights Act (FRA), 2006. Apart from the legislation of Central Government, there are various State-level legislations such as United Khasi-Jaintia Hills Autonomous District (Management and Control of Forests) Act, 1958 and

Garo Hills Autonomous District (Management and Control of Forests) Act, 1961 (Gokle, 2016). India is also a signatory to several international treaties and agreements in an attempt to strengthen international participation and commitment towards conserving biodiversity some of these are; The Convention on Biological Diversity 1992, The Convention on internation Trade in Endangered Species of Wild Flora and Fauna 1971, the Convention on Wetlands of International Importance 1971. It shows the commitment of our country towards conservation of Biological diversity

Apart from this in an effort for ex-situ conservation of its biological resources India has established six national bureaus dealing for conservation of the vast genetic resource, NBPGR maintains a national repository of total 408186 plant genetic resource accessions, NBAGR , maintains a repository of 1,23,483 specimens of frozen semen doses for 38 breeds of cattle, buffalo, sheep, goat, camel, yak and horse, NBAIM, maintains 4668 culture of indigenous and exotic microorganism of medical and agricultural importance, NBAII maintains 593 insect germplasm holdings. NBFGR maintains a repository of 2553 native fin-fishes (Mathur *et al.* 2014).

The goals of conservation can be met by involving people this have been achieved to some extent by State Biodiversity Boards and National Biodiversity Boards. Now is the appropriate time for linking ex-situ conservation and in-situ conservation for an effective protection of our biological diversity (Volis and Blecher, 2010). These efforts can be strengthened by involving Biodiversity Management Committee for establishment of Gene Bank at field level (in-situ) with an objective of conserving species in its natural habitat by protection. Seeds and propagules of native agricultural varieties and other economically useful plants can be collected and preserved; these Gene Banks and Seed Banks can be established at the village level. This will not only aid in conservation of native variety but it will also help communities to have a stake in the conservation and development of various species. Exchange of seeds between different Field Gene Bank will help enrich the genetic diversity and also provide a wide genetic base for genetic improvement and plant breeding.

**Conclusion**

The nature have given us the amenities far beyond our imagination, our societies in past have identified this and have always revered to the natural forces, plant and animals, by associating them with our deities. For supporting development we have explored and exploited our mineral resources and due to sheer neglect we have destroyed our precious Biological resource, which is supports our very existence on this planet. It is high time that conservation should be taken as priority at each level. The issues is well addressed at International and National level, individually also we can contribute to this cause by adopting eco-friendly way of living.

**References**

Chopra, K. (2000). Economic Aspects of Biodiversity Conservation: Micro and Macro Strategies for Intervention. Setting Biodiversity Conservation Priorities for India. S. Singh, A. R. K. Sastry, R. Mehta and V. Uppal. Delhi, WWF-India. 2:571-579

Gokhale, Y., Conservation of biodiversity and ecosystem services by REDD+ project in India. The Energy and Resources

Institute, New Delhi http:// www. moef. nic. in /assets/ redd-bk4. pdf. Retrived on 17 February 2016

Knight, M. 2012. Extinction threat' a call to world leaders' at rio earth summit. CNN World. June 20, 2012: 0955GMT Jun 19, 2012 @ 1:33 PMhttp:// edition.cnn.com /2012/06/19/world/rio-red-list-extinction-species/index.html. Retrieved on 11th Feb 2014Jun 19, 2012 @ 1:33 PM

Kumar, A., Walker, S., and Molur, S. (2000). Prioritisation of Endangered Species. Setting Biodiversity Conservation Priorities for India . S. Singh, A. R. K. Sastry, R. Mehta and V. Uppal. Delhi, WWF-India. 2:341-425

Kurz, W. A., Dymond, C. C., Stinson, G., Rampley, G. J., Neilson, E. T., Carroll, A. L., Ebata, T. and Safranyik, L. (2008). Mountain pine beetle and forest carbon feedback to climate change. Nature 452, 987-990 (24 April 2008)

Mathur, V., Kuppusamy, S., Pande, A., Chinnasamy, R. (2014). India's fifth national report to the convention ofbiological diversity 2014. Ministry of Environment and Forest Govt. of India: pp143.

Phelan, J. 2012 IUCN Red List update: Nearly 2000 species added. Global post June 19th: 1333 GMT http:// www. globalpost.com/dispatch/news/science/ wildlife- news / 120619/ iucn-red- list-update-2012 Retrieved on 11th Feb 2014Jun 19, 2012 @ 1:33 PM

Saberwal, V., Rangarajan, M., and Kothari, A., (2001). People Parks and Wildlife: Towards Coexistence. New Delhi, Orient Longman

Sidhi, K.S. 2012. Red list has 132 species of plants, animals from India. The Hindu Kochi 21 june 2012: 0824, IST http://www.thehindu.com/sci-tech/energy-and-environment /article3551664. ece? homepage = true Retrieved on 11th Feb 2014

Somanathan, E., Prabhakar, R., and Mehta, B. S. (2005) Does Decentralization Work? Forest Conservation in the Himalayas. Delhi, Indian Statistical Institute.

Staff Writers (2012) Threat to 'web of life' imperils humans, UN summit told; Terra Daily, June 19, 2012, http://www.terradaily.com/reports/Threat_to_web_of_life_imperils_humans_UN_summit_told_999.html . Retrieved on 11th Feb 2014Jun 19, 2012 @ 1:33 PM

Vasan, S. (2005). "In the Name of Law: Legality, Illegality and Practice in Jharkhand Forests. " Economic and Political Weekly 40(41):4447-4450

Volis, S., and Blecher, M. (2010). Wuasi in situ: A bridge between ex-situ and in-situ conservation of plants. Biodiversity Conservation. 19(9): 2441-2454

# *Anthocephalus cadamba*: A promising tree for industrial agroforestry

**S. Suresh Ramanan[1], R. Deepakkumar[2] and P. Bhuvanesh[3]**
[1]Department of Silviculture and Agroforestry,
College of Forestry, Kerala Agricultural, University, Thrissur– 680656.
[2]Department of Forest Utilization and Management
College of Forestry, Kerala Agricultural, University, Thrissur– 680656.
[3] Forest College and Research Institute, Mettupalayam- 641301.

Agroforestry is very old practice all round the globe. It has been defined in many ways. The simple definition for the agroforestry is a land use pattern in the tree component along with the agricultural crops and/ or animals maintained in a same piece of land.

The tree component is very important one in it as the benefit defines the entire success or failure of the agroforestry practice. It is because the package and practice of the different agricultural crops and good planting material are available for any agricultural crops while it's not the case of the many tree species. Many research institute and organizations are involved in developing package of practice- with main focus that the recommendations should suit the local conditions.

When looking into such conditions certain tree are extensively researched all-round the world like *Eucalyptus*, *Casuarina*, *Acacia mangium* and many others. In the list *Anthocephaluscadamba*to find its name. Here are some of the points that make it suitable for incorporation in agroforestry system.

From tropical origin it is a indigenous species to many tract of India. It can resist the drought condition for maximum of three months and can be grown in deep well drained loamy to red soil but its growth potential get reduced slightly in black cotton soil. It does not have any allelopathy effect on other component. Its leaves are being used as fodder. The main factor that makes it suitable for the agroforestry is the self-pruning ability of tree.

The lower most branches of the tree shed by itself but manual pruning enhance the growth of trees.

**Simple package of practices**

It is a largeevergreen or semi-evergreen tree, with a straight, cylindrical tree with tier branching. It can reach upto a height 15 m with a clean bole of about 9 m with smooth bark (young stage) and fissures appears during maturation. The leaves are alternate in arrangement, simple and glossy in structure without any epidermal growth making the leaf palatable for cattle and goats. The seeds are very minute in nature that they are dispersed by bats and also eaten by the bats due to the pulpy fruit.

**Phenology**

The tennis ball shaped fruit is green in colour and turns orange on ripening. The fruiting is followed by flowering on May to July and the fruits mature during January to February.

**Silvicultural characters**

Light demander and a moderately drought tolerant tree. It frost sensitive and light susceptible in young seedling stage. Has a

good coppicing ability that makes it as good fodder suitable tree.

**Propagation techniques**

Fruit are collected and sown after extraction by drying the fruits in sunlight and sieved to collect the seed. Apart from it soaking and extraction is also done. There around 1 million seeds (air dried) in 38-56g. The viability ranges from 6 months to 1 year to the maximum.

**Nursery technique**

Seeds being small in nature care are taken will going for nursery bed sowing. It has good germination of around 52 %. The germination of *A.cadamba* seeds in open beds is generally difficult and at best patch germination is obtained. Beds are protected from heavy rains during intial stage of the germination. Germination is completed by the end of 4 $^{th}$week.Out planting is done with 20-25 cm high seedlings.

**Planting technique**

The species are raised in polybags and are planted during June – July at start of monsoon when they are about 4-5 months old.

**Rate of growth**

The growth of tree is very promising in both block and as well as in linear planting. The fodder productivity is still being researched.

**Utility**

Wood Property: The wood is white to creamy white, odourless, light in weight (545 kg/cum at 12% moisture content), straight-grained and medium and even textured. Suspectible to sap staining fungus after cutting so proper treatment is need. Good for veneer making, pencil making and match wood production

**Fodder**

The leaves of the tree are used as fodder after mixing it with other forage grasses/

**References**

Krisnawati, H., Kallio, M. and Kanninen, M. 2011 *Anthocephalus cadamba* Miq. : ecology, silviculture and productivity, CIFOR, Bogor, Indonesia.

Forest College and Research Institute (FCRI). 2016. NAIP – A value chain on Industrial Agroforestry in Tamil Nadu [on line]. Available: http:// http://fcrinaip.org/ anthocephaluskadamba_cultivation.php.

# Carbon benefits from forest activities

**Vikas Kumar**
Department of Silviculture and Agroforestry, College of Forestry, Vellanikkara
Kerala Agricultural University, Thrissur, Kerala 680656, India

**Abstract**
Forestry has been recognized as a means to reduce $CO_2$ emissions as well as enhancing carbon sinks. Forests are a large sink of carbon. There is considerable interest to increase the carbon storage capacity of terrestrial vegetation through land-use practices such as afforestation, reforestation, and natural regeneration of forests, silvicultural systems and agroforestry. A couple of mechanisms have been created with the aim of supporting forestry activities that generate carbon benefits but due to lack of knowledge among forester and lack of information on how to estimate and measure the carbon benefits of forestry activities over time is the measure threat for application. The UNFCCC considers carbon benefits from forest ecosystems in three mechanisms such as REDD+, A/R CDM and NAMAs.

**Introduction**
Forest use and management practices in the past, which were concentrated more on timber production than forest services, resulted in a number of environmental and social problems, such as, land degradation, biodiversity loss, greenhouse gas emissions, and reduced access for local people. That means the forest use and management during this period was more timber-oriented than resource-based. Thus, important ecological values in the form of forest environmental services like ecotourism, water use, biodiversity, carbon stocks, with excellent potential development, were regarded as of minor importance. With respect to the shifting paradigm of forest management from timber-oriented to resource-based management, it stands to reason that the spirit of using the forest environmental services must be practically actualized and that carbon trade forms one of the promising potentials that need to be explored. In relation to the United Nations Framework Convention on Climate Change (UNFCCC), the Ministry of Forestry takes part in mitigation and adaptation activities that facilitate the implementation of both afforestation and reforestation under the Clean Development Mechanism (CDM) projects in Indonesia, either through the Kyoto Protocol or through other means outside the Protocol. The mitigation activities involve principally forest-tree planting with the main purpose of increasing carbon sequestration.

According to the Intergovernmental Panel on Climate Change (IPCC) reported that, the "Agriculture, Forestry and Other Land Uses" (AFOLU) sector produces 25 per cent of annual greenhouse gas (GHG) emissions globally (Smith et al., 2014). A significant fraction of the the AFOLU sectors arise GHG emission from tropical forests due to unsustainable land use and unscientific forest management practices. Agriculture is the biggest cause of deforestation, followed by logging, wildfires, and overgrazing. With that loss of forests, we lose the ecological services on which we all depend. Conversely, agroforestry and silvicultural systems,

Land Use, Land Use Change and Forestry (LULUCF), Reducing Deforestation and Forest Degradation and Enhancing Environmental Services (REDDES), Reforestation and forest preservation carbon offset projects, conservation and sustainable forest management can be provide carbon benefits which will ultimate mitigate climate change. A couple of mechanisms have been created with the aim of supporting forestry activities that generate carbon benefits but due to lack of knowledge among forester and lack of information on how to estimate and measure the carbon benefits of forestry activities over time is the measure threat for application. Forest activities can generate carbon benefits in three main ways:

I. Reducing GHG emission;
II. Sequestering carbon/ promoting carbon enhancement; and
III. Substituting carbon. Some of the forest activities are providing these benefits (Table 1).

**Table 1: Potential impacts of various forestry activities on carbon stocks**

| **Forest activity** | **Mitigation activity** | **Carbon benefit (according to decisions and ongoing discussions in the UNFCCC)** | **Relation to land use change if no project takes place (i.e. relation to "baseline /reference")** |
|---|---|---|---|
| Agroforestry and silvicultural systems | Increase landscape scale carbon stocks | Carbon sequestration/ carbon enhancement | Non forest to forest |
| Afforestation or reforestation | Increase forest area and carbon stock | | |
| Restoration | Increase site level carbon density | | Forest to forest |
| Conservation and sustainable forest management | Maintain a forest area and long term carbon density in areas under pressure | GHG emission reduction | Avoiding degradation and change forest to non forest |
| Biofuel plantations | Decrease GHG emission | Creating the potential for substitution | Non forest to forest |

Carbon benefits arise when the carbon stock maintained or increases. Forests have five carbon pools: aboveground biomass; belowground biomass; deadwood; litter; and soil organic matter (Figure 1). Agroforestry has an important role in reducing vulnerability, increasing resilience of farming systems and buffering households against climate related risk in additional to providing livelihood security (Kumar, 2015). The amount of carbon in the above ground and below ground biomass of an agroforestry system is generally much higher than in an equivalent land-use system without trees (Murthy *et al*., 2013). The growing body of literature indicates that agroforestry systems has the potential to sequester large amounts of above and below ground carbon in addition to soil organic carbon enhancement, as compared to treeless farming systems (Vikas, 2015).

