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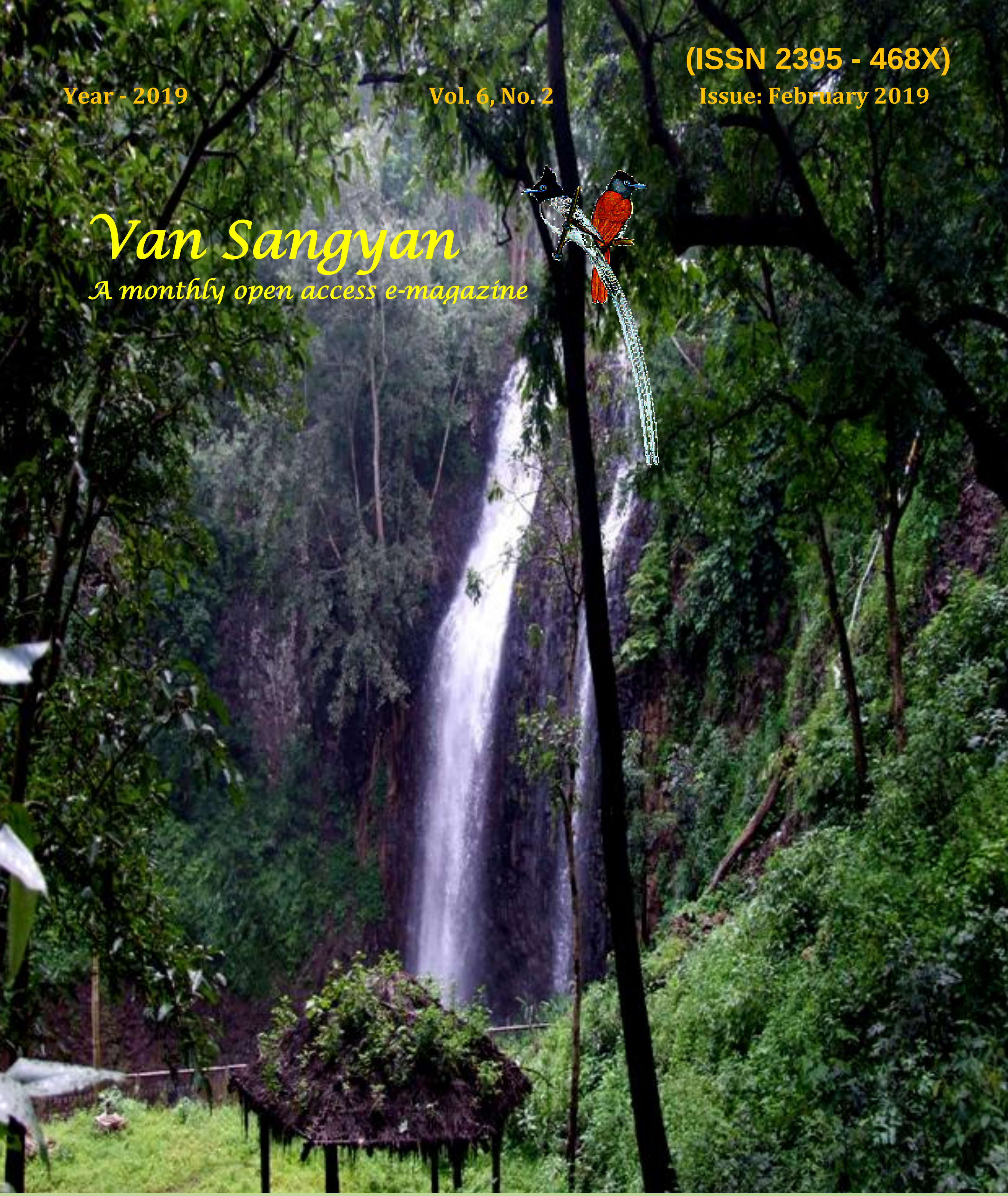

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Van Sangyan

Note to Authors:

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

by e-mail to vansangyan_tfri@icfre.org

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

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

From the Editor's desk

The Himalayas region in India houses several species of medicinal & aromatic plants (MAPs), including many rare and endemic species that are highly valued in the pharma and cosmetic industry. These Himalayan herbs are a priority for conservation action, since many of them are critically endangered today, threatened by both anthropogenic impacts and climate change. At the same time, the rapidly growing market demand for the species is also an opportunity for the economic development of farmers in Himalayan villages.

The Himalayas, stretching over 3,000 kilometers of northern India, Nepal and Bhutan, is a bio-geographically unique region, with a very high species diversity, supported by its ecological, phyto-geographical and evolutionary factors, and the maximum degree of endemism in the Asian region. The Indian Himalayan Region supports about 18,000 species of plants, including a large repository of medicinal & aromatic plant species , including many rare and valuable species. The medicinal plants are an integral part of the culture of the local communities of the Himalayas, woven into their lives in innumerable ways and a major input for the healthcare of the rural poor. In recent times, the market for alternative medicine and herbal products has also been growing exponentially, and many of the Himalayan medicinal & aromatic plant species are highly valued as inputs for these products.

The value of the Himalayan medicinal & aromatic plant species in local lives as well as far markets constitutes an opportunity as well as a threat that require a strategic approach and management. Most of the plant material in use is extracted from the wild, and the destruction of their habitats due to development pressures along with the negative impacts of climate change, have also contributed to their shrinking populations. Several Himalayan species of medicinal & aromatic plant species have suffered depletion rates of upto 80% in the last six to ten years, and many of them, including those endemic to the region, are at various levels of endangerment today. Apart from biodiversity and ecological impacts, the depleting plant resources in the wild also has adverse impacts on the Himalayan poor who are dependent on them for their healthcare and food supplements. At the same time, this exploding demand for medicinal plant material in the national and international markets is an opportunity that should be seized to help improve the economic status of Himalayan farmers in India. If cultivated, they could prove to be high value cash crops and help farmers benefit from the burgeoning herbal trade sector. However non-availability of cultivation packages, marketing problems, quality assurance issues, are some of the bottlenecks.

In line with the above this issue of Van Sangyan contains an article on Rapidly vanishing Himalayan medicinal floral wealth: needing immediate protection and Conservation planning There are other useful articles viz. Current trends and future prospects for utilization of mahua resources, Forest and energy - the betterment of future generation, Genes conferring insect resistance in crop plants, Influence of seed dressing fungisides on mycoflora of seeds of sesbania sesban under storage, Regeneration of forests, Itteri Biofence – Solution for the peafowl`s nuisance, Environment and radioactive pollution and Know your biodiversity.

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

Looking forward to meet you all through forthcoming issues

Dr. R. K. Verma
Scientist 'G' & Chief Editor

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Rapidly vanishing Himalayan medicinal floral wealth: needing immediate protection and Conservation planning

Kamini[1] and Naresh Kumar[2]

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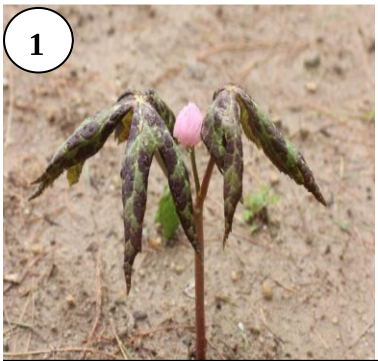
Indian Himalayas one of the global biodiversity hot spot centres covering 16.2% of country's total geographical area stretches between 27°50´N to 37°06´N and 72°30´E to 97°25´E and is habitat for 8000 species of angiosperms, 44 species of gymnosperms and 600 species of pteridophytes. Out of this huge floral wealth more than 1800 species are reported to be have therapeutic value besides this, these species are endemic to Himalaya as found nowhere in other region of world. The presence of unique medicinal floral wealth make Himalaya global centre of medicinal plants. Topographic, altitudinal, soil type variability along with climate and evolutionary factors are creator of this huge floral wealth. The medicinal plants of Himalaya are highly valued and globally renowned having huge demand in international and national market. Ability to cure deadly diseases as well as potential to cure multiple diseases is responsible for huge market demand of these medicinal plants. These medicinal plants are being used for curing disease since antiquity by human beings and gradually they have become part of Ayurveda, Unani, Sidhha, Tibetian, Chinese and modern system of medicine. In western countries the medicine system trend has also changed as medicinal plants are gaining importance in their mainstream healthcare system as complementary and alternative medicines. Other reason for ever increasing demand of medicinal plants is changing people's perspective as they prefer drugs which are free from serious side effects. Besides this, these medicinal herbs are source of other phyto-constituents that are used in cosmetic, flavouring, food and perfume industries.

Demand for medicinal plants is escalating at huge pace which is evident from report of National Medicinal Plant Board (NMPB) of India that shows that in year 2014-15 the export demand of Indian medicinal plants was 1, 34,500 MT (worth □ 3211 crore) and domestic demand was approximately 1, 95,000 MT. 1178 species of medicinal plants are traded from India out of which 242 species traded with huge annual amount more than 100 MT. Out of total medicinal plants traded from India; 18.00% are Himalayan medicinal plants and out of 960 mostly demanded medicinal species of India, 320 species demanded by pharmaceutical sector originates from Indian Himalaya.

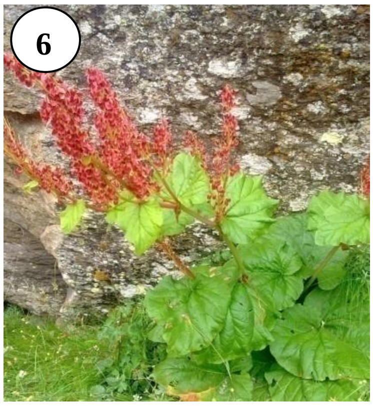
This ever increasing demand for Himalayan medicinal plants has given rise to excessive illegal unscientific over harvesting of medicinal plants from Himalaya leading most of them on the verge of extinction. Climate change, grazing, habitat destruction, lack of pollinations, their genetic and reproductive features are other prominent reason for loss of population of these species. Almost 90 per cent of the Himalayan medicinal plants utilized in various healthcare systems are wild harvested and out of this 70 per cent are harvested through destructive method. As per IUCN, out of total 80000 reported medicinal plants worldwide, 15000 are facing extinction risk and this risk is high in Himalayan region especially in China, India and Nepal.

Angelica glauca, Aconitum ferox, Aconitum heterophyllum, Valeriana jatamansi, Angelica glauca, Arnebia benthami, Arnebia euchroma, Atropa acuminata, Betula utilis, Dactylorhiza hatagirea, Dioscorea deltoidea Epherda gerardiana, Rhododendron anthopogon, Fritillaria cirrhosa, Gentiana kurroo, Habenaria intermedia, Hyoscyamus niger, Jurinea dolomiaea, Lilium polyphyllum, Malaxis musifera, Nardostachys grandiflora, Paris polyphylla, Picrorhiza kurroa, Polygonatum cirrhifolium, Podophyllum hexandrum, Polygonatum cirrhifolium, Rheum emodi, Rheum moorcroftianum, Berberis aristata, Bergenia ciliata, Swertia chirayita, Taxus wallichiana, Viola pilosa, Zanthoxylum armatum, Saussurea costus, Saussurea obvallata, Aconitum chasmanthum, Aconitum deinorrhizum are some of the traded medicinal plants from Indian Himalaya.

Many of these medicinal plants viz. *Aconitum ferox, Aconitum heterophyllum, Atropa acuminata, Epherda gerardiana, Gentiana kurroo, Jurinea dolomiaea, Nardostachys grandiflora, Picrorhiza kurroa, Rheum emodi, Rheum moorcroftianum, Saussurea costus, Swertia chirayita, Taxus wallichiana, Podophyllum hexandrum* etc are traded in quantity more than 100 Metric ton / year.