Carbon management through afforestation and reforestation in degraded natural forests is a useful option, but agroforestry is attractive because (Kumar, 2016):

1. It sequesters carbon in vegetation and possibly in soils depending on the reconversion soil C.
2. The more intensive use of land for agricultural production reduces the need for slash-and burn or shifting cultivation, which contributes to deforestation.
3. The wood products produced under agroforestry serve as a substitute for similar products unsustainably harvested from the natural forest.
4. To the extent that agroforestry increases the income of farmers, it reduces the incentive for further extraction from the natural forest for income augmentation.

According to LULUCF, carbon sinks and their inclusion under the Kyoto Protocol's flexibility mechanisms has been a controversial issue during climate negotiations (Dessai, 2001). There are fears that inclusion of LULUCF could result a reduction of technological and financial transfers to developing countries or increase the spread of commercial plantations (Dutschke, 2001). Carbon storage and sequestration benefits are tightly associated with vegetation communities, which can be characterized relatively, well by habitat or land cover types (Gibbs et al., 2007). Land-use planning decisions also influence the risk and vulnerability of human settlements and ecosystems to climate change-induced extreme weather events: hazards including heat stress and extreme precipitation affect health, habitats, infrastructure and economies, all of which influence not only where we live, but our quality of life. The following keys are identified for addressing climate change through land use planning through LULUCF:

**Action planning**

Develop and adopt strong objectives for adaptation and mitigation and, where possible, mainstream climate change into management and decision making.

**Energy**

Reduce fossil fuel consumption through energy efficiency and conservation and low carbon energy planning in aspects of infrastructure renewal and community development.

**Research**

Collaborate and coordinate on research, including low-carbon technology, climate data, impacts and adaptation. Harness partnerships with academia and the business community.

**Resilience**

Enhance the resilience of infrastructure, communities, natural heritage and agricultural lands. Ensure that sites and opportunities for resilience are identified and reserved.

**Technology**

Facilitate the deployment of technologies that advance mitigation and adaptation goals in buildings, transportation and utility systems, including increasing distributed low-carbon energy supply.

**Environmental design**

Construct, rehabilitate and maintain green infrastructure (including urban green infrastructure and green roofs) to support infiltration and water management and reduce flood risks. Recognize additional benefits of improved building energy efficiency and reduced heat island effects.

**Equity**

Ensure effective and ongoing public consultation to identify and prioritize areas and individuals with highest vulnerability. Recognize differing risk tolerance levels and risk perceptions.

**Food**

Foster and support local food production and the reduction of travel distances for food. Protect and enhance agricultural lands.

**Transportation**

Reduce car use through the development of compact, transit-oriented communities, better design of transit and urban form, and the provision of public and active transportation alternatives.

**Urban form**

Promote compact, mixed-use development to increase density, reduce sprawl, improve air quality and reduce transportation GHGs.

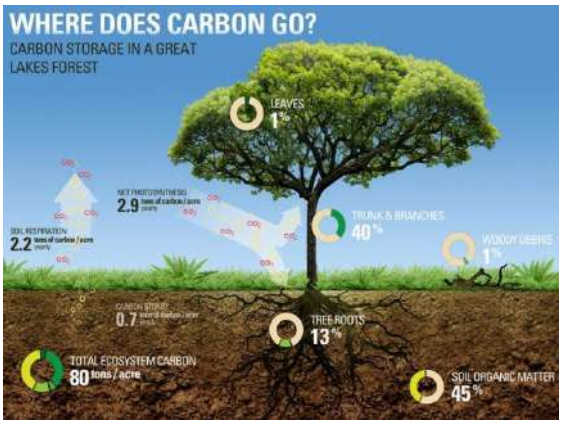


Figure 1: Forest carbon pools

Carbon benefits are estimated at the beginning or in the planning phase of an intervention and measured regularly during implementation. Two major challenges in estimating, measuring and monitoring carbon benefits are permanence and leakage. Permanence relates to the time that carbon remains in the biosphere. For example, a wildfire can release carbon into the atmosphere prematurely, reversing mitigation benefits, interventions should therefore promote an effect on the atmosphere that is as permanent as possible. Leakage concerns the potential for an intervention to cause GHG emissions beyond the boundaries of the intervention area, forester in change of mitigation activities should therefore try to ensure that interventions in one area do not result in emission in another area (Abad, 2015).

**Possible mitigation frameworks**

**Brief history of the framework convention on climate change**

Increasing scientific evidence about the possibility of global climate change in the 1980s led to a growing awareness that human activities have been contributing to substantial increases in the atmospheric concentrations of greenhouse gases.

**1988**

World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC).

**1990**

First finalization and adoption of the IPCC report and the Second World Climate Conference focused further attention on climate change.

**1990-92**

Original negotiation: On 11 December 1990, the 45th session of the UN General Assembly adopted a resolution that established the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC). Supported by UNEP and WMO, the mandate of the INC/FCCC was to prepare an effective framework convention on climate change.

**1992**

UNFCCC signed. Participants from over 150 states discussed the difficult and contentious issues of binding commitments, targets and timetables for the reduction of carbon dioxide emissions, financial mechanisms, technology transfer, and "common but differentiated"

responsibilities of developed and developing countries.

**1994**

UNFCCC entry into force.

**1995-97**

Kyoto protocol's first commitment period negotiations.

**1997**

Kyoto protocol signed. The Convention was complemented by the 1997, legally binding, Kyoto Protocol, which has 192 Parties, shown in green on the map to the right. Under this treaty, 37 industrialized countries and the European Community have committed to reducing their emissions by an average of 5% by 2012 against 1990 levels.

**1998-2001**

Kyoto protocol rules leading to development of "Marrakech Accords".

**2005**

Kyoto protocol entry into force.

**2006-12**

Kyoto protocol 2nd negotiation.

**2007-12**

UNFCCC negotiation on "Long-term cooperative action".

**2008-12**

Kyoto protocol 1st commitment period.

**2009**

Copenhagen accord.

**2011-15**

UNFCCC Durban platform on "Enhanced Action".

**2013-20**

Kyoto protocol 2nd commitment period.

**2014**

COP20 LIMA.

**2015**

New global treaty to be agreed in Paris.

**2020 onwards**

New global climate treaty/ protocol under the UNFCCC. Possible Kyoto Protocol 3rd commitment period.

**2020**

New global treaty entry into force.

**2020 and beyond**

The clean revolution is already underway. To achieve real emissions reductions we need the world decision makers to drive a clean revolution. The only feasible path to a smarter and better, more prosperous future.

The integrated framework builds on the experience of biodiversity mitigation while addressing the unique opportunities and challenges presented by ecosystem service mitigation. The United Nations Framework Convention on Climate Change (UNFCCC) defines carbon sequestration as the process of removing C from the atmosphere and depositing it in a reservoir. It entails the transfer of atmospheric $CO_2$, and its secure storage in long-lived pools (UNFCCC, 2007). From the agroforestry point of view, C sequestration primarily involves the uptake of atmospheric $CO_2$ during photosynthesis and the transfer of field C into vegetation, detritus, and soil pools for "secure" (i.e. long-term) storage (Nair et al., 2010). Different agroforestry systems sequestering varied amount of carbon based on type of system, species composition, soil and climate.

The guide differentiates between three mitigation frameworks are United Nations Framework Convention on Climate Change (UNFCCC), regulated market and voluntary market. The UNFCCC considers carbon benefits from forest ecosystems in three mechanisms such as REDD+, A/R CDM and NAMAs.

**REDD+**

Refers to a negotiation item within the UNFCCC as well as to a series of ongoing process, programmes and initiatives that

are exploring climate change mitigation options in the forest sector.

**A/R CDM**

Refers to project activities on Afforestation and Reforestation (A/R) in the Clean Development Mechanism (CDM) of the Kyoto Protocol and the possibility of establishing programmes of activities at the national level. This scheme gives smallholder rural communities, an opportunity to participate. Such projects should be able to sequester a maximum of 8 kg $CO_2$ per year. This could potentially involve an area of 500-800 ha depending on the species chosen and management of the project. The A/R CDM were agreed in 2003 and several approved methodologies are available such as National appropriate Mitigation Action (NAMAs) and Forest Carbon Market and voluntary standards (example: Climate, Community and Biodiversity Standards (CCBS), Vertified Carbon Standards (VCS), the Gold Standards, the American Carbon Registry (ACR), REDD+ Social and Environmental Standards (REDD+-SES)). The Clean Development Mechanism (CDM) is the only Kyoto mechanism that allows developed and developing countries to collaborate. There are a number of requirements to be met by project activities to ensure that they truly support "development" for the people living in the area, that they are "clean" and follow proper procedures. Technically, eligibility of lands for the implementation of CDM project activities has to comply with international rules and national regulations and priorities. In the first commitment period of the Kyoto Protocol, LULUCF activities under the CDM are limited to afforestation and reforestation or A/R CDM.

**References**

Abad, C.R. 2015. Quantifying the carbon benefits of forestry activities. ITTO Tropical Forest Update, 24(2): 23-26.

Dessai, S. 2001. Why did the Hague Climate Conference fail?, Environmental Politics 10(3): 139-144.

Dutschke, M. 2001. Permanence of CDM forests on non permanence of land use related credits? HWWAHamburg Discussion Paper, number 134.

Gibbs, H. K., Brown, S., Niles, J.O. and Foley, J. A. 2007. Monitoring and estimating tropical forest carbon stocks: making REDD a reality. Environ. Res. Lett., 2: 045023.

Kumar, V. 2015. Estimation of Carbon Sequestration in Agroforestry Systems. Van Sangyan, 2(5): 17-22.

Kumar, V. 2016. Universal Agroforestry Systems in Tropics Region- a review. Nature Environment and Pollution Technology. 25(2) (In press).

Murthy, I.K., Gupta, M., Tomar, S., Munsi, M., Tiwari, R., Hegde, G.T. and Ravindranath, N.H. 2013. Carbon sequestration potential of agroforestry systems in India. Journal of Earth Science & Climate Change 4(1): 1–7.

UNFCC, 2007. Report of the conference of parties on its thirteeth session, Bali, Indonesia. United Nations framework convention on climate change, Geneva.

# Management of poplar cotton menace in Kashmir valley

**M. A. Islam**

Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Benhama, Gandderbal-191201 (J&K), India

**Poplar in Kashmir**

Poplar trees, belonging to the genus Populus of the Salicaceae family, comprise a plethora of species, locally called "Pharas" and identified as the "people's tree" (Dar, 2013). Being ideal for agroforestry and social forestry the cultivation of poplars viz., *Populus ciliata, P. alba, P. nigra, P. caspica, P. tremula and P. deltoides* has been traditional in Kashmir for a long time (Islam *et al*., 2012). Wood from poplars is the backbone of vibrant plywood, board, match and paper industrial units in the valley (Masoodi *et al*., 2014).

**Poplar farming in Kashmir**

**Road side poplar plantation in Kashmir**

Russian poplar (*P. deltoides*), introduced into Kashmir on large scale as part of a World Bank aided Social Forestry project in 1980 to create wooded landscape, to meet the demand for construction timber and making fruit crates, propel the economy and to reduce the pressure on valuable coniferous forests (Kumar and Singh, 2012). *P. deltoides* provide huge cash returns to individuals and communities engaged in their cultivation and management, contribute considerably to government exchequer, reduce pressure on forests and entail massive ecological and environmental benefits besides providing a wide range of other wood products and employment opportunities to various subsidiary sectors (Kaushik *et al*., 2012). Kashmir cannot afford to do without *P. deltoides* because the tree provides low cost timber for roofing rafters, plywood, fencing, making crates to transport valuable produce like apples, peaches and pears.

**Cotton menace**

Unfortunately, the exhaustive plantation of *P. deltoides* by the Social Forestry Department and private landholders along the entire length and breadth of the Kashmir valley, without the identification of appropriate clones, has created the problem of cotton menace (Gangoo *et al*., 2015). The female clones of the *P. deltoides* on attaining maturity produces seeds enclosed in "cotton fluff" which is a characteristic feature of female poplars and

keep people baffled during summer in the valley. Usually female (pistillate) flowers are located in drooping catkins, when fully developed and are 10 to 15 cm long. Each catkin carries about fifty separate flowers, and each flower consists of a single green bract, a basal green cup and a pear shaped green ovary tipped by four styles. These flowers ripen rapidly to small green fruit pods, which split to release masses of tiny seeds in the mid-summer (May and June). Each seed is surrounded by tufts of long, white, silky hairs attached to the short stalks of the seeds.

**Poplar male catkin**


**Poplar female catkin**

Poplars are generally prolific annual seed bearers and produce enormous quantities of cotton virtually every year (Gangoo *et al*., 2015). The cotton is dispersed only by female trees, and only for 5 to 8 weeks to distribute their seeds as widely as possible. Though, both sexes flower, only the female trees produces fruits. Airborne pollens and spores trapped in poplar cotton, on entering in the human nose and throats results in pollen allergy, which is commonly known as hay fever and also triggers asthma and conjunctivits. Visible signs include post-nasal drip with sneezing and coughing, stuffy nose, itchy and watering eyes along with inflammation of eyelids causing redness, headaches, sore throat, temporary loss of smell sense and trouble in breathing. The poplar cotton also becomes potential fire catching material in the valley.

**Poplar cotton**

**Cotton dispersal**

**Management**

**Public awareness**

The measures which can be adopted to manage the poplar cotton menace in Kashmir valley are:

Making people aware that poplar cotton do not induce any allergic condition in human. However, it could be a carrier of

some of the pollen and fungal infections that cause allergic reactions.

**Precautionary measures**

People sensitive to seed pollen allergies should use mask when exposed to the cotton during April-June when seeds are shed. They should avoid going to places having large scale poplar plantations.

**Lopping of female poplar**

The upper branches of the trees produce more seeds and therefore, more cotton than the lower branches, so lopping of these branches before fruit formation could help in minimizing the dehiscence quantum.

**Controlled destruction of cottony stuff**

The cotton tufts may be collected and destroyed by burning or burying under control conditions, so that it does not spread and become a fire hazard.

**Removal of female poplars**

Identification of female poplars at the time of flowering and subsequent removal in a phased manner will help to curb the cotton menace.

**Multiplication of male poplars**

The male poplars should be identified and multiplied vegetatively through cuttings.

**References**

Dar, M.A. 2013. Poplar Seedling-Nuisance in the paradise Valley. *Science Reporter*, 5: 19-22.

Gangoo, S.A., Masoodi, T.H., Shah, M. and Islam, M.A**.** 2015. Management of exotic poplars for production of quality timber and reducing cotton menace in Kashmir. *The Indian Forester*, 141(5): 514-519.

Islam, M.A., Banyal, R., Rai, R. and P.K. Singh, 2012. Determinant Factors of Agroforestry Adoption in North Kashmir. *Indian Journal of Social Research*, 53(2): 123-129.

Kaushik, A., Negi, R., Barthwal, S. and Singh, Y.P. 2012. Mapping Research on Poplar (*Populus spp*.) in 'Forest Science Database', *Forestry Bulletin*, 12(1): 151-156.

Kumar, D. and Singh, N.B. 2012. Status of Poplar Introduction in India. *Forestry Bulletin*, 12(1): 9-14.

Masoodi, T.H., Ahmad, H., Gangoo, S.A., Sofi, P.A., Bhat, M.A. and Islam, M.A. 2014. Ecological occurrence of Himalayan Poplar (*Populus ciliata* Wallich. Ex. Royle.) and its nursery evaluation under temperate conditions of Kashmir. *The Bioscan*, 9 (2): 585-588.

# *Lantana camara*: An important medicinal plant

**Shubhi Jain**
Forest Ecology and Rehabilitation Division
Tropical Forest Research Institute
P.O. – RFRC, Mandla Road, Jabalpur (M.P.)

*L. camara* (Linn.) is a small perennial shrub reaching up to the height of 1-3 m and grows in variety of environmental and edaphic conditions (Sharma, 1988). It has small tubular flowers that have four petals and are arranged in clusters at the end of stems. Flowers come in many different colors including red, yellow, white, pink and orange depending on location, age and maturity (Mohan Ram, 1984). Leaves are egg shaped, simple, arranged oppositely on stem and have a strong odour when crushed. The fruits of are berry like and turns to a deep purple color on maturity.

*L. camara* is an important medicinal plant commonly known as 'Spanish Flag' or 'West India Lantana'. It is native to central and south America and was brought to India around 80 years ago. It grows widely up to an altitude of 2000 m MSL. Its widespread and diverse distribution is a clear reflection of its wide ecological tolerances. The species occurs in varied habitats which include wastelands, rainforest edges, beachfronts and forests disturbed by activities such as fire or logging. It also thrive well in disturbed areas which includes roadside, railway tracks and canals. Anthropogenic activity further aggravates the invasion and allows it to spread (Day *et al.*, 2003). The two principal ingredients responsible for its widespread distribution are its growth under varied climatic conditions and no cap on temperature or rainfall limit. This species possesses antimicrobial, antifungal, medicinal, antioxidant,

antiulcerogenic and antifungal activities.

**Medicinal properties of *Lantana camara***

**anticancer and antiproliferative activity**

Antiproliferative means tendency to stop

cell growth specially malignant cells of tumour, which causes cancer. Different plant parts of *L. camara* have been reported for anticancer and

antiproliferative activity. Leaves of *L. camara* have been found to have antiproliferative activity against laryngeal and lung cancer cell lines. Methanol extract of *L. camara* leaves exhibited antiproliferative activity against NCI-H292 cells (% living cells= 25.8±0.19). Its leaves exhibited cytotoxic effect on Vero cell line. The methanol extract (500 µg $ml^{-1}$) inhibited the growth of cells 2.5 times less than Triton 100 × 1% (Gomes *et al.*, 2010; Pour *et al.*, 2011)**.** Oleanonic acid isolated from *L. camara* was screened for anticancer activity against a murine tumour (Ehrlich ascites carcinoma), and three human cancer cell lines, namely malignant skin melanoma, epidermoid laryngeal carcinoma and lymphoma (Ghosh *et al.*, 2010).

**Antibacterial activity**

The ability to resist growth is known as antibacterial activity. Ethanolic extract of *L. camara* leaves and roots were reported for antibacterial activity. The extracts exhibited antimicrobial activity against *Escherichia coli, Proteus vulgaris,* S*taphylococcus aureus, Víbrio cholareae*, and two multiresistant strains of *E. coli* and *S. aureus*. Three different solvent extract of leaves and flowers exhibited significant antibacterial activity against *E. coli*, *Bacillus subtilis* and *P. aeruginosa* and insignificant against *S. aureus*. Methanolic extract of different parts of *L. camara* were screened for antimicrobial activity against 10 bacteria and 5 fungi by disc diffusion method and broth microdilution method. The extract from leaves recorded the highest activity against Gram positive *Bacillus cereus* and Gram negative *Salmonella typhi* (Badakhshan *et al.*, 2009).

**Antifungal activity**

The ability to resist fungal growth is known as antifungal activity. The ethanol and hot water extract of *L. camara* exhibited efficient antifungal activity against white and brown rot fungi and its ethanol extract was highly potential at very low concentration (0.01%) against *Alternaria* sp. which causes different plant diseases especially in vegetable plants (Srivastava *et al.*, 2011, Tripathi *et al.*, 2009).

**Antimutagenic activity**

Antimutagens are the agents which interfere with the mutagenicity of a substance. The interference can be in the form of prevention of the transformation of a mutagenic compound into mutagen, inactivation, or otherwise the prevention of Mutagen-DNA. 22 β-acetoxylantic acid and 22 β-dimethylacryloyloxylantanolic acid from *L. camara* showed antimutagenic activity. Both compounds exhibited high antimutagenic activity in Mitomycin C induced mutagenesis in mice (Barre *et al*., 1997).

**Antiulcerogenic activity**

Open sore on an external or internal surface of the body, caused due to breakdown in the skin or mucous membrane is known as ulcer and the ability to resist ulcers is known as antiulcerogenic activity. Antiulcerogenic activity of the methanol extract of leaves of *L. camara* was reported on asprin, ethanol and cold resistant stress induced gastric lesions in rats. Pretreatment of the affected rats with the extract (200 and 400 mg/kg body weight) showed significant protective effect in all types of induced ulcers in rats. The extract resulted in dose dependent antiulcerogenic activity in all models (Thamotharan *et al*., 2010).

**Antioxidant activity**

Antioxidants are a group of molecules that prevents oxidation of molecules. Ethanolic extract of *L. camara* leaves exhibited significant antioxidant activity in *in vivo* studies. Younger leaves exhibited strong antioxidant activity than the older or matured ones. The extract decreased the extent of lipid peroxidation in the kidneys of urolithic rats (Bhakta *et al.,* 2009). *In vitro* studied were carried out by DPPH radical scavenging assay and Nitric oxide free radical scavenging assay. Extract exhibited high antioxidant properties in both the assays.

**Antihyperglycemic activity**

Tending to reduce hyperglycemia (high blood sugar) is known as antihyperglycemic activity. Oral administration of a methanol extract of *L. camara* leaves in alloxan induced diabetic rats showed significant dose dependent reduction of blood glucose concentration (Ganesh, 2010). In other study also methanolic extracts of *L. camara* leaves showed promising anti hyperglycemic activity against alloxan induced diabetic rates.

**Anti-inflammatory activity**

Antiinflammatory refers to the property of a substance or treatment that reduces inflammation or swelling. Aqueous extract of *L. camara* was reported for antiinflammatory activity in albino rats. Extract treatment (500mg/kg body weight) significantly decreased paw volume in carrageenan induced paw oedema test in rats (Gidwani *et al.,* 2009).

**Wound healing activity**

Wound healing is the process by which skin or other body tissue repairs itself after trauma Wound healing property of aqueous extract of leaves of *L. camara* was reported in rats. Topical application of the extract on the wound significantly enhanced the rate of wound contraction (98%), synthesis of collagen and decreased wound healing time (Nayak *et al.,* 2009). Ethanol extract of leaves of *L. camara* also reported wound healing activity in adult male Wister rats. Topical application of the extract over the wound significantly increased the wound healing activity. Histological analyses of healed wounds confirmed the role of extract in healing (Abdulla *et al.,* 2009).

**Antimotility activity**

Antimotility agents are drugs used to alleviate the symptoms of diarrhea Methanol extract of *L. camara* leaves was reported to possess antimotility activity in mice. Intestinal motility was assayed by charcoal meal test in mice. At a dose of 1 g/kg body weight, the extract completely inhibited the transit of charcoal in normal mice. Intra peritoneal administration of the extracts significantly reduced the fecal output in castor oil induced diarrhoea in mice (Sagar *et al.,* 2005).

**Antiurolithiatic activity**

Antiurolithiatic drugs prevent the formation of calculi in kidneys, uterus or bladder. Ethanolic extract of the leaves of *L. camara* was reported for antiurolithiatic activity against ethylene glycol and ammonium chloride induced calcium oxalate urolithiasis in male albino rats. Extract treatment significantly reduced the deposition of calcium, oxalate and also reduced urinary excretion of calcium, oxalate and creatinine (Mayee *et al.,* 2011).

**Mosquito controlling activity**

Mosquito control manages the population of mosquitoes to reduce their damage to human health and economies Mosquito larvicidal activity of methanol and ethanol extracts of leaves and flowers of *L.*

*camara* were reported against 3rd and 4th instar larvae of *Aedes aegypti* and *Culex quinquefasciatus* mosquito. Both extracts exhibited significant larvicidal activity against both species of mosquitoes. Essential oil from the leaves of *L. camara* was reported to possess adulticidal activity against *A. aegypti*, *C. quinquefasciatus*, *Anopheles culicifacies*, *A. fluvialitis* and *A. stephensi* mosquitoes with LD50 values 0.06, 0.05, 0.05, 0.05 and 0.06 mg/cm$^2$ while LD90 values were 0.10, 0.10, 0.09, 0.09 and 0.10 mg/cm$^2$ against *A. aegypti*, *C. quinquefasciatus*, *A. culicifacies*, *A. fluvialitis and A. Stephensi* respectively (Kumar *et al.*, 2008; Dua *et al.*, 2010).

**Antifilarial activity**

Filariasis is a parasitic disease caused by an infection through a roundworm of the filaroidal type and the agents or drugs that destroy the filarial worm is known as antifilarial agents and the activity is known as Antifilarial activity. Crude extract of *L. camara* stem possessed antifilarial activity. It resulted in the death of adult *Brugia malayi* and sterilised most of the surviving female worms in the rodent model *Mastomyscoucha* (Misra *et al.*, 2006).

**Effect on red blood cells**

Red blood cells (also known as RBCs, red blood corpuscles or erythrocytes) are cells in the blood which transport oxygen. The application of aqueous extract of *L. camara* indicated a significant increase of hemolysis and modifications on the morphology of RBC.

The present study was planned to achieve the following objectives:

- Phytochemical evaluation of different plant parts of *L. camara*.
- Evaluation of antioxidant activity in different plant parts of *L. camara.*
- Assessment of antibacterial activity in different plant parts of *L. camara.*

*Lantana camara* is considered to be one of the World's most invasive weeds. In India, it has occupied 13 million hectares area and is continuously spreading throughout the country. This species out-competes other more desirable species, leading to a reduction in biodiversity and cause serious problems if invades agricultural areas as a result of its toxicity to livestock as well as its ability to greatly reduce the productivity of farm land.

*L. camara* can be controlled to a large extent in the country with the use of this species in medicinal purposes. Hence, the research on different medicinal aspects and development of life curing drugs using this species is the urgent need of the hour.

**References**

Abdulla, M. A., P. Hassandarvish, H.M. Ali, S.M. Noor, M.F.H. Ahmad and N.S. Bashah, 2009. Acceleration of wound healing potential by *Lantana camara* leaf extract in experimental rats. *Res. J. Med. Sci*., **3**: 75-79.

Badakhshan, M.P., S. Sasidharan., N.J. Rameshwar and S. Ramanathan, 2009. A comparative study antimicrobial activity of methanol extracts of *Lantana camara* various parts. *Pharmacognosy Res*., **1**: 348-351.

Barre, J.T., B.F. Bowden., J.C. Coll., J. De Jesus., V.E. De La Fuente., G.C. Janairo and C.Y. Ragasa, 1997. A bioactive triterpene from *Lantana camara*. *Phytochem*istry, **26**: 321-325.

Bhakta, D. and D. Ganjewala, 2009. Effect of leaf positions on total phenolics, flavonoids and proantho-cyanidins content and antioxidant activities in *Lantana camara. J. Sci. Res.*,, **1:** 363-369.

Day, M.D., 2003. *Lantana* current management status and future

prospects. *Australian Centre for International Agricultural Research*. **5**: 1-20

Dua, V.K., A.C. Pandey and A.P. Dash, 2010. Adulticidal activity of essential oil of *Lantana camara* leaves against mosquitoes. *Ind. J. Med. Res*., **131**: 434-439.

Ganesh, T., S. Sen and M. Thilagan, 2010. Pharmacognostic and anti-hyperglycemic evaluation of *Lantana camara* var. aculeate leaves in alloxan-induced hyperglycemic rats. *Int. J. Res. Pharm. Sci*., **1**: 247-252.

Ghosh, S., and M. Sharma, 2010. Anti-inflammatory and anticancer compounds isolated from *Ventilago madraspatana* Gaertn., *Rubia cordifolia* Linn. and *Lantana camara* Linn. *J. Pharma. Pharmacol*., **62**: 1158-1166.