1. *Podophyllum hexandrum* **2. *Angelica glauca*** **3. *Nardostachys grandiflora***



4. *Gentiana kurooa* **5. *Valeriana jataman*** **6. *Rheum emodi***

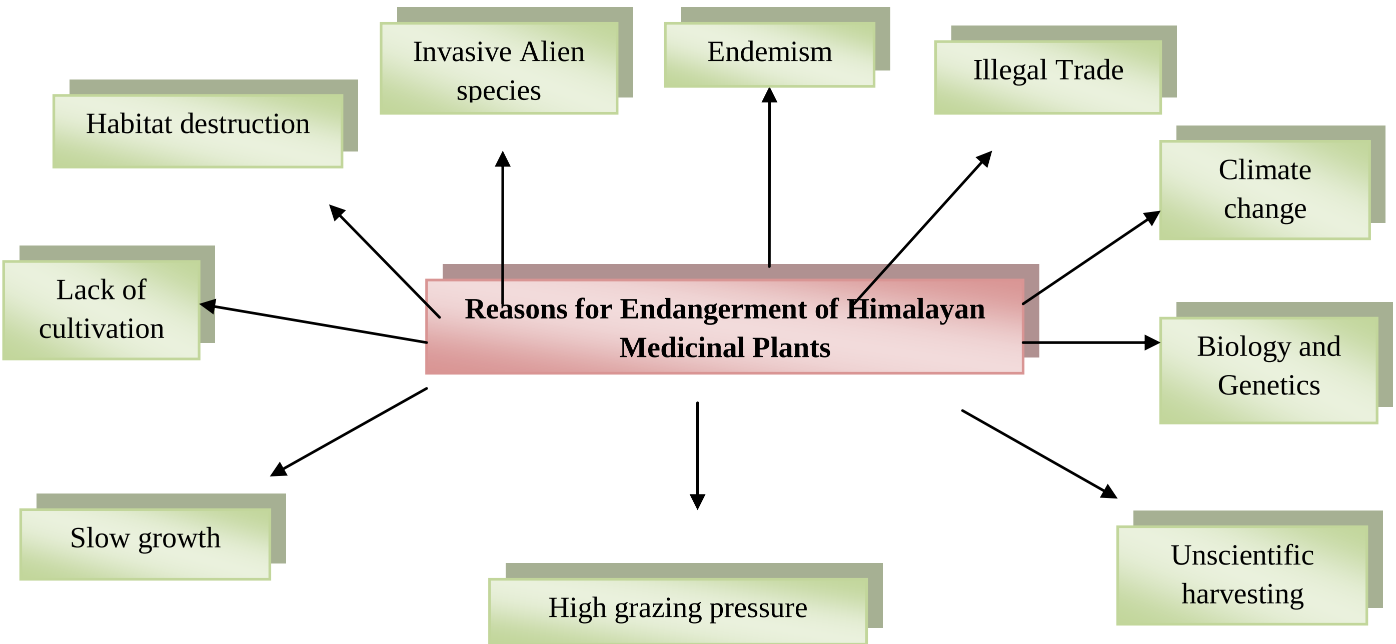
Rare, Endangered & Threatened species

Aconitum chasmanthum, Aconitum deinorrhizum, Aconitum ferox, Aconitum heterophyllum, Angelica glauca, Arnebia benthami, Arnebia euchroma, Atropa acuminata, Betula utilis, Dactylorhiza hatagirea, Dioscorea deltoidea, Epherda gerardiana, Ferula jaeschkeana, Fritillaria cirrhosa, Gentiana kurrooa, Habenaria intermedia, Hyoscyamus niger, Jurinea dolomiaea, Lilium polyphyllum, Malaxis musifera, Meconopis aculeate, Nardostachys grandiflora, Paris polyphylla, Picrorhiza kurroa, Podophyllum hexandrum, Polygonatum cirrhifolium, Rheum emodi,, Rheum moorcroftianum, Saussurea obvallata, Saussurea costus, Swertia chirayita, Taxus wallichiana, Zanthoxylum armatum are Himalayan medicinal plants that falls under one or the other threat categories described by IUCN.

Reasons for endangerment of himalayan medicinal plants

At present Himalayan medicinal plants are in peril of extinction due to following reasons:

- Over exploitation owing to multiple uses and this coupled with unscientific harvesting i.e. harvesting plants when the active chemical constitute responsible for therapeutic action is not present in optimum quantity. This leads to harvesting of raw material of poor quality with poor yield of active constituents and due to this large amount of raw material is required.



- Excess unnoticed Illegal trade of Himalayan medicinal plant is going at international boundary which is contributing towards loss of these plants.
- Restricted habitat owing to unique microclimate and associated micro and macro flora & fauna requirement for survival hamper wide distribution of these medicinal plants which is another cause of loss of population of these plants when harvested profusely from nature. This coupled with higher grazing pressure and growing high presence of invasive alien plant species in Himalaya leads to higher extinction rate.

- Among all the medicinal plants harvested from Himalaya for various uses only 2-3 plants are cultivated for fulfilling their commercial demand and rest are harvested from wild.
- Most of these medicinal plants are perennial herb and slow growing which become ready for harvesting after 3-4 year after seed germination. Due to this local inhabitants and pharmaceutical companies are not willing to cultivate these species and depend on wild stock harvest for procuring raw material.
- Habitat destruction by various development activities is also contributing towards loss of these medicinal plants. It is reported that more than 70% of Himalayan ecosystem is degraded and destroyed now.
- Climate change leading to change in weather parameters is disturbing microclimate of these medicinal plants which is also adding to threatening survival of these medicinal plants.
- Many of these medicinal plants also have some biological features viz. slow growth, dependency on pollinators, self incompatibility, poor seed germination and poor seed set that are also responsible for loss of population as these factors hampers natural regeneration of these species.
- Rapid loss of medicinal floral wealth demands immediate protection and conservation planning if these plants are to be conserved for future as these are not mere therapeutic agents but form an integral part of our Himalayan ecosystem and biodiversity which are required to maintain stability and functioning of Himalayan ecosystem and biodiversity.

Suggested conservation measures

Collaborative and sincere efforts from government agencies, local people, pharmaceutical companies and research institutes are need of the hour for conservation of Himalayan medicinal plants. Therefore suggested conservation measures are as follows:

***In-situ* and *Ex-situ* conservation**

Both *In-situ* and *Ex-situ* conservation should go hand in hand as both are equally important. *Ex-situ* conservation should focus on conserving germplasm in such a way that maximum genetic diversity is conserved. Exploration should be conducted by research institutes involved in conservation to cover maximum threatened species of Himalayan medicinal plants for conservation of germplasm. *In-situ* conservation should not only focus on protecting the habitats, but also on reintroduction of species into wild to enrich wild stocks and monitoring regeneration of species effectively.

Commercial cultivation

Commercial cultivation of threatened medicinal plants should be encouraged in suitable agro-ecological regions. National medicinal plant board has already prioritized threatened medicinal plants species for different states. State government and research institutes should encourage farmers to grow medicinal plants. Besides this NGOs can be encouraged for starting cultivation of medicinal plants. Pharma-companies and local practitioners should be encouraged to grow their own plants for raw material to reduce pressure from wild. Research institutes should be encouraged to focus on developing high yielding, fast growing and early maturing genotypes so that growers can take up cultivation easily and get early returns. Propagation protocols should be developed for each and every species facing endangerment. Cultivation will also ensure regular supply of evenly matured quality raw material.

Research on medicinal flora

Complete research on biology and ecology of medicinal plants should be carried out by various research organizations working on medicinal plants to unravel various climatic requirements of species and any inherent biological feature deterring natural regeneration of the species in wild. Very few medicinal plants of Himalaya have been studies extensively for ecology and biology. Therefore these studies are need of the hour if these plants are to be conserved for future.

Sustainable utilization

Sustainably utilizing medicinal plants by harvesting scientifically and timely can reduce loss of medicinal plants. Medicinal plant parts used for medicinal purpose should be harvested when they have highest amount of phyto-chemical responsible for therapeutic action. In most of Himalayan medicinal plants either roots or rhizome are official parts and harvested at wrong time leading to loss of natural regeneration capacity of plants. Roots and rhizomes should be harvested when seeds have ripened and shed on the forest floor during dormant season as at this time active content is high and seeds has shed which will help in natural regeneration of these species. Exploring alternative plant parts like leaves, fruits, for presence of similar phyto-chemical present in roots/ rhizomes is required as uprooting is most detrimental. In species like *Gentiana kurroa* presences of similar chemical constituent have been reported in leaves as in its roots and with higher concentration which is a win-win situation as now leaves should be harvested which will provide higher amount of phyto-chemical and will also avoid destructive harvesting via uprooting. So such kind of research to explore alternative plant parts for presence of phyto-chemical should be taken up for sustainable utilization of medicinal plants.

Assessment of wild stocks

Moreover exploration on finding the status of natural stocks of a species and its natural regeneration rate should be done so that we can find out how much amount of these plants can be harvested annually without hampering the natural regeneration and survival in nature. Knowledge of exact amount natural stock and natural regeneration rate vis-a-vis ongoing trade in the particular species should be known to fix the amount that can be extracted annually on sustainable basis.

Species specific conservation plan

Each and every species has its own biological and ecological requirement especially Himalayan medicinal have own unique microclimatic requirement. Therefore species specific conservation plan has to be developed. Climatic zone wise enlisting of species should be done and various institutes involved in conservation/ research in Himalayan medicinal plants must be given some prioritized species to focus on. Researchers should focus on studying complete ecology and biology of medicinal plants which will give clear picture of reasons behind loss of species population and then develop species specific conservation plan along with government agencies, state government involved in conservation.

Details of trade and ban on it

The most challenging task is to quantify actual amount of trade going on in these medicinal plants. Till now we don't have exact picture of the quantity of trade going on in Himalayan medicinal plants despite of the fact that this trade is going on since ages. Ban on trade should be imposed to assist natural stock recovery along with supplementing natural regeneration with planting seedlings in wild habitat via raising in nursery.

Local People involvement

People involvement is must for successful conservation plan, local people in the vicinity of forests must be involved to conserve this medicinal flora and incentive should be given to them for involving in conservation.

Conclusion

Indian Himalaya harbour unique medicinal plant wealth and most of the plants are internationally renowned for their unique therapeutic values. But now these plants are facing extinction risk, therefore instant planning of species specific conservation strategies is need of the hour to preserve our valuable Himalayan medicinal flora.

Current trends and future prospects for utilization of mahua resources

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Introduction

Mahuva (*Madhuca longifolia* var. *latifolia*) is a versatile tree provides variety of products to the local people. Tree is an important NWFP species produce edible products to many fauna as well. Tree is medium to large in size having good crown growth. The tree matures and starts bearing flowers and fruits in 8 to 15 years. Flowers are sweat scented appears in bunches at the end of the branches. Fruits ovoid enclosed with elongated seeds and they are brown and shining. The flowering season extends from February to April depends upon locality. It shows a temporal sequence, starting from top portion to the lower branches and also from the more illuminated part to the shaded part of the tree. Fruits ripening take place during in May-July. However there is lot of tree to tree variation also noticed when phenological phases are concerned. For example the fruit ripens early in northern Gujarat as compared to the southern part.

The species is distributed in northern, central and southern part of peninsular India. Mahua can be seen both in forest and non-forest areas (like revenue, community & agricultural land) in the state of Gujarat.

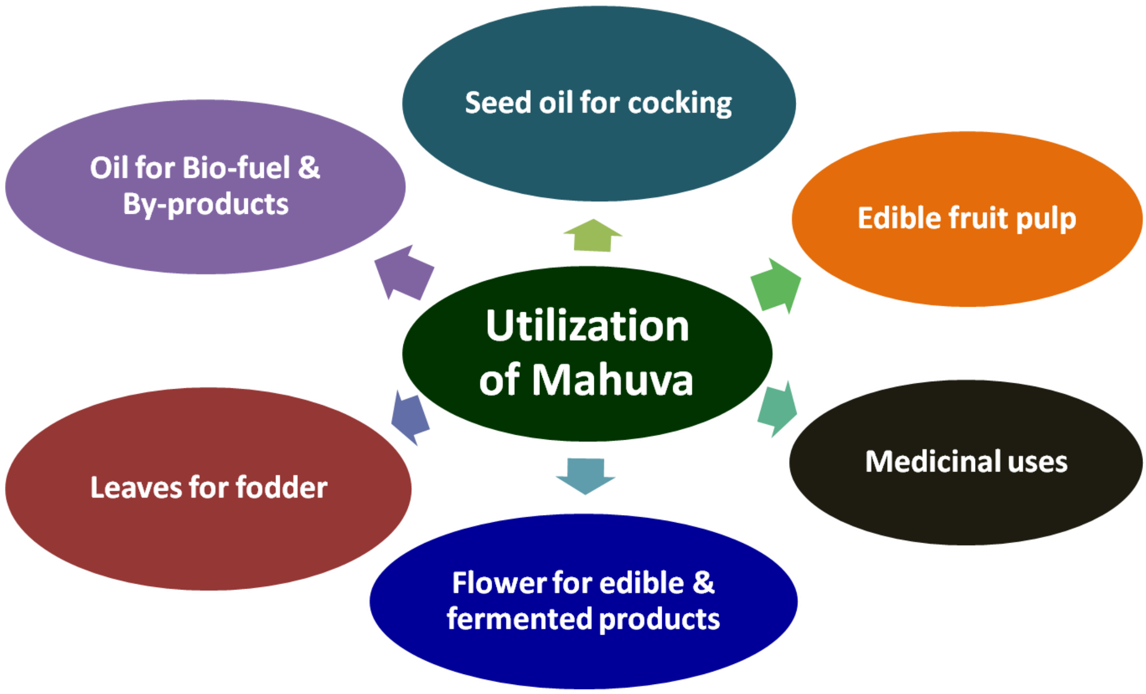

Fig. 1 Utilization pattern of Mahua resources

Local people including tribes engaged in the collection of various mahua resources like flowers, fruits and seed. Our field observations shows that it is one of the very important livelihood options and income generating source for the people living near the mahua forest. The tribal people are using these products to full of its extent. Irrespective of the age and gender people are mostly involved in the collection of mahua resources and its utilization during flowering and fruiting season. Figure 1 showing utilization pattern of mahua resources and their details are given below.

Utilization of mahua flower

Total yield of Mahuva flowers in the country is estimated to be about fifteen to twenty lakh tons per year. Most of these are either used for domestic purpose or sold in local market at very low prices. Dried mahua flowers are used in production of different fermented products (alcohol, lactic acid and acetone) sugar syrup. Production of liquor from mahua flower is a traditional practice for centuries in our country (Madhimita Patel and Naik, 2010). Moreover most of this product is restricted to domestic usage and not giving any economic benefits to the people. Mahua, being an indigenous tree of high economic value, it has vast potential for good quality wine which may find extensive export market. There are few scientific reports regarding the systematic way of preparation of authentic fermented products of mahua (Yadav *et al*, 2009; Anon, 2016), which can be one of the best source of wine/liquor as flowers of mahua are rich in sugar (68-72%), in addition to a number of minerals. It is time to think that, why people in India would prefer French, Spain, Argentina wine and English scotch when something fresh and rejuvenating like mahua are available in our country? Mahua has a great potential and could be developed into an industry like the Maharashtra government has used grapes for wine or Goa has used cashew nuts for Feni. Tribal people and forest dwellers should be allowed to collect the mahua sustainably, trade them in fair market but local illegal distillation should be prohibited. However, the drink thus, prepared is of low quality and sometimes health hazardous if not prepared properly. According to report of Times of India (Deogharia, 2013) illegal brewing and spiking the drink with battery fluid and other toxic substance to give a kick has made it worse. Other disadvantage is that, mostly it contains alcohol. When these types of products commercialized, there is a great chance that, collectors get better price and species will be conserved and cared. In case of *Garcinia indica* (Kokum) fruits, the earlier price was Rs 35-40 per kg. In the past four to five years, value-added products such as kokum juice, kokum syrup and kokum date have become popular (Shrivastava, 2018). The result of commercialization helped farmers to take up this crop in large scale and getting more prices (Rs 60 per kg and up to Rs 100 per kg expected).

At local level, flowers are directly consumed after drying and sometimes dried flowers are used in local sweet eatables prepared by tribal community. It is believed to be an instant energy provider and a good supplement in lean period. Mahua flowers are also considered good for cooling body, eyes and used against asthma, blood diseases, thirst and burning sensations as well as used as a tonic. Recent studies showed that, various kinds of value added products can be prepared from mahua flowers like cake, jam, jelly, juice, sauce and confectioneries (Madhimita and Naik, 2010; Sunita and Sarojini, 2013).

Utilization of mahua seeds

In our country domestic production of crude oil and natural gas are less as compared to the present demand at domestic and international market. There is huge gap between the demand and supply which is presently met by imports, resulting in heavy burden of foreign exchange on the country. Production of biodiesel from plant/tree based oil (TBOs) is considered as the best substitute of diesel in the country. Mahua tree is valued for their seeds which yield fatty oil commercially known as Mahua butter. Mahua oil is reported to have potential use in biodiesel production. The seeds should be de-shelled by pressing and then dried to get the kernel. According to the study of Kulkarni *et al.*(2013), the amount of oil extracted from the kernel of the Mahua ranges from 20 to 43 % based on the quality of the kernel (weight, dryness, healthiness genetic quality, *etc.*) and method of oil extraction (crushed in ghanis, expellers and solvent extraction method). Identification and screening of good genotypes of mahua is essential for large scale production of quality seeds. In Gujarat, the mahua oil is mainly used for domestic cooking. People will locally extract the oil by crushing in local ghanis (oil extraction mills) and use it for their daily needs. Crude mahua oil has some bitterness in taste, however there are methods for removing bitterness from the mahua seed oil. This traditional knowledge of bitterness removal is very simple and people are following it from many generations by their own experiments and experience. For example, boiling the mahua oil with the leaves of *Aegle marmelos* (Bael tree) to remove the bitterness in the oil being traditionally practiced in the middle Gujarat region (Hegde, 2018). In other states like Maharashtra, Madhya Pradesh, Chhattisgarh, Jharkhand, tribal community also using mahua resources mainly for domestic usage.

Unless the species like Jatropha or Karanj, this species was not explored much for biofuel purpose; though it has all the potential biofuel characteristics. Further, as compared with Jatropha, it has lot of other advantages like flowers and fruits, oil are used for edible purpose and it has potential of medicinal value. Sometimes leaves can be used as fodder. Moreover, the tree has got a lot of respect in tribal culture and people are traditionally aware of these multiple usage. Therefore this species would be potential to become one the good source of bio-fuel.

Risks associated with mahua resources

In most of the mahua population trees are of very old age. Although tree produce good amount of viable seeds, the rate of natural regeneration is very poor due to the complete collection of seeds by local people. In many areas, to facilitate the easy collection, every year people burn the area in and around the mahua trees which destroy the regeneration. Collection of both flower and seeds are in bulk may lead to poor quality of mahua produce. Since collected lots have damaged, rotten and inferior quality flowers and seeds. Further it affects the final price and market value. At present there is a scanty work or facility available at local level to store and process the mahua resources. There is lot of scope for value addition in mahua resources. Even though there is a good marketing facility provided by the Government for mahua products in Gujarat and Madhya Pradesh, still flowers and seeds are sold in local weekly market sometimes small traders usually collect these resource directly from their houses at very low price.

Future prospects

In order to regulate the damage to the mahua trees and their ecosystem, there is a need of strong legislation and conservation measures. Conservation of mahuva resources from ground burning and complete collection is need of the hour to retain the good genotypes. Scientific intervention for conservation and sustaible development of mahua resources is very essential. Further, demonstration approach for commercial harvesting of mahua resources is needs to be worked out. Moreover, high yielding genotypes may be incorporated in Agroforestry module to obtain quality mahua seeds/flowers in large scale.

Marketing channel needs to be strengthened at local level in such a way that collectors get proper and fair price. Storage, processing and value addition facilities need to be provided at accessible proximity to utilize the mahua resources in more efficient way. Awareness and training programmes for local people on conservation, sustainable collection, marketing and post harvest products would provide livelihood security and sustainable development of mahua population in the country.

References

Anonymous. 2016. Central Indian Liquor made of Flowers, (*Madhuca longifolia*). Accessed from http://www.niir.org/information/content.phtml on 03/01/2019.

Deogharia, J. 2013. High time to make most of mahua. Accessed from https://timesofindia.indiatimes.com /city/ranchi/ High-time-to-make-most-of-mahua. on 02/01/ 2019).

Hegde, H.T. 2018. Assessment of population structure, characterization of seed and seedling dynamics and utilization pattern of *Madhuca longifolia* var. *latifolia* (Roxb.) A. Chev. in Gujarat. Ph.D. Forestry Thesis submitted to Navsari Agricultural University, Navsari, India.

Kulkarni, P.S., Sharanappa, G. and Ramesh, M.R. 2013. Mahua (*Madhuca indica*) as a source of biodiesel in India. *International Journal of Scientific and Engineering Research*, **4** (7): 2319-2329.

Madhimita, P. and Naik, S.N. 2010. Flowers of *Madhuca indica* J. F. Gmel.: Present status and future perspectives. *Indian Journal of Natural Products and Resources*, **1** (4): 438-443.

Preeti Y., Neelima, G. and Deepa, D. 2009. Effect of location of cultivar, fermentation temperature and additives on the physico-chemical and sensory qualities on Mahua (*Madhuca indica* J. F. Gmel.) wine preparation. *Natural Product Radiance*, **8** (4): 406-418.

Shrivastava, K.S. 2018. Small sweet success; Farmers in the Western Ghats warm up to wonder fruit kokum after local organisations create a market for it. Accessed from https://www.downtoearth.org.in/coverage/food/small-sweet-success on 07/01/2019.

Sunita, M. and Sarojini, P. 2013. *Madhuca longifolia* (Sapotaceae): A review of its traditional uses and nutritional properties. *Int. J. Humanities, Soc. Sci. Invent*. **2**(5): 30-36.

Collected mahua flowers

Utilization of mahua seeds by local people

Mahua fruits

Collection of mahua fruits

Forest and energy - the betterment of future generation

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Energy plays a central role in the world economy and changes in energy costs have significant effects on economic growth, especially in oil importing developing countries. Currently, a major shift is underway in the sources from which energy is expected to be derived in coming years. The changes result from three primary concerns:

- High fossil fuel prices
- Perceived risks of fossil fuel dependence
- Increasing greenhouse gas emissions from fossil fuels.

Forests and energy are at the centre of the global debate on climate change. Wood energy is most competitive when produced as a byproduct of the wood processing industry. Wood residues provide possibly the greatest immediate opportunity for bioenergy generation given their availability, relatively low value and the proximity of production to existing forestry operations. Wood residues from felling and processing operations generally constitute more than half of the total biomass removed from forests. Forest plantations established solely for the purpose of energy production are becoming more common in developing and developed countries and it is likely that plantations with multiple end uses may provide logs for wood fuels as well as logs for other purposes as markets demand. Forest plantations dedicated to the production of wood for energy have existed in many countries (NAS, 1980), so in theory energy crops are not an innovation. On the other hand, most of the energy plantations around the world are on a small scale, use poorly developed technology and focus generally on the supply of fuelwood for local consumption. Forest and energy offers the opportunity of reducing carbon dioxide emissions per unit energy production, reducing dependence on energy imports and together with other alternative fuels, creating a cap on soaring oil prices.