Gidwani, B.K., S. Bhargava, S.P. Rao, A. Majoomdar, D.P. Pawar and R.N. Alaspure, 2009. Analgesic, antiinflammatory and antihemorrhoidal activity of aqueous extract of *Lantana camara* Linn. *Res. J. Pharma. Technol.*, **2**: 378-381.

Kumar, M.S. and S. Maneemegalai 2008. Evaluation of larvicidal effect of *Lantana camara* Linn. against mosquito species *Aedesaegypti* and *Culex quinquefasciatus*. *Adv. Biol. Res*., **2**: 39-43.

Mayee, R. and A. Thosar, 2011. Evaluation of *Lantana camara* Linn. (*Verbenaceae*) for antiurolithiatic and antioxidant activities in rats. *Int. J. Pharma. Clin. Res*., **3**:10-14.

Misra, N., M. Sharma, K. Raj, A. Dangi, S. Srivastava and S.M. Bhattacharya, 2006. Chemical constituents and antifilarial activity of *Lantana camara* against human lymphatic filariid *Brugia malayi* and rodent filariid *Acanthocheilone maviteae* maintained in rodent hosts. *Parasitol. Res*., **100**: 439-448.

Mohan Ram, H.Y., 1984. "Flower colour changes in *Lantana camara*". *J. Exp. Bot.*, **35**: 1656–1662.

Nayak, B.S., S.S. Raju, M. Eversley and A. Ramsubhag, 2009. Evaluation of wound healing activity of *Lantana camara* L. - a preclinical study. *Phytotherapy Res*., **23**: 241-245.

Sagar, L., R. Sehgal and S. Ojha, 2005. Evaluation of antimotility effect of *Lantana camara* L. var. acuelata constituents on neostigmine induced gastrointestinal transit in mice. *BMC Complementary Alternative Med.*, **5**: 18-23.

Sharma, O.P., 1988. How to combat *Lantana camara* - A current perspective. *J. Sci. Ind. Res.*, **47**: 611–616.

Srivastava, D. and P. Singh, 2011. Antifungal potential of two common weeds against plant pathogenic fungi-*Alternaria* sp. *Asian J. Exp. Biol. Sci.*, **2**: 525-528.

Thamotharan, G., G. Sekar, T. Ganesh, S. Sen, R. Chakraborty and S.N. Kumar, 2010. Antiulcerogenic effects of *Lantana camara* Linn. leaves on *in vivo* test models in rats. *Asian J. Pharma. Clin. Res*., **3**: 57-60.

Tripathi, S., K. Rawat, D. Swati and P. Himani, 2009. Potential of *Lantana camara* Linn. weed against wood destroying fungi. *Ind. Forester*, **135**: 403-411

# Wild edible fruits, their nutritional and medicinal properties

**Dr. P. Shivakumar Singh**
Department of Botany, Palamuru University, Mahabubnagr-509001,
Telangana, India.

**Abstract**
In the current article the 34 reveals the edible wild fruits and their nutritional, medicinal properties were reported. The outcome of this research is exploring the wisdom on documentation and conservation of wild fruit plants consumed by rural, folkloric people. Of 34 wild edible fruit species belonging to 24 genera and 19 families were found valuable. The leading families Anacardiaceae (04 species) followed by each of three species from Annonaceae, Arecaceae, Moraceae, whereas Combrataceae, Cucurbitaceae, Euphorbiaceae, Rhamniaceae, Rutaceae having 02 species of each family. The remaining nine families show single species. There are no side effects if we have consumed wild edible fruits. The rich amount of anti-oxidants, secondary metabolites and micro, macro elements were found in wild fruits. This type of information could contribute awareness in rural, below poverty people.

**Keywords:** Wild edible fruits, Medicinal properties, Folkloric knowledge, Mahabubnagar, Telangana.

**Introduction**

From the time when early times, the man had used plants for various purposes like medicine, fuel, timber and food. The documented wisdom on the usage of traditional, folkloric, ethnic knowledge on plants as medicine is glowing accredited (Anonymous, 1994; Maheswari, 2000), but there are no evidences on wild fruits authentication. However, the knowledge on the use of wild fruit plants as food is very much limited (Jain 1964; Durby, 1997; Katewa et al., 2000; Lalramnghinglova, 1992; Priya Ranjan, 2000; Sudhakar and Vedavathy, 2000; Uniyal et al., 2002; Viswanathan, 2000). Major sections of population of Telangana living in villages and remote forests depend on edible wild fruits. Even the people in cities showing very much interest in purchasing wild edible fruits marketed by village folk. The plant assortment is very rich and an excellent quantity of wild fruit plants are using in the nutritional medicinal resources. There was no detail document on wild fruits from the specific study area.

There is no precise documentation on wild edible fruits and their nutritional, medicinal properties of wild plant fruits. The folk wisdom is hasty declining due to factors such as relocation of villagers to cities, input of high quality food in markets, etc. therefore, a investigation was undertaken to document rural knowledge on wild edible fruits of specific study area of Telangana state.

**Methodology**

Numerals of field trips were undertaken in south district of specific study area (Fig. 1). At each one time of trip, varied folkloric and forest or rural people's information was composed in diverse seasons. The information was accrued after discussions with several users like village workers, elder women and other local formers. Repetitive interviews through questionnaires were made in different villages to confirm the

information. Fruits and plants specimens were collected and identified with regional floras (www. ethnobotanicalsociety. blogspot.in. 2014; Pullaiah, 2010; Hooker, 1978; Pullaiah, 2015).

**About the boad study area**

Telangana State is situated in the central stretch of the eastern seaboard of the Indian Peninsula. Telangana state has an area of 114,840 square kilometres (44,300 sq mi). The area is divided into two main regions, the Eastern Ghats and the plains. Telangana lies between 15 50' – 19 55' North latitudes and 77 14' – 78 50' East longitudes. Telangana is bordered by the states of Maharashtra to the north and north-west, Karnataka to the west, Chattisgarh to the north-east and Odisha to the east and Andhra Pradesh to the south. The state is drained by two major rivers, with about 79% of the Godavari river catchment area and about 69% of the Krishna catchment area, but most of the land is arid. It is an extensive plateau with an average elevation of about 400 m above sea level. This plateau consists mainly of the ranges of erosion surface: (i) above 600 mt, (ii) from 300 – 450 mt and (iii) from 150 – 300 mt. The State Telangana has the monsoon type of tropical climate. On the whole State enjoys warm climate. In northern Telangana tropical rainy type of climate prevails. Hot Steppe type of climate is noticed in the southern parts of the State. In Tropical Rainy type, the mean daily 0 temperature is above 20C with an annual rainfall of 150 to 200 cms, mostly in summer and South-West monsoon. In the Hot Steppe type, the mean daily temperature is 18C and less. In the state of Telangana Maximum temperature in the summer season varies between 37C and 44C and minimum temperature in the winter season ranging between 14C and 19C. The State has a wide variety of soils and they form into three broad categories - red, black and laterite. The type of forests met within Telangana, as per the classification of Champion and Seth (1968) are Tropical moist deciduous forests, Southern dry deciduous forests, Northern mixed dry deciduous forests, Dry savannah forests and Tropical dry evergreen scrub[14]. In Telangana state there is about more than 20 tribes were recorded. Commonly they are located hilly and interior forest areas. The research report focusing on a number of the important wild food plants, which need to be documented for food security in future.

**Figure 1: Specific Study area Mahabubnagar District, Telangana State, India.**

**About the specific study area**

Mahabubnagar is the largest district (Figure 1) in Telangana in terms of area (18432.00 sq. km) covered. It is also known as Palamoor. The name was changed to Mahabubnagar in honour of Mir Mahbub Ali Khan Asaf Jah VI, the Nizam of Hyderabad (1869-1911 AD). The district was situated between 77° 15' and 79° 15'E, of the eastern longitudes and 15° 55' and 17° 20'N, of northern latitudes. Mahabubnagar is southern district of Hyderabad state under Nizam and bordered with River Krishna in the south and surrounded by the Guntur District of AP to the east, Kurnool district of AP to the south, Nalgonda and Ranga Reddy Districts to the north and Gulbarga and Raichur Districts of the state of Karnataka to the West.

The district has population of 40, 53, 028 as per the 2011 census which accounts for 11.52% of the total population of the State with 15.34% decadal growth. The people of this district are economically backward. They can speak three languages, knowledge flows from one culture to other. The plant assortment is very rich and an excellent quantity of wild fruit plants are using in the nutritional medicinal resources. There was no detail document on wild fruits from the specific study area.

**Results and discussion**

The present report on wild fruits and their medicinal and nutritional resources revealing a total of 34 wild fruits using in specific study area of Mahabubnagar district, Telangana state. The documentation has been carried out using standard questioner. Of 34 wild fruit species belonging to 24 genera and 19 families were found valuable. The leading families Anacardiaceae (04 species) followed by each of three species from Annonaceae, Arecaceae, Moraceae, whereas Combrataceae, Cucurbitaceae, Euphorbiaceae, Rhamniaceae, Rutaceae having 02 species of each family. The remaining 09 families showing single species. The current report described them in meticulous along with the habit, vernacular name, botanical name, family and nutritional, medicinal properties. The maximum nutritional ethnic or seasonal importance of wild fruit findings were predicted [Table 1]. The habitat of the wild fruit plants are shown in Fig. 2.

**Table 1: Wild edible fruits and their nutritional/medicinal properties.**

| Sl. No | Habit | Local Name | Botanical Name | Family | Nutritional, medicinal properties |
|---|---|---|---|---|---|
| 1 | Tree | Maredu | *Aegle marmelos* | Rutaceae | Aeromatic Tannin diarrhoea Dysentery Sweet drinks |
| 2 | Tree | Uduga | *Alangium salvifolium* | Alangiaceae | Astringent Laxative |
| 3 | Tree | Jeedimamidi | *Anacardium occidentale* | Anacardiaceae | nuts highly nutritious, adessert |

| | | | | | |
|---|---|---|---|---|---|
| 4 | Shrub | Anasa | *Anana sqomosus* | Bromiliaceae | Antiscorbutic Purgative Abortifacient |
| 5 | Tree | Lakshmana phalum | *Annona muricata* | Annonaceae | wine or cognac |
| 6 | Tree | Ramaphalum | *Annona reticulata* | Annonaceae | Anthelmintic. |
| 7 | Tree | Seetaphalum | *Annona squamosa* | Annonaceae | Vitamin-C |
| 8 | Tree | Tati | *Borassus flabellifer* | Arecaceae | Source of Vitamins |
| 9 | Tree | Sarapappu | *Buchanania lanzan* | Anacardiaceae | Leprosy |
| 10 | Climber | Thonda | *Coccinia grandis* | Cucurbitaceae | Skin diseases |
| 11 | Tree | Ravi | *Ficus religiosa* | Moraceae | Scarcity laxative |
| 12 | Tree | Konda ravi | *Ficus auriculata* | Moraceae | curries or jams |
| 13 | Tree | Medi Atti | *Ficus racemsoa* | Moraceae | diabetes bagatha. |
| 14 | Tree | Velaga | *Limonia acidissima* | Rutaceae | gum-arabic Acidity |
| 15 | Tree | Chimachinta | *Pithecolobium dulce* | Mimo*saceae* | eaten raw curries |
| 16 | Tree | Nallajeedi | *Semecarpus anacardium* | Anacardiaceae | skin diseases |
| 17 | Tree | Rachausiri | *Sicca acida* | Euphorbiaceae | chetnyes pickels |
| 18 | Herb | Mulla vankaya | *Solanum anguivi* | Solanaceae | skin diseases urinary retention fever cough asthma, |
| 19 | Herb | Kamanchi | *Solanum nigrum* | Solanaceae | Delightful jam. |
| 20 | Tree | Neradu | *Syzygium cuminii* | Myrtaceae | diabetic |
| 21 | Tree | Chinta | *Tamarindus indica* | Caesalpiniaceae | Refrigerant. |
| 22 | Tree | Mamidi | *Mangif era indica* | Anacardiaceae | vitamin C Scarcity. |
| 23 | Tree | Palachettu | *Manilkara hexandra* | Sapotaceae | Edible oil. |
| 24 | Climber | Agakara | *Mimordica dioica* | Cucurbitaceae | vegetable |

| | | | | | |
|---|---|---|---|---|---|
| 25 | Shrub | Nagajamudu | *Opuntia dillenii* | Cactaceae | Secretion of the bile. |
| 26 | Herb | Tigabenda | *Pavonia odorata* | Malvaceae | Highly nutrient |
| 27 | Shrub | Chittietha | *Phoenix loureiroi* | Arecaceae | astringent |
| 28 | Tree | Etha | *Phoenix sylvastris* | Arecaceae | Restorative preservative |
| 29 | Tree | Usiri | *Phyllanthus emblica* | Euphorbiaceae | Liver, piles,stomach eye treatments C vitamin |
| 30 | Tree | Tani | *Terminalia bellerica* | Combretaceae | purgative |
| 31 | Tree | Karakaya | *Terminalia chebula* | Combretaceae | dentifrices asthma |
| 32 | Climber | Adavi draksha | *Vitis heyneana* | Vitaceae | Eaten as raw |
| 33 | Tree | Regu | *Zizyphus jujuba* | Rhamnaceae | antidote to nausea vomiting abdominal pain |
| 34 | Tree | Pedda regu | *Zizyphus mauritiana* | Rhamnaceae | Cooling Chest troubles. |