Energy supply and demand

Global Scenario

Energy demand is expected to increase considerably in the coming years as the result of population growth and economic development (EIA, 2007). Many people in the world are currently experiencing dramatic shifts in lifestyle as their economies make the transition from subsistence to an industrial or service base. The largest increases in energy demand will take place in developing countries where the proportion of global energy consumption is expected to increase from 46 to 58 per cent between 2004 and 2030 (EIA, 2007). Energy consumption in developing countries is projected to grow at an average annual rate of 3 per cent from 2004 to 2020. In industrialized countries, where national economies are mature and population growth is expected to be relatively low, the demand for energy is projected to grow at the lower rate of 0.9 per cent per year. About half of the increase in global energy demand by 2030 will be for power generation and one fifth for transport needs mostly in the form of petroleum based fuels (EIA, 2007).

Much of the increase in energy demand will result from rapid economic growth in Asian economies, especially China and India. Energy demand in the developing countries of Asia is projected to grow at an average rate of 3.7 per cent per year, far higher than any other region. Asia will more than double its energy consumption over the next 20 years and is expected to account for around 65 per cent of the total increase in energy demand for all developing countries. While all regions will play a role in future energy supply and demand, the enormous consumption increases projected in Asia (especially in India) make the region of key interest in future energy development. The vast majority of the world's energy is generated from non renewable sources specifically oil, coal and gas. Just over 13 per cent of global energy is derived from renewable sources, 10.6 per cent of which from combustible renewables and renewable municipal waste. The remainder of renewable energy comes from hydro, geothermal, solar, wind and tidal and wave sources.

Indian scenario

India imports more than 70 per cent of its energy needs and has the second fastest growing motor vehicle industry in the world, after China. These factors have accelerated the government backed development of a biofuels industry to diversify the national energy mix. India's huge land mass and long agricultural tradition have the potential to make the country a world leader in both ethanol and biodiesel production. India is heavily populated, however, and has just started its biofuels programme. In addition, it has given priority to producing ethanol from lower yielding molasses and promoting Jatropha based biodiesel, which has not been commercially proven. The viability of the programme therefore remains uncertain.

In the 1990s, the local industry made significant advances in developing and implementing tree based biomass co generation systems, using bagasse as the fuel source. This system is believed to provide an efficient and sustainable energy alternative that can supply process steam and electricity to local industries, as well as surplus power to the public electricity grid. CO_2 generation developments in India's sugar mills have been supported by international cooperation.

In 2002, rising oil import bills prompted the Indian Government's Planning Commission to establish the Committee on Development of Biofuel, in a bid to diversify the national energy mix. In April 2003, the commission submitted a report on the country's potential in biofuels and recommended establishing a National Mission on Biodiesel. To improve coordination of the different ethanol and biodiesel policies that have since been implemented, the Ministry of New and Renewable Energy is drafting a National Policy on Biofuels.

The contribution of wood energy to future energy demand

The future of bioenergy and wood energy development is largely dependent on the effectiveness of policies and the consistency with which they are implemented. Abundant coal reserves are still available in areas of the world where economic and population growth rates are predicted to be highest. If high fossil fuel prices cease to exist as an incentive for biofuel development, only where policy is effectively implemented will demand increase.

Widely differing systems of production and use of wood energy exist throughout the world, and there are likely to be a range of responses to the recent shifts in energy policy in various countries. Supply and demand of traditional biomass, liquid cellulosic biofuels, residues from the forest industry and other forms of wood energy will be affected differently by different factors across developed and developing countries.

Factors associated with climate change, energy efficiency and supply location will play a central role in wood energy production. In addition, an array of ecological, economic and social issues will come into play. Low labour availability could also favour forest over agricultural crops. Other factors may reduce demand on forests for energy production, for example, technological problems with liquid cellulosic biofuel production and transportation - related constraints. In general, the contribution of forestry to future energy production will be influenced by:

- The competitiveness of wood based energy in achieving the objectives of recent energy related policies;
- The costs and benefits of wood energy related systems in social, economic and environmental terms;
- Policies and institutions that provide the framework within which forestry acts.

Energy plantations

Forest plantations dedicated to the production of wood for energy have existed in many countries for some time (NAS, 1980), though most of them are small, use poorly developed technology and generally focus on supplying fuelwood for local consumption. In temperate zones, there are a number of fast growing tree species suitable for energy plantations, including *Acacia mangium*, *Gmelina arborea* and several *Eucalyptus*, *Salix* and *Populus* species (Perley, 2008). Tree growth rates are highly variable depending on management, species and location. In tropical countries, growth rates are highly dependent on water availability (Lugo, Brown and Chapman, 1988).

Significant investments have been made in plantation forests, mostly of fast-growing *Eucalyptus* spp. dedicated to the production of wood for industrial charcoal to feed the steel industry. Clear and consistent policies, laws and best practice guidelines can help to balance the cultural, economic and environmental trade-offs caused by increased investment in forest plantations (FAO, 2007a). High-productivity plantations, efficient harvesting and good logistics are fundamental in producing biomass at costs that allow for competitively priced energy generation. As a source for bioenergy, trees offer an advantage over many agricultural crops, which usually have to be harvested annually, increasing the risk of oversupply and market volatility (Perley, 2008).

Traditional uses of bioenergy

Traditional uses of biomass for energy including fuelwood, charcoal, manure and crop residues play a major role in many developing countries. This form of energy accounts for most of the energy supply of many dispersed and poor rural populations around the world, and in some countries is also important for industry.

Wood fuels

Much of the wood harvested worldwide is used for energy production. Based on FAOStat (2007) data, global production of roundwood is about 3.3 billion m^3 per year; more than half of this total is classified as non-industrial roundwood, mostly used as fuelwood. In addition, part of the wood classified as industrial roundwood is used for energy generation, mainly in the forest industry. Wood has a long history as an energy source and remains a significant one, especially in the domestic sector of rural areas of developing countries. Wood fuels contribute an estimated 7 percent of the world's total energy supply, but they are often viewed as a primitive energy form that is a major cause of deforestation in developing countries. This is because of the belief that most wood fuels originate from forests.

In recent years, wood energy has attracted attention as an environmentally friendly alternative and investments have been made in developing more efficient use of wood residues to expand wood utilization, including for large scale industrial applications for heat and energy generation. Changes in energy policy in several parts of the world have favoured the development of wood energy based systems. New biomass energy technologies are improving the economic feasibility of energy generation from wood, particularly in countries that are heavily forested and have well established wood processing industries.

Fuelwood

Developing countries account for almost 90 per cent of the world's fuelwood production. The last 15 years global consumption of fuelwood has remained relatively stable and is currently about 1.8 billion m^3. Studies in developing countries where fuelwood is used for domestic purposes have found that the inefficient use of fuelwood (and of other bioenergy material) results in significant exposure to indoor pollution. Industrial applications are important in many parts of the world, in both developed and developing countries. A large portion of the energy used in the forest industry of several countries is based on wood and the use of wood in other industrial sectors has also increased in recent years. Wood is a competitive source of energy and its utilization for energy generation in the food and beverage industry has increased significantly.

Charcoal

People have produced and used charcoal as fuel for cooking since the Stone Age, and for producing metal implements since the Bronze Age. In developing countries, charcoal is still widely used in urban and rural areas as a smokeless domestic cooking fuel, with high heat value. As observed for fuelwood, most of the world's charcoal is produced in developing countries - 95 percent. While fuelwood production has remained relatively stable, charcoal production has increased, rising by an annual 3.7 percent from 1990 to reach 44 million tones in 2005. The increase in charcoal use for energy seems to be largely associated with expanded industrial applications.

Potential benefits and negative effects of forest and energy (Perley, 2008**)**

Potential benefits

- Diversification of forestry and agricultural output

- Stimulation of rural economic development and contribution to poverty reduction
- Increase in food prices and higher income for farmers
- Development of infrastructure and employment in rural areas
- Lower greenhouse gas emissions
- Increased investment in land rehabilitation
- New revenues generated from the use of wood and agricultural residues, and from carbon credits

Potential negative impacts

- Reduced local food availability if energy crop plantations replace subsistence farmland
- Increased food prices for consumers
- Demand for land for energy crops may increase deforestation, reduce biodiversity and increase greenhouse gas emissions
- Increased number of pollutants
- Modifications to requirements for vehicles and fuel infrastructures
- Higher fuel production costs
- Increased wood removals leading to the degradation of forest ecosystems
- Displacement of small farmers and concentration of land tenure and incomes
- Reduced soil quality and fertility from intensive cultivation of bioenergy crops

Policy and consideration

The Clean Development Mechanism (CDM) of the Kyoto Protocol could offer additional incentives for establishing energy plantations and financing the conversion of energy generation systems to sustainable biofuel use. The Kyoto Protocol also facilitates technology transfer to developing countries. In principle, CDM projects should be integrated into national development programmes and the focus should be on sustainable development. An essential feature of CDM implementation is the balance between contributing to the sustainable development of the host country and the need for the donor country to reduce GHG emissions. CDM projects provide an opportunity to move away from the official development assistance (ODA) framework to a far more private sector led framework. Because of this, projects funded via CDM are expected to make an effective contribution to sustainable development and renewable energy investments; modern bioenergy technologies provide significant means of achieving this objective (FAO, 2000).

Conclusion

Energy consumption will continue to grow and fossil fuel will continue to be the main source of energy over the next few decades, in spite of concerns about climate change and energy security and the efforts of several countries to develop alternatives. Biomass is an important source for energy generation in several developing countries, but its use is normally limited to heating and cooking, with few developments in power generation and other applications.

Developing countries policies and programmes to further bioenergy alternatives are still in their early stages and focus on liquid fuels, especially for the transport sector. These policies and programmes are also generally limited in terms of scope, with more attention on regulatory measures than on investments in other relevant areas, such as R&D, market liberalization, information and training. Furthermore, several developing countries forests have enormous potential to produce biomass for energy with relatively low investments and risks, but this potential is not properly reflected in national energy development strategies. So switch on to the effective production of energy from the forest for the betterment of future generation.

References

Broadhead, J.S., Bahdon, J. and Whiteman, A. 2001. Past trends and future prospects for the utilisation of wood for energy. Global Forest Products Outlook Study Working Paper No. 5. FAO, Rome.

EIA. 2007. International energy outlook. Washington DC.

FAO. 2000. The energy and agriculture nexus. Environment and Natural Resources Working Paper No. 4. Rome.

FAO. 2007. Forest and Energy in Developing Countries. Forest and Energy Working Paper. Food and Agriculture Organization of the United Nations Rome.

FAO. 2007a. Bioenergy homepage. Rome, Natural Resources Management and Environment Department. Available at: www.fao.org/nr/ben/ben_en.html.

FAO. 2007b. State of the World's Forests. Rome. Available at:www.fao.org/forestry/sofo

FAO. 2007c. FAO STAT database. Rome. Available at: faostat.fao.org.

FAO. 2008. Forest and Energy – Key Issues. Food and Agriculture Organization of the United Nations. Rome.

FAO Stat. 2007. Database: http://faostat.fao.org/.

Lugo, A.E., Brown, S. and Chapman, J. 1988. An analytical review of production rates and stems wood biomass of tropical forest plantations. Forest Ecology and Management, 23(2–3): 179–200.

NAS. 1980. *Firewood crops: shrub and tree species for energy production*. Washington, DC, National Academy of Science (NAS).

Perley, C. 2008. The status and prospects for forestry as a source of bioenergy in Asia and the Pacific. Bangkok, Thailand, FAO Regional Office for Asia and the Pacific.

Ravindranath N.H., P. Balachandra. 2009. Sustainable bioenergy for India: Technical, economic and policy analysis. Energy 34 (2009) 1003–1013

TERI. 2010. Bioenergy in India. International Institute for Environment and Development. Report.

WWF. 2007. www.worldwildlife.org/.

Genes conferring insect resistance in crop plants

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Genetic Engineering technology has introduced a wide variety of traits into crop plants. Tools of molecular biology and genetic engineering have provided human kind with unprecedented power to manipulate and develop novel crop genotypes towards a safe and sustainable agriculture in 21st century. Many insecticidal proteins and molecular are available in mature which are effective against agriculturally important pests but are innocuous to mammals, beneficial insects and other organisms.

A variety of genes coding for different classes of insecticidal proteins such as :

1. Insecticidal crystal proteins (ICPs) or δ *endotoxins* of *Bacillus thuringiensis* (Bt)
2. Vegetative Insecticidal Proteins (VIP) of Bt
3. Protease inhibitors
4. Amylase inhibitors
5. Lectins
6. Plant chitinases
7. Insect viruses
8. Genes from bacterial other than Bt
9. Insect chitinases
10. Plant metabolic enzymes
11. Novel genes of plant origin
12. Oxidative enzyme
13. Lipid oxidases
14. Manipulation of secondary metabolism
15. Fusion proteins

Toxin genes from *Bacillus thuringiensis*

Bt is a gram-positive soil bacterium distinguished from other bacilli by its production of insecticidal proteins. Because of their insecticidal activity, a large number of *Bt* strains have been isolated and characterized. These isolates are classified into some 30 subspecies differentiated by the antigenic properties of their flagellae as well as a variety of biochemical tests. During sporulation, *Bt* synthesizes massive quantities of one (or) more insecticidal proteins that are organized as a crystal (or) crystals in the sporangium. These crystals are eventually released into the environment as the spores mature and the cells lyse. Most of the *Bt* isolates produce crystals in the shape of a bipyramid, a configuration composed of two pyramids bound together at the base. The insecticidal protein as crystal protein (or) Cry and its gene encoded as *Cry*.

Insecticidal crystal proteins

Bacillus thuringiensis has several sub-species which produces different Cry proteins.

Based on the crystal shape, molecular weight, many *Bt* sub-species are there.

Classification of crystal genes

Cry genes	susceptible insect orders
Cry I	Lepidoptera
Cry II	Lepidoptera and Diptera
Cry III	Coleoptera
Cry IV	Diptera

Mode of action

The crystals must first be ingested by *Bt*-sensitive insects. The crystal is then solubilized and processed concurrently by the alkaline gut juice into an active toxin by the action of the insects own midgut proteinases. When artificially solubilized in an alkaline solution without proteinase, most crystal proteins, particularly those of the 130 k Da classes are not toxic to insect cells. The crystal protein is therefore called 'protoxin' signifying that it requires activation. It is accepted that the toxin recognizes specific receptors on the surface of the gut epithelial cells and that the toxin-receptor complex forms a pore through the cell membrane. The insect cells affected by toxin lose the ability to regulate osmostic pressure and eventually lyse due to massive water intake.

Development of transgenic *Bt* crops

DNA technology makes it possible to locate the gene that produces *Bt* proteins lethal to insects and transfer the gene into crop plants.

Research to transfer insect resistance genes from *Bt* to crop plants is well under way. Corn, cotton and potatoes are three of the many commercial crops targeted for *Bt* insect resistance.

- *Bt* in corn confirm resistance to European corn borers.
- *Bt* in potato confirm resistance to Colorado potato beetle.
- *Bt* in cotton confirms resistance to tobacco budworm, cotton bollworm and pink bollworm.

Protease inhibitors

Protease inhibitors of plants are involved in plant defense against insect and nematode attack. Transgenic tobacco plants expressing soybean trypsin inhibitor (*SBTI*) result in increased mortality, reduced growth, and reduced plant damage by *H. virescens* . Accumulation of SBTI in rice also confers resistance to the brown plant hopper (*Nilaparvata lugens* Stal) Transgenic plants expressing cowpea trypsin inhibitor (*CpTi*) have shown resistance to *H. armigera* in tobacco.

Alpha-amylase inhibitors

Transgenic tobacco plants expressing alpha-amylase inhibitors from wheat (*WAAI*) increase the mortality of the lepidopteran larvae by 30 to 40 per cent.

Insect-resistant transgenic crops expressing α-amylase inhibitors

Pea	α-amylase inhibitors from *Phaseolus vulgaris*	Resistant to bruchids.
Tobacco	α-amylase inhibitors from wheat (WAAI)	Increased the mortality of Lepidopteran larvae by 30 to 40%
	α-amylase inhibitors from bean (BAAI)	Collasobruchus sp.
Adzuki bean	α-amylase	bruchids.

Pea	α-amylase inhibitors (*alpha Al-1* and *alpha Al-2*)	*Alpha Al-1* inhibits pea bruchid

Plant lectins

Plant lectins are particularly effective against the sap sucking Hemiptera. A gene encoding the mannose specific lectin from snowdrop, *Galanthus nivalis* (GNA) has shown resistance to peach aphid (*M. persicae*) in tobacco and Potato.

Insect-resistant transgenic crops expressing plant lectin genes

Tobacco	GNA from *Galanthus nivalis*	peach potato aphid, *Myzus persicae*
	Pea lectin	*Heliothis virescens*
Cotton	*GNA*	*Heliothis virescens*
Rice	*GNA*	, *Nilaparvata lugens* and green leaf hopper, *Nephotettix virescens*
		Resistant to potato leaf hopper, *Empoasca fabae*
Potato	*GNA* and *ConA*	Less susceptible to peach potato aphid, *Myzus persicae*
Tomato	*GNA*	Tomato moth, *Lacanobia oleracea*
Maize	Wheat agglutinin (*WGA*)	*Ostinia nubilalis and Diabrotica sp.*

Vegetative insecticidal proteins (Vips)

These proteins are produced during vegetative growth of cells and are secreted into the growth medium sequences encoding for Vip have been cloned sequenced and the protein has been expressed in *E. coli*. It has structural dissimilarity with Bt toxin structure so it has divergent insecticidal mechanism. These toxins together with Bt toxins make them ideal candidate for deployment in insect management programmes.

Plant chitinases

Effects of plant chitinases on insects seen marginal at best (eg. Slight deleterious effects of bean chitinase on aphids when fed in artificial diet) transgenic tobacco plants expressing chitinase from tobacco hornworm were protected from feeding by larvae of tobacco budworm, which decreases larval biomass and survival.

Insecticidal viruses

There are many viruses pathogenic to insect pests. Genomes of small viruses can be introduced into crop plants, which will synthesize the viral particles and acquire entomocidal property.

Eg. *H. armigera* stunt virus (HaSv) is a tetravirus specific to lepidopteran insects. It is harmless to beneficial insects and the environment and its deployment in transgenic plants would not pose any risks.

Genes from bacterial other than *Bt*

Photorhabdus liminescens dwells inside the gut of *entomophagous* nematodes belong to family Heterorhabdtitidae. These nematodes invade the insect haemocoel and release the bacteria from other gut. The bacteria proliferate and kill the host within 24-48 hr. The nematodes feed on the bacteria and host cadaver. It was found that bacterial synthesize high molecular weight protein complexes toxic to insects ranging from Lepidoptera, coleoptera and dicryoptera. Four genes encode toxin complex which provide an effective alternative to Bt and can also serve as a good candidate to be expressed along with Bt in transgenic plants.

Plant metabolic enzymes

Tryptophan decarboxylase from periwinkle was expressed in tobacco where in it induced synthesis of tryptamine and tryptamine – based alkaloids. Mechanism by which tryptamine interferes with insects eg. Pupal emergence of whitefly decreased as a result of feeding on such plants.

Insect chitinases

Chitin is insoluble structural polysaccharide that occurs in the exoskeletal and gut lining of insects which protect the insect against water loss and abrasive agents.

Eg. Expression of cDNA for chitinase obtained from the tobacco hornworm, *Manduca sexta*, in tobacco plants offered partial protection against *Heliothis virescens*. The larvae feeding on transgenic plants exhibited several growth aberrations and died prematurely.

Novel genes of plant origin

Cloning of genes from higher plants resistant to insect pests is feasible by a molecular breeding approach.

Eg. Cloning of Mi-1 gene from wild tomato has given an opportunity to control root-knot nematode and potato aphid simultaneously.

Oxidative enzymes

Polyophenol oxidase and peroxidase enzymes have the potential to oxidize components present in plant tissues into potentially toxic compounds; polyphenol oxidase can significantly reduce the protein quality of an insect diet and thus reduce the growth of larvae feeding on the diet.

Lipid oxidases

Two enzymes oxidize lipids, lipoxygenase and cholesterol oxidase are potential insecticidal proteins for expression in transgenic plants. Lipoxygenase oxidizes long chain unsaturated fatty acids to their peroxides and is responsible for the development of rancidity in legume flours. Lipoxygenase has been shown to be toxic to lepidopteran larval when fed in artificial diet, also toxic to BPH.

Manipulation of secondary metabolism

Secondary metabolites of plants act as most significant factors in determining host resistance, reliance on defensive proteins noted in plant genetic engineering for insect resistance. Nevertheless, genetic manipulation of secondary metabolism remains a goal for plant genetic engineers, and its exploitation to increase insect resistance in transgenic crops is inevitable.

Fusion proteins

Proteins with known insecticidal properties may be fused either to proteins that will increase their binding activity or fused to other insecticidal proteins. Gna (*Galanthus nivalis*) gene has been fused to a gene encoding insect hormone elatostain and to a gene encoding spider venom. Expression of single hybrid δ-endotoxin gene and SN 19 gene in potato confer resistance to CPB (Colorado Potato Beetle) and PTM (Potato Tuber Moth).

References

Alexander M 1985 Ecological consequences: reducing the uncertainties. Issues Science Technology 1: 57-68.

Hoy J 1995 Molecular insect genetics. Academic Press, New York.

Nirmala X and James AA 2003 Engineering plasmodium refractory phenotypes in mosquitoes. Trends in Parasitology 9: 384-387.

Presnail, JK and Hoyt MA 1996 Maternal microinjection of a endoparasitoid *Cardiochiles diaphaniae* (Hymenoptera: Baconidae), *Ann. Entomol Soc. Am.*, 89, 576.

Robertson HM 1995 The Tcl – *Mariner* super family of transposons in animals. Journal of Insect Physiology 41, 99.

Stouthamer R 1993 The use of sexual versus asexual wasps in biological control, *Entomophaga*, 38, 3.

Werren JH and O'Neill SL 1997 The evolution of heritable symbionts, in *Influential Passengers: Inherited Microorganisms and Arthropod Reproduction*. O' Neill S L, Hoffmann A A, Werren J H, Eds. Oxford University Press, New York, 1.

Influence of seed dressing fungisides on mycoflora of seeds of *sesbania sesban* under storage

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Abstract

Twelve fungi were isolated from the seeds of *Sasbania sesban*. Among these fungi *Aspergillus Spp*. were found to be predominating. Dry seed treatment with Dithane M-45, Bavistin and Thiram were effective in checking growth of various fungi associated with seeds except Fytolan which was not effective in case of *Aspegillus fumigatus*.

Key words: *Sesbania sesban*, seed mycoflora, fungicides, germination.