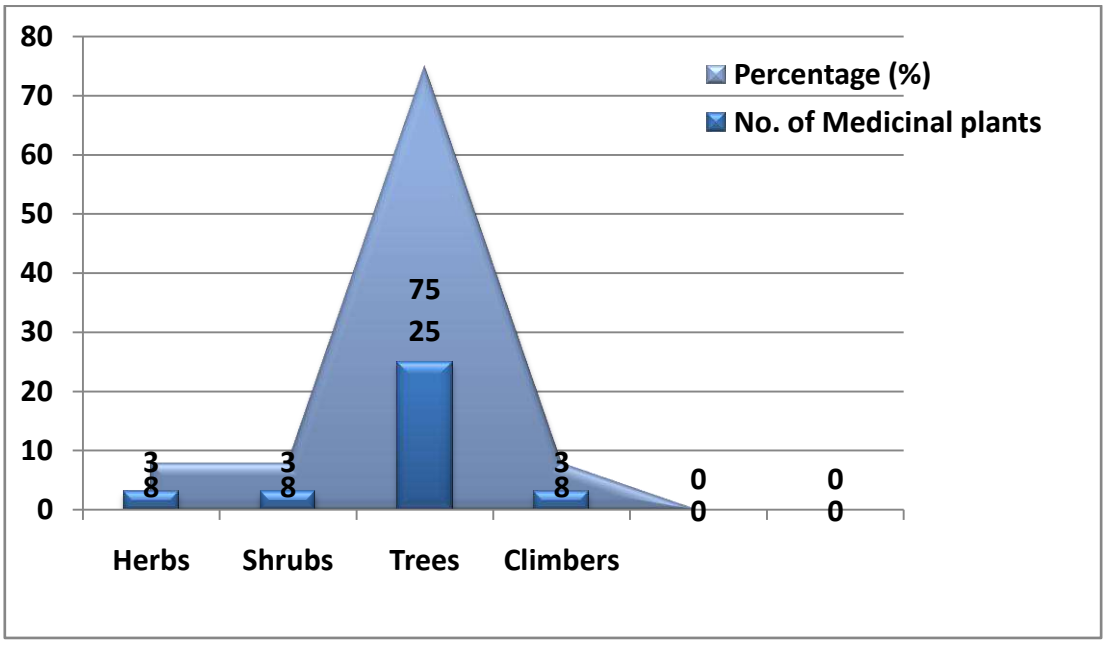


**Figure: 2: Fraction allocation of expansion forms of wild fruits and their habitat.**

Due to the importance of 34 species of wild fruit plants, The fruit pulp of *Limonia acidissima* mixed with bellam forms a good refreshing drink, which has an export value. Perusal of literature indicates the diversity of wild edible plants in different

regions in India. For example, edible wild fruit plants documented in North India (Kumar and Goel, 2000; Das, 2000; Jain, 1964; Arya, 2002; Sikarwar, 2002; Kothari and Rao, 2000; Sharma et al., 2000; Lalramnghinglova, 2000) are entirely different compared to South India (Viswanathan, 1997; Rajendran, 1994; Rajendran et al., 1997). Even in South India, the diversity of wild edible plants for Andhra Pradesh (Rajendran, 1994; Rajendran et al., 1997), Karnataka (Rao, 2000) is different from that of Telangana. Therefore, it is imperative to document the folk knowledge on wild fruit plants in specific study area for their optimum utilization and conservation.

**Conclusion**

Day by day the inhabitants are increasing abundantly, at the same time people are depending on artificial or cultivated fruits. This is resulting in the deficiency of nutritionals and medicines. Our ancestors' usually had been taken seasonal wild fruits. So that they wouldn't got any deficiencies. Today human being has been forgotten about the wild fruits or seasonal fruits. So the results we are observing. The present report is exploring awareness of wild fruits and their nutritional and medicinal properties. The outcome of this article is contributing some of interesting in conservation of traditional knowledge on wild fruits and their conservation.

**Acknowledgement**

Investigator is appreciative to rural, folkloric, ethnic peoples of specific study area Mahabubnagar district of Telangana for sharing their clandestine information on wild fruits.

**References**

Anonymous, Ethnobotany in India – A status report (Ministry of Environment and Forests, Govt. of India), 1994.

Maheswari J K, (Ed.) Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 672.

Jain S K, Wild food plants of the tribals of Bastar (M P), Proc Nat Inst Sci India, 30 (B), (1964), 56.

Durby W J, Gatiounglic P & Grivetti L E, Food- the gift of Orisis, 2 Volumes, (Academic Press, London), 1997.

Katewa S S, Ambica Nag & Buddadev Guria, Ethnobotanical studies on wild plants for food from the Aravalli Hills, South East Rajasthan, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 259.

Lalramnghinglova H, Food plants, Fruit plants and Medicinal plants of Mizoram, (Environment and Forest Department, Aizawl), 1992, 149.

Priya Ranjan, A contribution to some wild edible plants of Indo-Nepal border area, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 661.

Sudhakar A & Vedavathy S, Wild edible plants used by the tribals of Chittoor district (Andhra Pradesh), India, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 321.

Sanjay Kr Uniyal, Anjali Awasti & Gopal S Rawat, Traditional ethnobotanical uses of plants in Bhagirathi Valley (Western Himalaya), Indian J Traditional Knowledge, 1(1) (2002) 7.

Viswanathan M V, Edible and Medicinal plants of Ladakh (J&K), in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 151.

Www.ethnobotanicalsociety.blogspot.in. 2014.

Pullaiah T. Flora of Andhra Pradesh. Vol. 1-3. 2010.

Hooker JD. Flora of British India, Vol. 1-7. Bishen Singh and Mahendra Pal Singh, Dehra Dun.1978.

Pullaiah T. Flora of Telangana. Vol. 1-3. 2015.

Kaushal Kumar & Goel A K, Frequently used ethnomedicinal plants of Bihar, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 645.

Debabrata Das, Wild food plants of Midnapur, West Bengal, during drought and flood, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 539.

Jain S. K., Some less known plant foods among the tribals of Purulia district (West Bengal), Sci Cult, 30 (1964) 285.

Arya K R, Traditional uses of some common plants in indigenous folklore of Dronagiri: a mythic hill of Uttaranchal, Indian J Traditional Knowledge, 1(1) (2002) 81.

Sikarwar R L S, Mahua (Madhuca longifolia (Koen.) Macbride) – a paradise tree for the tribals of Madhya Pradesh, Indian J Traditional Knowledge, 1(1) (2002) 87.

Kothari M J & Rao K M, Ethnobotanical studies of Thane district, Maharastra, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 265.

Sharma H Manoranjan, Sharma B Manohar & Devi A Radhapyari, Contributions to the edible fruits of Manipur, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 615.

Lalramnghinglova H, Ethnobotanical and Agroecological studies on genetic resources of food plants in Mizoram state, in: Ethnobotany and Medicinal plants of Indian Subcontinent, (Scientific Publishers, Jodhpur), 2000, 637.

Viswanathan M V, Ethnobotany of the Malayalis in North Arcot district, Tamil Nadu, India, Ethnobotany, 9(1 & 2) (1997) 77.

Rajendran A & Henry A N, Plants used by the Tribe Kadar in Annamalai Hills of Tamil Nadu, Ethnobotany, 6 (1994) 19.

Rajendran A, Rama Rao N & Henry A N, Rare and noteworthy plants of eastern ghats in Andhra Pradesh with their ethnic uses, Ethnobotany, 9(1 & 2) (1997) 39.

Kameswara Rao C, Material for the Database of Medicinal plants, (Karnataka State Council for Science and Technology for the Department of Forests, Environment and Ecology, Govt. of Karnataka, Bangalore), 2000, 458.

# Wasteland development through forestry

**Abhishek Raj[1] and M.K. Jhariya[2]**

[1]Department of Forestry, College of Agriculture, Indira Gandhi .Krishi Vishwavidyalaya, Raipur- 492012. (C.G.), INDIA

[2]Department of Farm Forestry, Sarguja University, Ambikapur-497001. (C.G.), INDIA

**Abstract**

Forestry and Wasteland development as a sector plays a vital role in the socio-economic and rural development of a country apart from its role in maintaining ecological stability. Wasteland is degraded land, can be reclamation by the planting of suitable tree species and turning barren sterile wasteland into that is fertile and suitable for habitation and cultivation. This involves growing appropriate species of trees of economic value on degraded land that has been unutilized/ underutilized. Farm forestry, agroforestry, community forestry, social forestry, commercial forestry and commercial nurseries etc are various management practices used for reclamation of degraded and wasteland. In addition, the nature and causes of the land degradation, and the degree and extent of damaged lands need to be determined, so that developmental agencies in participation with stakeholders proactively adopt measures to reclaim degraded lands.

**Introduction**

Wastelands are degraded lands that lack their life sustaining potential as a result of inherent or imposed disabilities such as by location, environment, chemical and physical properties of the soil or financial or management constraints (CSIR, 1990). It includes area affected by water logging, ravine, sheet and gully erosion, riverine lands, shifting cultivation, salinity, wind erosion, extreme moisture deficiency etc. Due to complete loss of top soil these degraded lands are ecologically unstable and are unsuitable for cultivation. The main causes responsible for development wasteland include deforestation, shifting cultivation, over grazing, unskilled irrigation, industrialization activities, etc (Jhariya *et al.*, 2015). Out of total geographical area (329 million ha) of India, degraded area comprises 187 million ha (57%), of which 162 million ha is way of wind and water related degradation. Nearly 120.72 m ha of land in the country is degraded due to soil erosion and about 8.4 million ha has soil salinity and water logging problems (ICAR, 2011). The degradation of wasteland can be overcome by participatory approach like social forestry, joint forest management, community forestry, etc. with the help of local people in the planning and management of lands (Ramchandra, 2003) through afforestation of suitable species like Jatropha, Neem (Jhariya *et al.*, 2011 and 2013), Acacias (Raj *et al.*, 2015) etc. In addition, *Acacia nilotica* has other special value as gum production. *Acacia nilotica* gum is known as 'Indian gum Arabic'. It exudes from the wounds in bark. It generally exudes during March-May. It occurs in the form of rounded or ovoid tears and size up to 1cm and color varies from pale-yellow to brown or almost black (Raj, 2015a). As per Painkra *et al.* (2015) India is a rich

diversity centre of medicinal and aromatic plants and plays an important role in supporting health care system in India. Exploiting Babul tree for gum tapping will help farmers to strengthen their socioeconomic conditions as well as to help conserve environment and biodiversity too (Raj, 2015b). Likewise, Neem is natural source of insecticides, pesticides and agrochemicals and also used as bio-control agent to control many plant disease (Raj, 2014; Raj and Toppo, 2015).

**Causes of wasteland**

The main reasons of land degradation are over cultivation, deforestation, overgrazing, improper irrigation, increasing biotic presence, absence of adequate investments and appropriate management practice, high incidence of poverty in rural areas, faulty land use practices. Forty percent of the world's degraded lands are located in areas with high poverty rates, with the greatest threat being loss of soil quality, followed by biodiversity loss and water resource depletion and quality degradation (FAO, 2011d). The results of wasteland are soil erosion and land degradation, depletion of natural resources, lower or almost zero productivity and pressure on 'Forestland ', which is for our ecological security.

**Approaches in wasteland management**

The problem of wasteland must be tackled on an emergency basis. Management programmes should be given based on prioritized based on the severity of the degradation problems arising owing to water and wind erosions and anthropogenic activities. Reclamation of acidic, saline and sodic soils should get priority than other types of wasteland as these are chemical land degradation processes and materials needed for their amelioration and reclamation are easily available. As per Garg (1999) *Dalbergia sissoo* and *Prosopis juliflora are used* for the rehabilitation of sodic wastelands. These tree species produced significant root spread and deep penetration and able to rehabilitate sodic soil effectively. Further among tree species, *Prosopis juliflora* proved more effective than *Eucalyptus tereticornis* and *Dalbergia sissoo* in its ability to enrich a sodic soil with organic matter and establishing better soil–water characteristics (Mishra and Sharma, 2010). Likewise, tree species of *Albizia procera, Derris indica , Glyricidia sepium Gmelina arborea, Tamarindus indica*, etc suitable for reclamation of acidic soil; *Acacia auriculiformis, Bambusa* spp, *Terminalia arjuna, Thespesia populnea*, etc suitable for marshy soils; *Acacia auriculiformis, Anacardium occidentalis, Dalbergia sissoo, Dendrocalamus strictus* etc suitable for sandy soil. Similarly, cultivation of bio-fuel producing plants and fuel trees/crops should be encouraged in the degraded and wastelands. Wastelands due to mining should be reclaimed with suitable technologies and appropriate land use plans may be drawn up for better utilization of such landscapes. The commercial and cooperative agencies should be fully involved for requisite financial inputs and consumption loans for afforestation and reclamation. Whenever owner of a wasteland in unwilling to revegetate, government should take over such lands and being them under cultivation.

**Afforestation activities**

For making a good and clean environment, a huge-scale plantation should be done on the plain and hilly areas. Degraded lands, i.e. unfertile land, barren land and wasteland, are also reclaiming by with the

help of large-scale suitable plantation of suitable tree species. Moreover, wasteland can be reclaimed through afforestation activities like agroforestry, silviculture and social forestry; these should be adopted to protect agricultural lands from further deterioration arising out of degradational processes (Jhariya *et al.*, 2015). Afforestation is the establishment of forest or stand of trees in an area where there was no forest. In afforestation programme, forest plantation constitutes 5% of the world's total forest area or around 187 million ha (FAO, 2001). The average rate of successful plantation establishment over the last decades was 3.1 million ha per year, of which 1.9 million ha was in tropical area. Of the estimated 187 million ha of plantations worldwide, Asia has by far the largest area of forest plantation, accounting for 62% of the world total (Singh *et al*., 2005).

Reclamation depends on the type of wasteland. Some kinds of wastelands can be made fit for the development of agriculture. Others within a reasonable cost can only be made suitable for growing grasses, shrubs or trees and not crops. Afforestation activities like agroforestry, silviculture and social forestry should be adopted to protect agricultural lands from further deterioration arising out of degradational processes. Afforestation of degraded and wastelands should be given priority. This can be undertake with knowledge of choice of species and their role in different land use system which leads to influence both the rate and trajectory of rehabilitation process (Raj *et al.*, 2016).

Moreover, in the present scenario of climate change, agro-forestry practices, emerging as a viable option for combating negative impacts of climate change (Singh *et al*., 2013). In agroforestry model, a suitable combination of nitrogen fixing and multipurpose trees with field crops are played a major role in enhancement of better yield productivity, soil nutrient status and microbial population dynamics which plays a major role in nutrient cycling to maintain ecosystem (Raj *et al*., 2014a). As per Raj *et al*. (2014b) the soil biological attributes are also responsible for determination and maintenance of physical properties of soil.