Introduction

Studies on role of seed-borne fungi in deteriorating seed quality, both in field and storageis limited, particularly in case of tropical tree species in India. Sen Sharma *et al*.,(1988) have reviewed this work on seed borne fungi associated with seeds under storage in India. Screening of literature reveals that seed mycoflora of leguminous tree species i.e. *Pongamia pinnata*(Jamaliddin*et al*., 1983), *Butea monosperma* (Purohit and Jamaluddin, 1993), *Pithecelobium dulce* and *Tamarindus indica* (Purohit and Jamaluddin, 1996), *Albizia lebbek* (Mittal and Sharma, 1979), *Dalbergia sissoo* (Mittal and Sharma, 1980),*Cassia fistula* (Mittal and Sharma, 1981), *Cassia siamea*, *Bauhinia variegate* and *Acacia catechu* (Bharadwaj and Paul, 1995) have been studied in India but information regarding seed borne fungi of *Sesbania sesban* seems to be lacking. It is a popular species in afforestation programmes for wastelands. The seeds do not require any pre-treatment before sowing and have high rate of percentage of germination i.e. 80-90%. The variation in seed coat colour (i.e. brown and green seed) was prominent in seeds collected from the same tree at the same time. The role of seed coat is considerably important as it forms the barrier between the embryo and its immediate environment. The permeability of seed coat to water and gases initiates the process of seed germination. The present studies were, undertaken to study the effect of seed borne fungi on seed germination in relation to seed coat colour during storage and their control by using fingicide.

Materials and methods

Mature pods of *Sasbania Sesban* were collected by hand plucking from the tree during June, 1996 from Narayanganj village in Mandla district (M.P.). Seed were extracted manually and kept in polythene bags at room temperature which varies from 15°C to 35°C during the year. The seed sample was graded on the basis of seed coat colour i.e. green seeds, brown seeds and mixed lot of seeds. Germination studies were conducted and occurrence of fungi was recorded on three working samples each from brown seed lot, green seed lot and mixed seed lot. Following the ISTA rules (1996), 400 seeds of each category were kept for germination in each of the 4 replicates on moist germination paper in petridishes and maintained at 30°C ± 2°C. The number of germinants was recorded daily till the end of germination period i.e. 21 days. Simultaneously seeds from each category were examined for the occurrence of fungi following standard blotter method and agar techniques using Potato Dextrose Agar medium. The incidence of fungi was recorded after 5 days of incubation at 30°C ± 2°C till the no new fungi appeared.

To determine the efficacy of different fungicides in checking seed borne fungi, seeds of each category were treated separately with four fungicides, namely Diathene M-45, Thiram, Fytolan and Bavistin @3%. The treated seeds were plated by blotter method as well as agar plate method after 24 hours of treatment. the incidence of fungi was again recorded after five days of incubation at 30°C ± 2°C till no new fungi appeared.

Result and discussion

Difference in germination with respect to seed coat colour were not significant. Brown seeds showed 93.66% germination while green seeds shoes 82.33% and mixed lot 85.00%. Maximum germination percent in brown seed implied that these seeds were physiologically mature as compared to the green seeds, where some seeds were not physiologically mature or had under-developed embryo. All the categories showed more than 80% germination suggesting that there is no need to categorize the seed on the basis of seed coat colour.

Twelve fungi belonging to nine genera were found associated with mixed lot of *Sesbania sesban*. Out of them 11 fungi were isolated from green seed and 10 fungi from brown seeds (Table-1). Amongst the various fungi recorded species of *Aspergillus*, *Alternaria alternata*, *Chaetomium globosum*, *Penicillium* sp., *Phoma suaerostoma* and *Rhizopus* sp. were invariably found associated with all the three seed categories. While *Curvularia lunata* and *Fusarium pallidorosum* were not detected from brown seed lot and *Memnoniella ectinata* from from green seedlot.

Amongst the dry seed treatment with four fungicides, namely Dithane M-45, Thiram, Fytolan and Bavistin, all fungicides were effective in checking the occurrence of fungi except Fytolan which was not effective in controlling of *Aspergillus fumigatus*. Other researchers have also reported differences in effectiveness of different fungicides in checking growth of seed born fungi in different leguminous tree species (Purohit and Jamaluddin, 1993 and 1996; Jamaluddin, *et al*. 1983; Bharadwaj and Paul, 1995).

Of the two techniques adopted for the isolation of storage moulds, there were no remarkable difference in blotter method and PDA method. The blotter method is, therefore, recommended for routine health testing of the seed of species as it has low cost and minimum labour.

Table-1: Seed mycoflora of *Sasbania sesban* seeds

S.No.	FUNGI	Brown seeds					Green seeds					Mix lot				
		C	D	T	B	F	C	D	T	B	F	C	D	T	B	F
1	***Alternaria alternata***	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
2	***Aspergillus flavus***	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
3	***A.fumigatus***	+	-	-	-	+	+	-	-	-	+	+	-	-	-	+
4	***A.niger***	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
5	***A.sulphurus***	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
6	***Chaetomium globosum***	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
7	***Curvularia lunata***	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-
8	***Fusarium palludorosum***	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-
9	***Memnoniella echinata***	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-
10	***Penicillium* sp.**	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
11	***Phoma suaerostoma***	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
12	***Rhizopus* sp.**	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-

Note: + = Present; - = Absent; D = Dithane M-45; T = Thiram; B = Bavistim; F = Fytolan; C = Control

Table-2: Germination characteristics of *Sesbania sesban* seeds

S.No.	Characteristics	Green Seeds	Brown Seeds	Mix Lot
1	100 seed weight(gm)	01.18	01.40	01.32
2	Germination%	82.33	93.66	85.00
3	Germination period (days)	06.00	04.00	06.00
4	Viability %	84.33	97.66	90.00
5	Hard seed%	09.00	04.00	05.00
6	Dead seed%	10.00	08.50	08.70
7	Range of germination% (Max.-Min.)	82-79=03	97-90=09	88-79=09

References

ISTA(1996). International rules for seed testing Proc. Int. Seed Test. Assoc., 31:1-152.

Bharadwaj, L.N. and Y.S. Paul (1995). Studies on seed mycollora of some forest tree species and their control. Jour. Trop. Forest., 11(II):41-43.

Jamaluddin, V.S. Dadwal and K.K. Soni (1983). Fungicidal effect on mycoflora and oil contents of sal (*Shorea robusta*) and Karanj (*Pongamia pinnata*) seed during storage . Seed Res., 13(2): 64-66.

Mittal, R.K. and M.R. Sharma (1979). Seed mycoflora of *Albizia lebbek* Benth. Indian Jour.For., 5(2): 156-157.

Mittal, R.K. and M.R. Sharma (1980). Seed mycoflora of *Dalbergia sissoo*. Paper read at the 7th Annual session of the society for advancement of Botany, India. p-28.

Mittal, R.K. and M.R. Sharma (1981). Seed mycoflora of *Cassia fistula*. Indian Jour. For., 4(1) 70.

Purohit, Mamta and Jamaluddin (1993). Seed mycoflora of Palas (*Butea monosperma* (Lam.) Taub.) during storage. Seed Res., 21 (2): 126-127.

Purohit, Mamta and Jamaluddin (1996). Testing of seeds of some tropical tree species for germination and mycoflora. Indian For., 122(6) :492-495.

Sen Sharma, P.K., M.I. Thakur and H.S. Sehgal (1988). Protection of forest seeds against insect pests and fungi during storage. Jour. Trop. Forest., 4: 350-358.

Regeneration of forests

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Forests are not only home to important species of animals and birds, but also store a lot of carbon in trees, which would have otherwise escaped into the atmosphere as carbon dioxide and warmed the planet. Hence, reclaiming plantation lands that were

once forests, helps in regeneration and the health of forests.

Natural regeneration is the process by which woodlands are restocked by trees that develop from seeds that fall and germinate in situ. For most of the last two or three centuries foresters have restocked and created woodlands by using transplants grown in nurseries. Natural regeneration was rarely used until the late 1980's when a combination of factors, including a desire to "do things more naturally", and a change in the grant structure, lead to its use becoming more popular. However, few woodland managers had any experience in the successful use of natural regeneration, which is much less predictable, than restocking using transplants.

Restocking by natural regeneration is often unsatisfactory, frequently for unknown reasons; which demonstrate the need for research to understand the processes occurring. Development of the ground flora can be extensive following the forest operations carried out to promote natural regeneration. The changes in the ground flora within both temporary and permanent plots have been observed at a variety of sites in order to investigate how they may influence the survival and growth of tree and shrub seedlings.

Seedling establishment of some species has been observed by following the growth and survival of tree species growing after silvicultural operations to promote natural regeneration. Browsing damage by deer is a serious problem in most lowland woodlands, and it can retard or prevent satisfactory natural regeneration. Competition with other vegetation can inhibit the growth or cause the death of tree seedlings. Nursery studies have investigated the competition between tree seedlings and grass.

Natural regeneration is a key component for securing the sustainability of forests and forest dynamics because it has the potential for the development of future generations, the storage of carbon, and it leads to the recovery of the ecosystem functions. The research conducted in sub-tropical forests of India showed that an absence or a small number of seedlings and saplings of tree species in a forest stand indicates poor regeneration; on the other hand, a greater number of seedlings and saplings shows successful regeneration. The maintenance of a forest stand with sufficient regeneration is the main target in conservation ecology.

Natural regeneration has also been used as a tool in the implementation of large-scale restoration programs in degraded forest areas, especially in the tropical regions. When we consider species distribution and the diversity of forests in tropical ecology, natural regeneration should also be included in the assessment because it can help us to envisage the upcoming forest stand. Therefore, understanding the mechanism and nature of natural regeneration facilitates the enhancement of natural regeneration, as well as the changes in future forest structure. Natural regeneration could be affected by both abiotic (environment) and biotic (overstory structure) factors and securing a sufficient regeneration of a forest is a great challenge in forest management. A reduction in precipitation, especially drought, can limit the regeneration potential and composition of plants because almost all species are very susceptible to environmental factors at the seedling stages. It is reported that species composition at regeneration stages varied in regions with an annual rainfall of 300 to 900 mm. It is also estimated, by simulation analysis that species diversity and composition at the regeneration stage could change in upcoming decades due to an increase in temperature and decrease in precipitation. On the other hand, changes in overstory structure, such as species distribution and canopy cover, could directly affect the diversity, survivorship and composition of natural regeneration of some species.

Therefore, monitoring the changes in natural regeneration in response to different overstory structures and climatic regions has been essential in ecological studies. Only a few studies have focused on natural regeneration ecology. Among them, some studies have addressed the effect of overstory structure on natural regeneration at relatively small scales in Acadian forests , disturbed forests, and Amazonian forests. Although the factors driving the structure and composition of natural regeneration have been studied by modeling approaches, there is also no convincing evidence to date relating to which overstory factors have a stronger relationship with natural regeneration than others do, especially in Asian regions. Beside this, the regeneration-rainfall gradient hypothesis has to our knowledge only been tested in a few studies.

Different tree species have developed different regeneration strategies over millions of years of evolution. Some trees produce many, small seeds and depend upon the wind for their dispersal. Other trees produce a few, large seeds and depend upon animals for their dispersal. Some tree seeds need little light or heat in order to germination; others need much heat and light. Some sprout from stumps and roots; others do not.

If there are seedlings of desirable species already established when a forest is cut or otherwise disturbed, a new, high quality forest can develop immediately. Many of our best timber stands developed in this way after heavy cutting in the past. For whatever reasons, conditions were right for germination and growth of those seedlings and sprouts before the overstories were harvested.

Unfortunately, however, the opposite is more often the case. Desirable seedlings were not there before the last harvest; the right kinds of seeds didn't blow in or get carried in, and they didn't sprout from stumps and roots. The same usually happened when old pastures or fields were abandoned. Good quality seed sources were not available, or if they were, the seeds did not germinate and grow.

When forests are repeatedly high-graded, that is, when the best trees are cut and the rest are left to grow, the results are forests dominated by low-grade species, poor quality trees of grade species, and cull trees of all species. Such forests would probably have been better off if they had been clear-cut because then at least the poor quality trees would have been removed.

In order to control and optimize regeneration, foresters have developed silvicultural systems to regenerate forests of different species mixes and ages. These systems are designed around the regeneration strategies of the desired species. They involve manipulation (cutting) of forest stands to influence the seed mix and light/heat conditions on the ground. Sometimes they also involve manipulation of existing (advance) regeneration and treatment of the seed bed (forest floor).

The way in which abiotic and biotic factors affect the structure and composition of natural regeneration by actual field surveys is still not well understood. Forest natural regeneration is a natural biological process of forest resource reproduction in ecosystem dynamics. During this process, tree-dominated plant communities develop and evolve, which has far-reaching impact on the structure of forests in the future. Forest environment can be restored with natural regeneration through seedling establishment and resprouting from cut stumps, which results in high-quality forests with high biodiversity. For the restoration to be successful, it is important to enhance the natural regeneration of trees and create self-sustaining communities. The improvement of natural regeneration in stands may also be the most cost-effective way to obtain a species-rich productive stand. Therefore, understanding the natural regeneration processes and dynamics is crucial to planning and carrying out management activities.

References

Harmer R., Kiewitt, A., Morgan, G. and Gill , R. (2010). Does the development of bramble (*Rubus fruticosus* L. agg.) facilitate the growth and establishment of tree seedlings in woodlands by reducing deer browsing damage? Forestry Advance Access published on January 6, 2010. doi:10.1093/forestry/cpp032.

Harmer, R. and Morgan, G. (2007). Development of *Quercus robur* advance regeneration following canopy reduction in an oak woodland. Forestry, 80, 137 -149.

Harmer, R. and Morgan, G. (2005). Does bramble facilitate the natural regeneration of broadleaved trees? (PDF-296K). Unpublished Forest Research Report.

Harmer, R., Boswell, R. and Robertson, M. (2005). Survival and growth of tree seedlings in relation to changes in the ground flora during natural regeneration of an oak shelterwood. Forestry 78, 21-32.

Harmer, R., Tucker, N. and Nickerson, R. (2004). Natural regeneration in storm damaged woods – 1987 storm sites revisited (PDF-221K). Quarterly Journal of Forestry, 98, 183-190.

Harmer, R. (2003). Seedling root growth of six broadleaved tree species grown in competition with grass under irrigated nursery conditions. Annals of Forest Science, 60, 601-608.

Harmer, R. (2002). Restocking after storm damage from an English perspective. In: Restocking of storm-felled forests: new approaches. Proceedings of an International Workshop in Denmark, March 2001. Ed. A. Brunner. Danish Centre for Forest, Landscape and Planning Report No. 12, Hørsholm, 47-52.

Harmer, R. (2001). The effect of plant competition and simulated summer browsing by deer on tree regeneration. Journal of Applied Ecology 38, 1094-1103.

Harmer, R. (2001). Thinking about using natural regeneration? Smallwoods, Winter 2001, Journal of the Small Woods Association.

Harmer, R. (2001). Dazzled by light? Continuous Cover Forestry Group Newsletter January 2001, 25-27.

Kerr, G., and Harmer, R. (2001). Potential use of alternative silvicultural systems in broadleaved woodlands. ICF News 1/2001, 3-4.

Harmer, R. and Gill, R. (2000). Natural regeneration in broadleaved woodlands: deer browsing and the establishment of advance regeneration. Forestry Commission Information Note 35 (PDF-121K)

Harmer, R., Willoughby, I. and Robertson, M. (2000). Use of herbicides to control weeds and promote the natural regeneration of Fagus silvatica. In Vegetation Management in Changing Landscapes (ed. Boatman, N. D., Clay, D., Goodman, A., Marrs, R. H., Marshall, E. J. P., Newman, J. R., Putwain, P. D. and Pywell, R. F.). Aspects of Applied Biology 58, 9-14.

Harmer, R. (1999). Survival and new shoot production by artificially browsed seedlings of ash, beech, oak and sycamore grown under different levels of shade. Forestry Ecology and Management 116, 39-50.

Harmer, R., Kerr, G. and Boswell, R. (1997). Characteristics of lowland broadleaved woodland being restocked by natural regeneration. Forestry 70, 199-210.

Harmer, R. (1996). Growth of seedling tree root-systems in competition with grasses. Aspects of Applied Biology 44, 47-54.

Harmer, R. and Kerr, G. (1996). Natural regeneration – is more advice needed? Quarterly Journal of Forestry 90, 190-196.

Harmer, R. (1995). Natural regeneration of broadleaved trees in Britain: III.

Germination and establishment. Forestry 68, 1-9.

Harmer, R. and Kerr, G. (1995). Natural regeneration of broadleaved trees. Forestry Commission Research Information Note 275 (PDF-120K).

Harmer, R. (1994). Natural regeneration of broadleaved trees in Britain: I. Historical Aspects. Forestry 67, 179-188.

Harmer, R. (1994). Natural regeneration of broadleaved trees in Britain: II. Seed production and predation. Forestry 67,275-286.

Harmer, R. (1994). Selecting sites for natural regeneration of broadleaves. Forestry and British Timber, 23, 16-18.

Harmer, R. and Forrester, M. (1994). Natural regeneration of broadleaves in perspective. Quarterly Journal of Forestry, 88, 141-144.

Harmer, R., Kerr, G. and Fisher, D. (1994). The potential for natural regeneration of broadleaves in central southern England. Quarterly Journal of Forestry 88, 297-302.

Wang H, Li G, Yu D, Chen Y (2008) Barrier effect of litter layer on natural regeneration of forests: a review. Chinese Journal of Ecology 27: 83–88.

Han Y, Wang Z (2002) Spatial heterogeneity and forest regeneration. Chinese Journal of Applied Ecology 13: 615–619. [PubMed]

Pickup M, Wilson S, Freudenberger D, Nicholls N, Gould L, et al. (2013) Post-fire recovery of revegetated woodland communities in south-eastern Australia. Austral Ecology 38: 300–312.

Liira J, Sepp T, Kohv K (2011) The ecology of tree regeneration in mature and old forests: combined knowledge for sustainable forest management. Journal of forest research 16: 184–193.

Mwavu EN, Witkowski ET (2009) Seedling regeneration, environment and management in a semi-deciduous African tropical rain forest. Journal of Vegetation science 20: 791–804.

Puhlick JJ, Laughlin DC, Moore MM (2012) Factors influencing ponderosa pine regeneration in the southwestern USA. Forest ecology and management 264: 10–19.

Itteri Biofence – Solution for the peafowl`s nuisance

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Introduction

In recent years, Coimbatore, Tirupur, Erode, Karur, Tiruchirappalli and Namakkal like western districts in Tamil Nadu are well-known for its severe crop damage due to peafowls. These peafowl dug up the vegetables and agricultural crops while looking for worms, insects and roots. In addition to this huge damage to the crops, while moving across the field in search of food. Even though peafowls are damaging the agricultural crops, the farmers are not willing to kill the bird due to religious mythology (Vehicle for Lord *Murga*). Since, most of the matured agricultural crops are widely damaged by the peafowls in addition with other factors, farmers of the regions are thought of dropping the agriculture profession moving towards nearby cities in search of employment. In these scenarios, there is urgent need to find ways to control the crop damages from peafowl.

Trends in crop damages by peafowl

During 1990s, seeing the peafowl is not possible in most of the districts in Tamil Nadu especially agricultural landscapes. Most commonly wild vegetations (Bushy type) like trees, shrubs, herbs etc. are maintained in and around the agricultural fields locally called *Itteri* – a green strips. While interacting and analysing the past lives of farmers, it is true that tremendous increase peafowls population in recent years in these regions.

***Itteri*- Biofence**

Itteri is a local word in North Western region of Tamil Nadu (*Kongu Naadu*) which means bullock cart road or walkable road consists of bushes along the both side of the road.It was otherwise known as *Itteli* or *Itterai* or *Olungai* are prominent in Kongu Nadu of Tamil Nadu. It is a part and parcel of the semiarid agricultural practices prevailing in these area since immemorial. *Itteri* consists of assemblage of plants which includes thorny, bushy and tree type vegetation growing in or adjacent to the agricultural fields. These *Itteri* green strips are mostly naturally evolved and managed members of farm holds. The products from *Itteri* green strips are mainly intended for household consumption whereas services from this are helps to enhance the productivity agroforestry.

Itteri has huge amount of thorn bushy vegetation like Vellaipoolaa (*Flueggea leucopyrus*), Karuindu (*Pterolobium hexapetalum*), Chooraimullu (*Ziziphus oenoplia*), Sippaai Kathaalai (*Cereus pterogonus*), Thiruhukalli (*Euphorbia tortilis*), Kalli (*Opuntia monacantha*), Eecham (*Phoenix loureiroi*), Sullimullu (*Opuntia ramosissima*) etc. in and around the edges. In between shrubs like Unnichedi (*Lantana camara*), Aavaram (*Cassia auriculata*), Kattunaarthai (*Citrus medica),* Pachaikiluvai (*Commiphora caudate),* Vedathalaa (*Dichrostachys cinerea*), Viraali (*Dodonaea angustifolia*), Sembulichan (*Erythroxylum monogynum*), Kalaaha (*Carissa carandas*), Karunelli (*Phyllanthus reticulatus*), Nilakkumalaa

(*Gmelina asiatica*), Kalunnu(*Grewia hirsuta*), etc.

Among these trees like Vembu (*Azadirachta indica*), *Karangaali (Acacia chundra),* Peenaari (*Ailanthus excelsa*), Aatthi (*Bauhinia racemosa*), Kanniramaram (*Cassine glauca*), Mammarai (*Chloroxylon swietenia*), Puli (*Tamarindus indica*), Vathanarayan (*Delonix elata*), Palai (*Wrightia tinctoria*), Karuvai (*Acacia nilotica),* Vaagai (*Albizia lebbeck*), Elanthai (*Ziziphus mauritiana*) Manajanathi (*Wrightia tinctoria*), Velvel (*Acacia leucophloea),* Maa *(Mangifera indica),* Kumbil (*Gmelina arborea*), Panai (*Borassus flabellifer*), Arappu (*Albizzia amara*), Arasu (*Ficus religiosa*), Aalamaram (*Ficus benghalensis*), *Ficus glomerata*, Nallaatthi (*Ficus racemosa*), Kaatthaadi (*Gyrocarpus americanus*), Aacha (*Hardwickia binata*), Ponga (*Millettia pinnata*), Vaengai (*Pterocarpus marsupium*), Sandhanam (*Santalum album*), Puchaa (*Sapindus trifoliatus*), Yetti (*Strychnos nux-vomica*), Naval (*Syzygium cumini*), Kadukkaai (*Terminalia chebula*), Puvarasu (*Thespesia populnea*), Mayilaadi (*Vitex altissima*), Elanthai (*Ziziphus Marsupium)* etc. are scatterly arranged.

Since these vegetations provides ample the source of dry plant matters with shades and cool climates, the number of insects are attracted towards this. By feeding insects living in this area, variety of lizards, sinks, chameleons living this *Itteri*. To feeding these snakes, peafowls, eagles, jackals, jungle cats like numerous animals present in these habitats. Some of the animals like snakes, owls, are control the population of rat population in the agricultural fields. Population of snakes are controlled by peafowls, peafowls are controlled by jackels, jungle cat like animals. Actually, these animals were helped the farmers in several ways by pollination, seed dispersal, scavenging dead materials, reducing weeds, controlling the insect, reptiles and rodent populations, nutrient cycling and restoration of ecosystem etc., in the agricultural landscapes.