**Conclusion**

Wasteland is regarded as a powerful tool of attacking the issues of poverty and backwardness. To mitigate these problems, we can adopt farming system under different agroforestry models *viz.*, alley cropping/hedgerow farming, multipurpose faming, boundary plantation and plantation with suitable pastures in erosion prone hilly area to reduce soil and water erosion. Overall, afforestation activities like agroforestry, silviculture and social forestry should be adopted to protect agricultural lands from further deterioration arising out of degradational processes.

**References**

CSIR (1990). Plants for Reclamation of Wastelands, Publications & Information Directorate, Council of Scientific and Industrial Research. New Delhi, India.

ICAR (2011). Vision- 2030. Krishi Bhavan, New Delhi, India.

Jhariya, M.K., Bargali, S.S. and Raj, A. (2015). Possibilities and Perspectives of Agroforestry in Chhattisgarh. In: Miodrag Zlatic, editors. *Precious Forests-Precious Earth.* InTech E- Publishing Inc; pp. 238-257.

Jhariya, M.K, Kittur, B. and Yadaw, K.N. (2011). Jatropha: An eco-friendly sustainable fuel source. *Int. Res. J. Lab to*

*Land*., 3(12): 566-569.

Jhariya, M.K., Raj, A., Sahu, K.P. and Paikra, P.R. (2013). Neem-A tree for solving global problems. *Indian Journal of Applied Research*, 3(10): 66-68.

Raj, A. (2014). Toxicological Effect of Azadirachta Indica. *Asian Journal of Multidisciplinary Studies*, 2(9): 29-33.

Raj, A. (2015a). *Evaluation of Gummosis Potential Using Various Concentration of Ethephon*. M.Sc. Thesis, I.G.K.V., Raipur (C.G.), pp 89.

Raj, A. (2015b). Gum exudation in Acacia nilotica: effects of temperature and relative humidity. In Proceedings of the National Expo on Assemblage of Innovative ideas/ work of post graduate agricultural research scholars, Agricultural College and Research Institute, Madurai (Tamil Nadu), pp 151.

Raj, A. and Toppo, P. (2015). Beneficial and Harmful Effects of Azadirachta Indica: A Review. *Paripex - Indian Journal of Research*, 4(3): 45-46.

Raj, A., Haokip, V. and Chandrawanshi, S. (2015). *Acacia nilotica:* a multipurpose tree and source of Indian gum Arabic. *South Indian Journal of Biological Sciences*, 1(2): 66-69.

Raj, A., Jhariya, M.K. and Pithoura, F. (2014a). Need of Agroforestry and Impact on ecosystem. *Journal of Plant Development Sciences*, 6(4): 577-581.

Raj, A., Jhariya, M.K. and Toppo, P. (2014b). Cow dung for ecofriendly and sustainable productive farming. *International Journal of Scientific Research*, 3(10): 42-43.

Ramachandra T.V. (2003). Cumulative Impact Assessment in Sharavathi river basin, Final Report submitted to Karnataka Power Corporation Ltd.

Singh, N.R., Jhariya, M.K. and Raj, A. (2013). Tree crop interaction in agroforestry system. *Readers Shelf*, 10(3): 15–16.

Painkra, V.K., Jhariya, M.K. and Raj, A. (2015). Assessment of knowledge of medicinal plants and their use in tribal region of Jashpur district of Chhattisgarh, India. *Journal of Applied and Natural Science*, 7(1): 434 – 442.

Raj, A., Jhariya, M.K. and Toppo, P. (2016). Scope and potential of agroforestry in Chhattisgarh state, India. *Van Sangyan*, 3(2): 12-17.

FAO (2011d). The State of the World's Land and Water Resources for Food and Agriculture: Managing systems at risk. Rome.

FAO (2001). State of the World's Forest. Food and Agriculture Organization of the United Nations, Rome.

Singh, J.S., Singh, S.P. and Gupta, S.R. (2005). Ecology Environment and Resource conservation. *Anamaya publication*, New Delhi. Pp. 492.

Garg, V. K. (1999). Leguminous Trees for the Rehabilitation of Sodic Wasteland in Northern India. *Restoration Ecology*, 7: 281–287.

Mishra, A. and Sharma, S. D. (2010). Influence of forest tree species on reclamation of semiarid sodic soils. *Soil Use and Management*, 26: 445–454.

# Enhancing terrestrial carbon sink through energy plantations

**Sangeeta Verma**
Forest Ecology and Rehabilitation Division
Tropical Forest Research Institute, Jabalpur

**Introduction**

Technically speaking, energy plantation means growing select species of trees and shrubs which are harvestable in a comparably shorter time and are specifically meant for fuel. The fuel wood may be used either directly in wood burning stoves and boilers or processed into methanol, ethanol and producer gas. These plantations help provide wood either for cooking in homes or for industrial use, so as to meet local energy needs in a decentralised manner. The energy plantations provide almost inexhaustible renewable sources (with total time constant of 3-8 years only for each cycle) of energy which are essentially local and independent of unreliable and finite sources of fuel. The attractive features of energy plantations are: (a) heat content of wood is similar to that of Indian coal, (b) wood is low in sulphur and not likely to pollute the atmosphere, (c) ash from burnt wood is a valuable fertiliser, (d) utilisation of erosion prone land for raising these plantations helps to reduce wind and water erosion, thereby minimising hazards from floods, siltation, and loss of nitrogen and minerals from soil and (e) help in rural employment generation. Selection of multipurpose species provides a number of by-products like oils, organic compounds, fruits, edible leaves, forage for livestock etc.

**Criteria for selection of species**

Useful criteria for selecting species for fuel-wood in developing countries are that they should be:

- Preferably coppicing hardwoods
- Adapt well to the site conditions
- Easy to establish and require minimum care, especially where the establishment is by farmers in agroforestry situations.
- Readily available as seed or plants
- Grow rapidly with early culmination of current annual increment
- Have nitrogen-fixing ability
- Produce high-calorific wood, which burns without sparks or toxic smoke, splits easily and dries quickly. Usually they are moderate to high-density species.
- Have resistance to goat and wildlife damage, unless grown also for fodder
- Multi-purpose species.

Stem straightness is not a criterion per se for fuelwood especially for non-industrial users; nor is always desirable to grow large sized trees, as this can make manual handling difficult. There is a wide range of species that meet many of the above criteria (National Academy of Sciences 1980, 1983; Nair 1993). Yields, given good sites without long dry seasons and careful management, can be high for some species such as some of the eucalypts and acacias. However, for arid regions without irrigation, productivity will be low. Many of the species suitable for these drier sites are either shrubs or small trees. Some potential species are

aggressive pioneers and can become weeds (e.g. *Prosopis juliflora* and some acacias).

**Silvicultural aspects**

Silviculture needs to be adapted to the situation, taking into account the species, biophysical aspects (climate, site, weeds) and social setting. For agroforestry-based plantings and small farmer woodlots, the actual silviculture should be simple and readily adopted by local people. The most important factors that need to be considered are species choice, seed or plant availability, perhaps local nursery production, spacing and layout, planting, initial weed control and animal control, if palatable. Big productivity gains can often be made if quality planting-stock are handled and planted carefully and subsequently kept weed-free in the early years. Subsequent management and biomass harvesting depends on the agroforestry system (Nair 1987, 1993). Plantations or woodlots designed for energy usually use the coppice system, providing that the species sprout reliably. The coppice with standards is useful where there is a desire to provide some larger logs for construction or other purposes, as well as wood fuel. With wood-fuel woodlots on farms, spacing often range from 1 to 3 m, planted on a square pattern. Closer spacing generally will produce the largest biomass of small piece size in the shortest possible time; wider spacings have the ability to produce larger piece size and will give more flexibility with rotation length without risking suppression of some stools. Wider spacings also allow for some crops or animal grazing beneath and may be more suited to arid regions. Occasionally irrigation is a possibility in some drier areas and if used along with weed control, will increase productivity substantially. Rotation length will vary with site and species and with coppicing species is related to ensuring stools are not suppressed. Typically rotation lengths range from 3 to 15 years. For larger scale industrial plantings more intensive silviculture may be possible, provided it is economic. For example, for eucalypts it could follow those used in pulpwood plantations and aim to produce uniform high-producing crops (Turnbull 1999).

Practices could include:

- Active seed selection and breeding programmes.
- The use of advanced nursery techniques, including clonal systems.
- Intensive establishment with practices such as soil cultivation, good chemical weed control and fertilisers at planting.
- Control of pests and diseases.
- Rotation lengths of 5-10 years.
- Mechanised harvesting which, where sustainability is a priority, will leave behind nutrient-rich parts of the biomass and concentrate removal of woody biomass.

Such advanced practices offer the possibility of increasing productivity substantially. There has been considerable research in northern temperate countries that have illustrated this possibility with closely planted willows, poplars and alders grown on very short rotations (Christensson et al.1993; Makeschin 1999). In a few situations irrigation may be a possibility, such as where waste water from sewage treatment plants is available.

**Benefits**

The main advantage of using "grown fuels", as opposed to fossil fuels such as

coal, natural gas and oil, is that while they are growing they absorb the near-equivalent in carbon dioxide to that which is later released in their burning. In comparison, burning fossil fuels increases atmospheric carbon unsustainably, by using carbon that was added to the earth's carbon sink millions of years ago. This is a prime contributor to climate change.

According to the FAO, compared to other energy crops, wood is among the most efficient sources of bioenergy in terms of quantity of energy released by unit of carbon emitted. Another advantage of generating energy from trees, as opposed to agricultural crops, is that trees do not have to be harvested each year; the harvest can be delayed when market prices are down, and the products can fulfill a variety of end-uses.

**Problems**

Although in many areas of the world government funding is still required to support large scale development of energy forestry as an industry, it is seen as a valuable component of the renewable energy network and will be increasingly important in the future.

The system of energy forestry has faced criticism over food vs. fuel, whereby it has become financially profitable to replace food crops with energy crops. It has to be noted, however, that such energy forests do not necessarily compete with food crops for highly productive land as they can be grown on slopes, marginal, or degraded land as well - sometimes even with long-term restoration purposes in mind (FAO 2001).

**Energy plantations: Success or failure?**

Recent studies have concluded that there was mixed success with large-scale programmes designed to meet chronic rural woodfuel shortages. In Asia large-scale woodfuel plantations were established in India, China, Pakistan, Indonesia, Myanmar, Vietnam and South Korea. Many of these were planted under government programmes either by the state itself or as community programmes; their success has been mixed. Sudan, Ethiopia and Rwanda are African countries with relatively large areas of forest plantations used for woodfuel (FAO 2000) while Brasil, Peru, Uruguay, Cuba and Mexico are the main Latin America countries. Brazil is notable for its large area of industrial wood fuel plantations. However, in general, WEC (1999) concluded that large-scale plantations have been the least successful method of providing wood fuel.

Problems associated with past efforts have been:

- Wood fuel plantations sometimes ended up being used for more profitable purposes and not for energy.
- Sometimes farmers became discouraged with tree planting because wood fuel has low market value. For example, some Indian farmers were encouraged to plant for industrial uses that never eventuated and subsequently firewood gave poor returns.
- Subsidies on prices of wood fuel from Government forests (e.g. in India) discouraged private tree planting (Saxena 1997).
- Using a ‘top-down’ approach, where ‘community participation’ involved experts telling the people what was planned.
- Lack of participation by local communities – the planting

programme was ignored or in rarer cases was hindered.

- Ignoring social structural aspects such as, who has the power, who has the land, who has the need and who does the work.
- Projects failed to define and establish rights to the trees and procedures for allocating benefits. This led to indifference by the people being assisted.
- Not recognizing that wood fuel is only one need among many. This led to incorrect choice of species and practices – often the focus was too narrow.
- Lack of adequate assistance and follow-up to ensure trees were correctly planted, tended and protected.
- Targeted areas associated with villages were not actually available because of encroachment or competition from other uses.
- Large-scale reforestation schemes, often on previous agricultural land, reduced grazing, food production and employment (Long and Nair 1999).

On the other hand planting on private farms was more successful (Long and Nair 1999).

**Social and environmental aspects**

The problems that have arisen with woodfuel planting in the past, suggest that to be successful greater attention needs to be given to social aspects. This is needed at all levels from policy development down to actual implementation of a programme (WEC 1999). In particular, biomass based rural energy development needs:

- Strong political commitment by government with clear energy policies
- People at the heart of planning and implementation
- Programmes that have a bottom-up approach and take account of social structures.
- Clearly defined responsibilities.
- Integration with other needs and activities (e.g. agriculture, education, infrastructure) and methods of improving energy-use efficiency.

The economics of growing trees for woodfuel production are often clouded because it must compete with the high proportion of woodfuel collected and marketed from public lands without payment. In India woodfuel prices have been artificially low because prices of woodfuel from government land have often been fixed or subsidised (Ahmed 1997; Saxena 1997; Long and Nair 1999). The use of multi-purpose trees in agroforestry systems acknowledges that planting solely for woodfuel is uneconomic. Many countries have used subsidies to encourage new tree planting, both in plantations and on farms.

Tree planting for woodfuel may have positive environmental outcomes. Ahmed (1997), for example, stated that 35 percent of the natural forests of India have been badly degraded by woodfuel collection and that the country's forests are being exploited in excess of their regenerative capacity; there is often a lack of regeneration. Nutrient cycling may also be interfered with, if the pressure of collection is too great, and in extreme cases the forest is destroyed. The increased production coming from tree planting can

therefore be seen in a positive light, particularly if the planting programme continues, even if at the present time these new plantations have not stemmed forest degradation. In Brazil legislation requires that charcoal be produced from plantations rather than taken from natural forests (Turnbull 1999). Increased tree planting may thus act as a conservation tool. Another benefit of using sustainable woodfuel plantations is that they do not add to the increasing atmospheric carbon dioxide level. Hence their uses are preferable to fossil fuels. Other possible added environmental benefits include land rehabilitation, erosion control and watershed maintenance.

On the negative side there been criticism around the choice of species (e.g. eucalypts) and the impacts of forest monocultures. Some of this criticism was really about social, rather than environmental factors (Turnbull 1999; Cannell 1999) in his review of the effects of monocultural plantations on water use, acidification, wildlife conservation, and carbon storage, suggested that these are usually relatively minor, or of concern in specific situations. The continual collection of leaves and twigs, both of which tend to be high in nutrients and the long-term use of short-rotation coppice poses a real risk of nutrient depletion. This will be particularly acute on low fertility sites. Currently, for example, very many eucalypt plantations have sub-optimal nutrition and there are particular concerns with the removal of P, K, Ca, and Mg, even with normal harvesting (Turnbull 1999). Returning the ash to the forest would assist. The use of N-fixing species, while important for the N status of the site, does not help the availability of other nutrients.

**Conclusion**

Current production of woodfuel from plantations makes only a small contribution to energy requirements, although it is very important in some localities and countries. Plantation currently supply 5 percent of woodfuel production and woodfuel are about 15 percent of total energy used in developing countries. In practice woodfuel is a residue and by-product system, as it includes leaves, twigs, branches as well as stems of both trees planted for industrial and non-industrial purposes, plus industrial wood waste. Woodfuel is only part of a larger bio-energy system that includes agrofuels and municipal by-products.

About a third of plantations in developing countries are devoted to non-industrial uses, mainly woodfuel. The bulk of these are in Asia. Production from these plantations is likely to double over the next 20 years, even with little expansion in area. In addition there will be increased woodfuel by-products coming from wood using industries. The situation is less positive in Africa; a few countries actually have projected declines in plantation-based woodfuel production.

Traditional plantations have been the least successful method of supplying bio-energy to the rural households. Agroforestry systems, which can include woodlots on farms or communal lands, have proved more useful because they integrate closer to the needs of the people.

Multipurpose trees, for example, are able to produce a range of needed benefits, of which woodfuel is but one. Nevertheless, there are examples where the traditional plantations have been very successful, such as when providing charcoal to local industries or fuel to power plants.

Rural energy plantation programmes have suffered from a number of failures. Many failures have resulted from not appreciating of the complexities of bioenergy supply and demand, of not taking into account social aspects and people's needs, as well as poor programme structures. Occasionally market factors have also led to poor outcomes for woodfuel. Many of these could be overcome by more careful development of policies, by making local people the centre of planning and implementation, and by careful integration with other sectors and methods of providing bio-energy.

The environmental outcomes from planting trees for woodfuel should usually be positive or have minimal effects. Nutrient depletion from collection of leaves, twigs etc. or long-term coppicing, poses a risk, particularly on lower fertility soils. Planting nitrogen-fixing trees helps maintain the nitrogen status of the site.

In general hardwood species have greatest potential for woodfuel and they should preferably coppice readily, have nitrogen-fixing ability and be multi-purpose species. The fuels they provide also need to be easy to handle and dry, have a high calorific value and burn without toxic smoke or sparks. Many species, from shrubs to larger trees, fit these requirements. Actual selection depends on what can be grown easily on the site and being acceptable by the users. In agroforestry situations silviculture will tend to be simple and adapted to the skills and resources of the rural people. Care in the establishment phase is very important. Industrial users should be able to adopt more intensive silviculture

**References**

Ahmed, M.F.1997. In-depth country study -India.FAO/APFSOS working paper 26.

Cannell, M.G.R.1999. Environmental impacts of forest monocultures: water use, acidification, wildlife conservation, and carbon storage. New Forests17: 239-262.

Christensson, L., Sennerby-Forsse, L. & Zsuffa, L.1993. The role and significance of woody biomass plantations in Swedish Agriculture. *Forestry Chronicle.*69: 687-693.

FAO: Forestry Department. Working Paper, FP/5: Plantations and Wood Energy: Donald J Meade, March 2001

Long, A.J. & Nair, P.K.R.1999. Trees outside forests: agro-, community, and urban forestry. New Forests17: 145-174

Makeschin, F.1999. Short rotation forestry in Central and Northern Europe introduction and conclusions. *Forest Ecology and Management*121: 1-7.

Nair, P.K.R.1987. Agroforestry and fuelwood production. Pp 367-386 In Hall, D.O. and Overend, R.P. (eds.) *Biomass*.John Wiley and Sons, Chichester, G.B.

Nair, P. K. R. 1993. An introduction to agroforestry. Kluwer Academic Publishers, Dordrecht, Netherlands.

National Academy of Sciences 1980. *Firewood crops*. National Academy of Sciences, Washington, USA.

National Academy of Sciences 1983. *Firewood crops II.* National Academy of Sciences, Washington, USA

Saxena, N.C.1997. The woodfuel scenario and policy issues in India. FAO/RWEDP Field Document 49.

Turnbull, J.W.1999. Eucalypt plantations. *New Forests17*: 37-52

WEC (World Energy Council)1999. The challenge of rural energy poverty in developing countries.FAO, World Energy Council, London, U.K.

# Tree insurance in India

**R. Deepakkumar and S. Suresh Ramanan**
College of Forestry, Kerala Agricultural University,
Thrissur, Kerala - 680 656

## Introduction

Agro forestry plantations are one of the main alternative sources of raw materials to industries, food, fuel and other forest products in present India (NRCAF, 2013). It also act as carbon sink, enhance the soil fertility and water use efficiency, conservation of biodiversity, biological pest control, thereby improving of rural livelihood and alleviation of poverty (Pandey, 2007; Jose, 2009; Chavanet *et al.*, 2015). Trees are grown along the farm lands and farm houses since time immemorial that are used to meet our present day demands (Pandey, 2007). Due to rapid economic, industrial and urban growth, there is tremendous demand for wood and other forest products. In addition to this the implementation of National Forest Policy 1988 emphasis that forest based industries need to develop of their own raw materials for their consumption and also mandates that 33 % of country's geographical area must be under the forest and tree cover (GOI, 1988). In the era of climate change, climate resilient agricultural practices like agro forestry are more promising (FAO, 2013; Lasco, 2014). National agroforestry policy 2014 also aims to promote agroforestry in the country (GOI, 2014). So there are progressively increased agroforestry plantations outside the natural forest. Today, India has around 3.39 % (111,554 $km^2$) of the country's geographical area under different agroforestry systems (FSI, 2013). Inspite of many success stories on tree farming, still farmers are reluctant to go for tree cultivation in their land (Parthiban *et al.*, 2014a). One among the many factors yet the most important is that, species which are preferred by industries are generally susceptible to pest and diseases, eg. Eucalyptus gall wasp. To overcome such problems and also to promote tree farming – 'Tree insurance' may act as tool for it (Parthiban *et al.*, 2014b).

## Need For Tree Insurance

Currently agriculture is facing various constraints such as technological, resources and capital constraints (Ramasamy, 2004). Technological challenges include lack of modern varieties, lack of safe agro-input, mechanization, post-harvesting and control of epidemics. Resources challenges like lack of labour availability, infrastructure, land degradation, inadequate monsoon and financial supports. Capital resources like lack of modern technology, poor profit, inadequate prices (Ramasamy, 2004; Dwivedy, 2011). To overcome these challenges tree based farming (agroforestry) is a viable option. Agroforestry have numerous advantages to the farmers like low labour intensity, low maintenance but better yield and income. These are encouraging the farmers to adopt the agroforestry farming in various parts of the country. Even agroforestry practices also have challenges like outbreak of pests and diseases, cyclones and wild animals. Some of the notable incidents are epidemic infestation of gall wasp in *eucalyptus*, Tamil Nadu,

Karnataka, Andra Pradesh, Kerala, Gujarat, Madhya Pradesh (Jhala *et al*., 2010). Devastation of Casuarinas' plantations in coastal districts of Tamil Nadu due to Thane cyclone (Dinamalar, 2011; Businessline, 2012). Under these conditions tree insurance can be effective tool to save the farmer from economic loss and avoid risks. Also it will encourages the tree based farming (Parthiban *et al.*, 2014a; GOI, 2014). National agroforestry policy 2014 also recommends that there need to be the insurance assistance to the tree based farming (GOI, 2014; Chavan et al., 2015).

**Picturesque of insurance**

Crop production and farm incomes in India as well as other parts of the world often affected by several elements which are beyond the hands of farmers (Mohapatra, 2016). They may be a natural disasters like droughts, lightening, floods, cyclones, storms, landslides, earthquakes etc. or biotic factors like wild animals, pests and diseases (Goudappa, 2012; Karanth et al., 2013). Apart from this man-made hazards like fire, terrorism, riots, sale of spurious agro inputs, different economic policy, price fluctuations for agro-products (Sain and Mohanty, 2013). Agricultural Insurance is a means of protecting the agriculturist against financial losses due to uncertainties that may arise agricultural losses arising from named or all unforeseen risks beyond their control (AIC, 2008). It will act as cushions for the resources poor farmers against crop losses by means of minimum amount of protection. Also over neutralize the crop loss time and rid of the negative fortunes and keep them forward. Even before Indian independence, some princely states like Baroda and Mysore had insurance for some of crop and grains (Narayanan, 2008). In 1965, central government introduced model crop insurance bill to all the states. In 1970, Agriculture Price Commission appointed to examine various crop insurance aspects (Venkatesh*et et al*., 2012). Formally agriculture insurance started by the general insurance company for only agriculture crops during 1972 (Manojkumar et al., 2003). After this there numerous crop insurance scheme implemented by government of India (Table 1). Most of schemes before national agricultural insurance schemes are not assure the insurance of planation/ annual crops. For the first time in the country, National agricultural insurance scheme 1999 offer the coverage to plantation farmers.

**Table 1. Different crop insurance schemes in India in relation to plantations/annual crops**

| S. No. | Schemes | Period | Applicable to plantations / annual crops |
|---|---|---|---|
| 1. | First individual approach | 1972-78 | No |
| 2. | Pilot crop insurance scheme | 1979-84 | No |
| 3. | Comprehensive crop insurance scheme | 1985-99 | No |
| 4. | Experimental crop insurance scheme | 1997-98 | No |
| 5. | National agricultural insurance scheme | 1999-10 | Yes |
| 6. | Modified national insurance scheme | 2010-15 | Yes |
| 7. | Pradhan mantra fasal bima yojana | 2016 onwards | Yes |

**Trees insurance schemes in India**

After 1999, annual/ plantation crops were also include under National agricultural insurance scheme. One such notable example in the country, is the collaboration United India Insurance company and Forest College and Research Institute (TNAU) that came forward to provide insurance for trees such as Eucalyptus, Casuarina, *Melia dubia*, *Dalbergia sissoo* in Tamil Nadu (The Hindu, 2013; Parthiban *et al*., 2014a). The basic premium rate is fixed as 1.25 % of the input cost. For one acre plantation there would be the premium ranged between Rs. 337 (First year) to Rs. 758 (Third year) based on the input cost of the plantations. Nowadays, various plantation insurance schemes by Agricultural Insurance company of India, New India Assurance Co Ltd and Oriental insurance company Ltd covering pulpwood, biofuel trees and other plantations crops. Various plantation crop insurance schemes are not much cover the different agroforestry systems in India (Table 2.)

**Table 2. Various plantation insurance schemes in India**

| S. No | Policy name | Insurance company and web page | Insurance period | Premium rate (% of the input cost ) | Assurance amount | Trees covered |
|---|---|---|---|---|---|---|
| 1. | Agroforestry plantation insurance | United India insurance https://uiic.co.in/product/miscellaneous/plantation-insurance | Annual | 1.25 | Input cost | Eucalyptus, Casuarina, Ailanthus, Melia dubia, Leucaena, Dalbergia sissoo |
| 2. | Pulpwood tree insurance | Agricultural insurance company of India http://www.aicofindia.com/aiceng/general_documents/product_profiles/pulpwood%20tree-eng.pdf | Annual | Depends on crop risks, risk profile, locations, etc. | Equivalent to input cost and extended up to 125-150% | Eucalyptus, poplar, Subabul, Casuarina |
| 3. | Plantation/ horticulture insurance | New India assurance co ltd. http://www.newindia.co.in/content.aspx?pageid=1176 | Annual | Depends on input cost | Input cost | Citrus, Eucalyptus, Tea, Oil palm, |
| 4. | Biofuel tree/plant insurance | Agricultural insurance company of India | Annual | Depends on species | Equivalent to input cost and | Jatropha, Karanja, Neem, |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | http://www.aicofindia.com/aiceng/general_documents/product_profiles/bio-fuel-eng.pdf | | risks, location | extended up to 125-150% | Mahua, Callophyllum, Simarouba |
| 5. | Plantation/ horticulture insurance | The oriental insurance company limited https://orientalinsurance.org.in/documents/10182/32354/rid-rev_plantation.pdf/3b714dde-e575-4d09-aef6-467ce014f1f7 | Annual | Plantation crop: 1.25 Fruit tree crops: 5.00 | Sum insured shall be based on the cultivation cost | Rubber, Eucalyptus, Poplar, Teak, Mangium, Areca nut, Cocoa, Chikoo, Citrus, Vanilla, Pomegranate |
| 6. | Rubber plantation insurance | Agricultural insurance company of India http://www.aicofindia.com/aiceng/general_documents/product_profiles/rubber%20plantation-eng.pdf | Immature: 7 years Mature : 8-25 years | Depends on the input cost and crop stage | Based on input cost and yield deduction | Rubber |
| 7. | Tea plantation insurance | The oriental insurance company limited https://orientalinsurance.org.in/documents/10182/32354/rid-tea++plantation.pdf/f6c58127-9249-4162-936c-32f0a44a7775 | Annual | 1.25 | 100 % input cost | Tea nursery and bush |
| 8. | Rainfall insurance scheme for coffee | Agricultural insurance company of India http://www.aicofindia.com/aiceng/general_documents/product_profiles/coffee-risc-eng.pdf | Annual | Depends on crop risks, past rainfall, coverage sought, locations, etc. | Basis of rainfall | Coffee |

**Pradhan Mantri Fasal BimaYojana**

Pradhan Mantri Fasal Bima Yojanaa new crop insurance scheme implemented in the January 2016. It encourages the plantation crop insurance by 5 % of the input cost with coverage of preplanting and post-harvest losses. Premium rates paid by the government which is five times that of farmers paid., Even if balance premium 90% will paid by government, there is no upper limit for government subsides. Modern technology like remote sensing and smart phones are used to reduce the delay claims (PIB, 2016).

**Further refinement of the scheme**

- Tree based farming are in sprouting stages of insurance and credits facilities which will boost the agroforestry among the resource poor farmers.
- Bankable projects need to be developed at regional levels for tree based farming in order to facilitate the insurance and financial credits to the farmers.
- Need to develop the suitable insurance guidelines for various tree cultivation.
- Insurance companies and government should come forward to encourage the tree/agroforestry insurance.
- Need to disseminate information about tree insurance to the various stakeholders.
- Need to develop mechanisms for easy and speedy claims settlement.

**Conclusion**

Tree insurance also important tool to increase agroforestry cover in the country in addition to the agro forestry packages. It will ensure the livelihood improvement of farmer, continuous supply raw materials to industries and also increase forest cover of the country. Agro forestry will help to sequester the atmospheric carbon into tree biomass and soil thereby minimise the hazards of climate change.

**References**

Agriculture Insurance Company (AIC) (2008). Agriculture Insurance Company of India Ltd *www.aicofindia.org* accessed 2006 to 2008.

Businessline. (2012). Cyclone Thane uprooted 2 crore trees in Cuddalore districthttp://www.thehindubusinessline.com/economy/agri-business/cyclone-thane-uprooted-2-crore-trees-incuddalore-district/article2850947.ece

Chavan, S. B., Keerthika, A., Dhyani, S. K., Handa, A. K., Newaj, R. and Rajarajan. K. (2015). National agroforestry policy in India: a low hanging fruit. Curr Sci. 108(10):1826-1834.

Dinamalar. (2011). Thane cyclone effect flashed on 30.12. 2011.

Dwivedy, N. (2011). Challenges faced by the agriculture sector in developing countries with special reference to India. *Int. J. of Rural Stud.* 18 (2):1-6

Food and Agricultural Organisation (FAO). (2013). *Climate Smart agriculture source book.* Food and Agricultural Organisation, Rome. 570p.

Forest Survey of India (FSI). (2013). India State of Forest Report 2013, Forest Survey of India, Ministry of Environment & Forests, Dehradun, India. 252p.

Government of India (GOI) (1988). *National Forest Policy 1988*. Ministry of Environment and Forests, Government of India, New Delhi.10p.

Government of India (GOI) (2014). *National Agroforestry Policy 2014*. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.14p.

Goudappa, S.B., Reddy, B. S. and Chandrashekhar, S.M. 2012. Farmers Perception and Awareness about Crop Insurance in Karnataka.*Indian Res. J. Ext. Edu*. 2:218-22.

Jhala, R.C., Pateland, M.G. and Vaghela, N.M. 2010. Effectiveness of insecticides against blue gum chalcid, Leptocybeinvasa Fisher & La Salle (Hymenoptera: Eulophidae), infesting eucalyptus seedlings in middle Gujarat, India. *Karnataka J. Agric. Sci.,* 23(1): 84-86.

Jose, S. 2009. Agroforestry for ecosystem services and environmental benefits: an overview. Agroforest Syst.76:1–10. (doi: 10.1007/s10457-009-9229-7).

Karanth, K.K., Gopalaswamy, A.M., DeFries, R., and Ballal, N. 2013. Assessing patterns of human-wildlife conflicts and compensation around a central Indian protected area. *PLOS one.* 7 (12):e50433 doi:10.1371/journal.pone.0050433.

Lasco, R.D., Delfino, R.J.P., Catacutan, D.C., Simelton, E.S and Wilson, D.M. 2014. Climate risk adaptation by smallholder farmers: the roles of trees and agroforestry. *Curr. Opinion in Environ. Sustainability* 6:83–88.

Manojkumar, K., Sreekumar, B., Ajithkumar, G.S. 2003. Crop Insurance Scheme: A case study of banana farmers in Wayanad district. Centre for Development Studies,Kerala Research Programme on Local Level Development, Thiruvananthapuram 56p.

Mohapatra, L., Dhaliwal, R K., and Kaur, M. 2016. Farmers knowledge about the agricultural Insurance scheme in Punjab. *Indian Res. J. Ext. Edu*. 16 (1):49-53.

Narayanan H. (2008), Indian Insurance - A profile, Jaico Publishing house, Mumbai. 547p.

NRCAF [National Research Centre for Agroforestry] 2013. *Vision 2050*. National Research Centre for Agroforestry, Jhansi, India. 30p.

Parthiban, K.T., Vennila, S., Kanna, S.U., Kumar, P., Saravanan, V., Subbulakshmi, V., and Durairasu, P. 2014a. Insurance for Casuarina plantations – an innovative intervention in industrial agroforestry. In: Fifth international Casuarina workshop, Mamallapuram, Chennai, India, 03-07 February 2014.

Parthiban, K.T. Umarani, R., Kanna, U.S, Sekar, I., Rajendran, P. and Durairasu, P. 2014b. *Industrial Agroforestry – Perspectives and Prospectives,* Scientific Publishers, Jodhpur. India. 396p.

PIB [Press Information Bureau] 2016. http://pib.nic.in/newsite/PrintRelease.aspx ?relid=134432

Ramasamy, C. 2004. Constraints to growth in Indian agriculture: needed technology, resource management and trade strategies. *Ind. J. of Agri. Econ.* 59(1): 1-41.

Sain, R.K. and Mohanty. A. K. 2013. Facets of agricultural insurance and its multi dimensional importance on the farming sector in Odisha. Cognitive Discourses International Multi disciplinary Journal, 1 (2):1-8.

The Hindu, 2003. Tree insurance scheme to take off. http:// www.thehindu. com/todays- paper/ tp-national/ tp-tamilnadu/ tree- insurance-scheme- to -take-off/ article 5223898.ece accessed on 2 February 2016.

Venkatesh. J., Sekar. S Aarthy.C and M. Balasubramanian. 2012. Modernizations in agricultural insurance in India: review and prospects. Global J. of Arts & Mgmt., 2 (3): .193-197.

# Know your biodiversity

**Dr. Swaran Lata and Dr. Ranjeet Kumar**
Himalayan Forest Research Institute (HFRI)
Shimla (Himachal Pradesh)

***Sinopodophyllum hexandrum***

*Sinopodophyllum hexandrum* is shade loving, high value medicinal plant of cold climatic zones. *Podophyllum hexandrum* and *Podophyllum emodi* are its synonyms. It belongs to order Ranunculales and family Podophyllaceae. It is known as Himalayan May Apple because its fruits ripen in Spring. The generic name '*Podophyllum'* means 'foot shaped leaf' and species name '*hexandrum*' means 'six stamens'. It is distributed from Indian Himalayas to Bhutan, Pakistan, Afghanistan, Nepal, Taiwan and China. In India it is found in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh at altitude of 2000-4500 m. In Himachal Pradesh it is found in Kullu, Chamba, Lahaul-spiti, Kinnaur, Kangra and Shimla districts and known as *Ban kakri.*

It is rhizomatous perennial plant, 15-40 cm tall, stem erect, unbranched, leaves rounded in outline, deeply cut into 3 ovate, toothed lobes, flowers cup shaped white or pale pink, petal 6, stamens 6, fruit large, scarlet or reddish colour, seeds many and embedded in pulp. Flowering and fruiting period is May-September. The highest percentage of resin is obtained in the flowering stage.

It contains polyphenolic substances known as lignans e.g epipodophyllotoxin, podophyllotoxone, aryltetrahydronaphtha - lene and flavonoids. The rhizomes and roots are the main source of anti tumor lignans such as podophyllotoxin, 4'-demethyl podophyllotoxin and podophyllotoxin 4-O-glucoside. Among these podophylotoxin is most important for its use in the synthesis of anti-cancer drugs etoposide, teniposide and etophos. It acts as a mitotic spindle poison and binds with the microtubules and causes mitotic arrest in metaphase.

Because of the presence of high lignans it is used to cure several diseases like warts, arthritis, malaria, HIV, constipation, cold, bacterial infection, blood cancer, brain cancer, bladder cancer, lungs cancer, testicular cancer and skin cancers since ages and in modern times. It is also uses as veterinary medicines as purgative and to for treatment of warts. Because of more podophyllotoxin content than *Podophyllum peltatum* (American species) its market demand is more in national and international market.

It is given endangered status in IUCN Red list category and listed in Appendix II of CITES. The population of Himalayan May Apple in western Himalaya is declining very fast and in some areas the plant has almost disappeared due to anthropogenic activities and over exploitation. Hence sustainable utilization and commercial

cultivation of this species is highly needed for its conservation and to fulfill its pharmaceutical demands.

***Ursus thibetanus***

*Ursus thibetanus* is large, carnivorus, solitary and nocturnal animal. It belongs to order Carnivora and family Ursidae. Its body is black and hairy. It has large head, small eyes, bell shaped ears and long tail. It has white V shaped marking on their chest because of which it is known as moon bear or white crested bear. It is also known as Himalayan black bear. It is distributed in Southern and Eastern Asia. In India it is found in tropical, subtropical, temperate and alpine regions of Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir (except Ladakh), Meghalaya, Manipur, Mizoram, Nagaland, Tripura and West Bengal.

The potential range of of Himalayan black bear habitat in India is estimated to be about 14,500 $km^2$ of which < 5% is in protected areas. It is recorded from 83 protected areas of India. In Himachal Pradesh it is commonly found in Great Himalayan National Park, Rupi-Bhaba wildlife sanctuary, Rackcham-Chitkul wildlife sanctuary, Lippa-Asrang wildlife sanctuary, Tundah wildlife sanctuary, Kugti wildlife sanctuary, Dharanghati wildlife sanctuary, Kalatop and Khajjiar wildlife sanctuary and Kais wildlife sanctuary.

Over the years different range countries have proposed tentative estimates on population and density of Himalayan Black bear. For India the tentative population estimate of the species is 7000-9000 individuals (Sathyakumar, 2006 and Garshelis & Steinmetz, 2011). It eats bamboo shoots, succulent grasses, wild fruits, nuts, acorns and insects but in the non availability of wild food it also kills domestic livestock (goat, sheep and cows). Gestation period is 6-9 months. Average life span is 25-30 years. Leopard is the main predator of Himalayan black bear.

Incidence of distruction of crops, livestock killings and attacks on local people is a major cause of concern in Western Himalayas and other parts of India because of non availability of wild food plants and shrinking home range. These incidences usually increase towards the end of the autumn which incidentally coincides with the pre-hibernation fattening season. During this season they become highly active and travel long distance in search of food. It has excellent memory that helps it to locate the seasonally available fruits in its habitat. *Cornus capitata*, *Elaegnus parviflora*, *Juglans regia*, *Prunus cornuta* (peach), *Prinsepia utilis*, *Solena heterophylla*, *Pyrus pashia*, *Quercus sp*, *Viburnum sp* and *Holboellia coriacea* etc are some of the favourite wild fruits of Himalayan black bear.

The population of Himalayan black bear is declining very fast in the Western Himalayan region because of loss of its habitat, changing land use practices, expansion of agricultural and horticultural lands, other developmental activities and Poaching. Beside this the demand of body parts especially gall bladder, paws and skin is very high due to its use in traditional medicinal practices and

decorative purpose. Like the cow bile, bear bile has many medicinal properties and used to cure fractures, conjunctivitis, hepatitis, fever and hemorrhoids. It is generally used in the form of powder or pills. Dried bile and gall bladder is also used in traditional Chinese medicines. "Nishi" tribes of Arunachal Pradesh wear bear skin on the back of their neck and use them in making knife holder known as 'dao'.

Because of its declining global population it is given Vulnerable status in IUCN Red list category and protected under Appendix I of CITES (1992) and Schedule I of Indian Wildlife Protection Act (1972). According to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), between 1975 and 1993 about 1,307 kg of bear gall bladder were reported in international markets along with 11,667 kg, 44,219 units, 750 cartons, and 500 boxes of bear derivatives (Mills *et al.*, 1995). Awareness among the local community is needed for its conservation and local people should be trained to handle the situation when it comes in human settlements.

**References**

Quazi, P.H., Rashid., A. and Shawal, S.A. *(2011). Podophyllum hexandrum*- A Versatile Medicinal Plant. *International Journal of Pharmacy and Pharmaceutical Science.* **3**(5): 261-268.

Sharma, V. Part based HPLC-PDA quantification of Podophyllotoxin in populations of *Podophyllum hexandrum* Royle *"* Indian Maple" from high altitude Himalayas. (2013). *Journal of Medicinal Plant Studies.***1**(3):176-183.

Chowdhery, H.J. and Wadhwa, B.M. (1984). Flora of Himachal Pradesh. 3 Volumes. Flora of India Series 2. Botanical Survey of India, Howrah, Calcutta. 860 pp.

Sunar, D., Chakraborty, R., Sharma, B.K., Gosh, P.S., Bhutia, P.T and Pradhan, S. (2012). Status and distribution of Asiatic Black Bear and the status of human bear conflict at Senchal Wildlife Sanctuary Darjeeling, West Bengal, India. WWF (Technical Report).

Wani, N.R. (2014). Himalayan Black bear human conflict, conservation and management strategies in Kashmir Valley: A review. *Asian Journal of Biological and Life Sciences.* **3**(1):1-5.

Mills, J. A., S. Chan, and A. Ishihara. (1995). The bear facts: The East Asian market for bear gall bladder. TRAFFIC International, Cambridge, United Kingdom.

# Tropical Forest Research Institute


**Published by:**

**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.org**
**Visit us at: http://tfri.icfre.org or http://tfri.icfre.gov.in**