Present scenarios of *Itteri*

Nowadys *Itteri* are replaced by iron fencing, metalled roads, cash crops like coconut, banana. With advent of modern agriculture technologies, the indiscriminate clearance of bushy vegetation happening in these regions. In addition to this changing cropping patterns, hunting for bush meats and less awareness among the farmers leads to the breakage of food chains especially predators like foxes, jackals, dholes, monitor lizards, mongoose, etc,. population are almost extinct. Since, no predator for peafowls like birds, drastic increase in the peafowls populations. Since it facing food problems, it voraciously feeding the seeds, leaves, flowers and fruits of paddy (*Oryza sativa*), ground nut (*Arachis hypogea*), tomato (*Lycopersicon esculentum*), aggregatum onion (*Allium cepa*), pearl millet (*Pennisetum glaucum*), jowar (*Sorghum bicolor*), cowpea (*Vigna unguiculata*), green gram (*Vigna mungo*) and black gram (*Vigna radiate*). In addition to these trampling, lodging and cutting down these crops. Even it is eats all small snakes in agricultural landscapes, there is a snake population also drastically going down.

Way forward

Hence the restoration of *Itteri* bio fencing systems will definitely improve the habitats for number of animals. Particularly increase population of predators like jackals, jungle cats will absolutely control the population of peafowl naturally. Thereby minimise the crop damages by the peafowl and also increases the yield of agriculture crops by increasing the soil fertility.

Fig. 1. Peafowls in tapioca (*Manihot esculenta*) fields

Fig. 2. Flocks of Peafowls in Rice (*Orza sativa*) fields

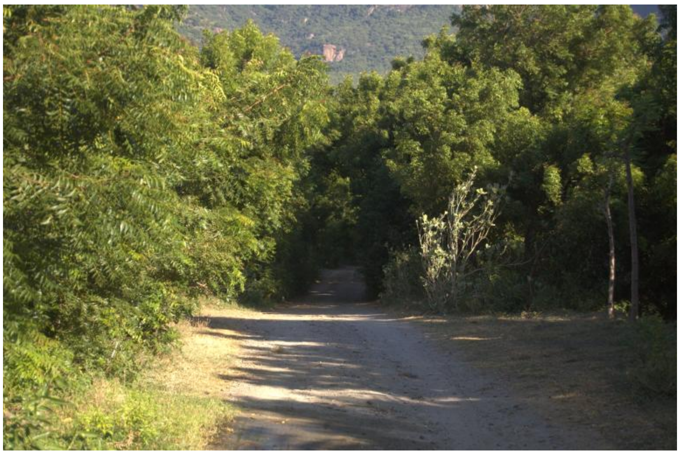

Fig. 3. *Itteri* biofence system – Central view

Fig. 4. *Itteri* biofence system – Side view

Fig. 5. *Itteri* biofence system – aerial view (Google satellite image)

Environment and radioactive pollution

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Humankind has achieved great feats in every occupation. New technologies are being developed and upgraded for efficient working of human civilization. Newer energy sources are looked for and we harness their optimal capabilities. One such avenue is radioactive energy, which has numerous applications in every sector. Radiation is the emission of particle or energy in waveform. This is stated as electromagnetic radiation. Examples consist of: visible light, radio waves, microwaves, infrared and ultraviolet lights, X-rays, and gamma-rays.

Radioactive isotopes (radionuclides) are present naturally everywhere, which includes our bodies, food and water. Half-life of radio-isotopes range from hundreds to thousands of year i.e huge amount of time required to reduce their radioactivity by half. All living beings encounter radiation on a daily basis. It comes from space, naturally-occurring radioactive materials (radionuclides) found in the soil, water and air.

Radioactive pollution is created when radioactive byproducts of a nuclear reaction, either man-made or natural, are dumped in the environment or in the vicinity of human settlements. Nuclear power and research stations are the major contributors to man-made radioactive waste. These facilities bring about a nuclear reaction (usually fission) for the purpose of either production of energy (electricity) or research. When a heavy atom of a nuclear fuel, such as uranium, undergoes nuclear fission, it results into two daughter nuclei, both radioactive in their own rights. These byproducts are not reusable and thus have to be dumped. The introduction of these radioactive byproducts causes radioactive pollution.

Radioactive pollution is fast becoming a major concern due to the increase in the usage of nuclear fuel. The radioactive byproducts of nuclear reactions are often disposed without any precautionary measures to isolate the harmful components, which can contaminate air, soil and water. A large amount of radioactive waste is generated from nuclear reactors used in nuclear power plants and for many other purposes. It may also occur during extraction and refining of the radioactive material.

Radioactive waste generates radioactivity and emits radioactive byproducts. Radioactivity is the spontaneous loss of energy from an unstable atom, in the form of various nuclear byproducts (radiation). It helps the atom gain a relatively stabler configuration. This spontaneous loss, known as radioactive decay, continues till a stable (nonradioactive) configuration is achieved.

The reason why radiation is considered a threat is that it contains enough energy to ionize a stable atom by separating an electron from it. If ionizing radiation enters the body of an organism, it ionizes the molecules found in the body. This leads to the formation of a large number of free radicals that react with vital bodily components, nullifying their effects by forming new compounds in their place. This can lead to cancer.

The three main types of emissions from radioactive substances are: Alpha Radiation, Beta Radiation and Gamma Radiation. Among the three, the effect of alpha particles (which is, in effect, a helium atom) is the lowest and the gamma rays, the most. Alpha particles can be blocked by a mere sheet of paper (or, at a sufficient distance, even air!), while protection from gamma particles requires thick lead plates. However, accidental ingestion or injection of alpha particles can be fatal, since they can come in direct contact with internal organs and important bodily fluids such as blood. Radiation is only harmful when it meets the body. If it can be blocked, the mere 'presence' of radioactivity is not harmful.

When radioactive substances contaminate soil, the harmful substances are transferred into the plants growing on it. It leads to genetic mutation and affects the plant's normal functioning. Some plants may die after such exposure, while others may develop weak seeds. Eating any part of the contaminated plant, primarily fruits, poses serious health risks. Since plants are the base of all food chains, their contamination can lead to radioactive deposition all along the food web. Similarly, when radioactive waste is washed up in a water source, it can affect the entire aquatic food web. Both terrestrial and aquatic radioactive contamination can culminate in human consumption. Since humans are apex predators, the accumulation of radioactive materials on the last rung of the food chain would be maximum.

There is no safe limit for radioactivity, since even the smallest amount has some effect on the body and holds the potential to be highly dangerous. However, various devices can detect radioactivity, so that preventive measures can be taken. A Geiger counter is a universally used device to detect radioactivity.

The threat of radioactive waste can be minimized to a great degree, or even completely negated, if it is stored for an appropriate time before being dumped.

A radioactive substance naturally undergoes radioactive decay until a nonradioactive isotope of the element, or a different, nonradioactive element is formed. The time required to achieve a nonradioactive byproduct varies with every radioactive element. Till then, these materials have to be kept in an isolated condition, so that the environment is not exposed to it.

Various processes have been put forth to reduce the radioactivity of the stored byproducts. Some of the most promising methods are nitrification (forming a mixture of the radioactive waste and glass and storing it in steel containers), reusing the radioactive waste until it becomes sufficiently benign (although it is not feasible right now, research is being done in the field), and storing spent nuclear fuel in dry casks after it has been treated in spent fuel pools for a long period, at least a year.

There are many forms of radiation. Some forms of radiation are found in the natural environment and others are due to modern technology. Whether natural or man-made, radiation can be both harmful and beneficial to the environment. The sun, for example can have positive and negative effects on plant and animal life. At low levels, radiation can be beneficial to the environment. On the other hand ionized radiation such as x-rays, gamma rays, alpha and beta particles can be particularly harmful in excessive amounts.

Natural radiation is often beneficial to plant growth. It is necessary for many plants to receive some form of non-ionizing radiation. Radiation that produces light in order for photosynthesis to occur is a positive effect that radiation has on plant life. However, according to the Environmental Literacy Council, ionized radiation that occurs from nuclear material may result in weakening of seeds and frequent mutations. For instance, a nuclear plant, called Chernobyl in Russia leaked in 1986 that caused excessive amounts of radiation pollution in that region. A huge cloud of radiation was formed which resulted in a massive amount of destroyed plant life; particularly pine trees in that area. High doses of radiation can be devastating to the environment.

The effects that radiation has on marine life can be dangerous. High levels of UV or ultraviolet radiation can cause a reduction in reproduction capabilities. It can also disrupt the timing that plants flower, which can result in changes in pollination patterns. According to NASA, it can also reduce the amount of food and oxygen that plankton produces. Plankton can respond to excessive amount of UV-B or Ultraviolet-B light by sinking deeper into the water. This decreases the amount of visible light required for photosynthesis, which reduces growth and reproduction. An increased amount of UV-B can also increase the amount of ozone produced at the lower atmosphere. While some plants can use this extra layer as a protective shield, other plants are highly sensitive to photochemical smog.

Radiation used in the food industry ensures packaged food stays longer on our shelves, without the accompanying micro-organisms. The ionised radiation used in the process — called food irradiation — is not strong enough to render the food radioactive, but is just about enough to kill the bacteria in it. Though irradiation hardly tampers with the nutrient value, there may be other reasons that cause chemical changes in the food. Chef Sushil Dwarkanath, assistant professor, Christ University, Bengaluru, highlights how restaurants continue to use cheap plastic bags (with a metallic finish) to pack food. “The curry that goes into that bag is anywhere between 75 and 80 degrees C, maybe more. At that temperature, the food is bound to react to the plastic,” he explains. The food may also end up absorbing the chemicals from the plastic.

The degradation of such radioactive waste is difficult, but there are some biological solutions that would mitigate this problem. Many microbes like bacteria and fungus could help in degradation of such radioactive pollutants thereby helping other organisms to sustain their biological functions. There are three basic tools that can provide protection against a radiation source. These are time, distance and shielding. The goal of the protection is to prevent over exposure from external radiation and to minimize the entry of radionuclides into the body or minimize internal radiation. Controlling Radiation Pollution can be done at various levels, such as usage and treatment of radiation waste, the control and mitigation of nuclear accidents, as well as the control and minimization of personal exposure to radiation at an individual level .Apart from being an inevitable series of negative effects of radiations, it is the duty of humans with regard to Radiation Standards Organizations to help in reducing the harmful effects of this kind of pollution.

Know your biodiversity

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Aconitum hetrophyllum

Aconitum heterophyllum is a perennial herb which is known for its important medical properties. It is belongs to order Ranunculales and family Ranunculaceae. *It* is commonly known as Atish, Patish and Ativisha and used as the main ingredient in many formulations in Ayurveda. It is widely distributed in alpine to sub-alpine open slopes at altitude range of 2000-5000 meters and prefers open, sunny sites with abundant soil moisture. This species is native and endemic to Himalayan region of India, Pakistan, Iran and Nepal. In India it is found in Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Sikkim. In Himachal Pradesh it is found in Kangra, Chamba, Sirmour, Shimla, Kullu, Lahaul- Spiti and Kinnaur districts at altitude 2500-4500 m.

It is herbaceous, perennial plant up to 15-20 cm tall. The tubers are up to 3 cm long and conical at the ends. The mother and daughter tubers occur in pairs. Tubers contain the alkaloids aconite, mesaconite, hypaconitine, atisine, heteratisine, telatisine and atidine. The stem is clasping, erect and upto 1m tall. The branches are absent or rarely one or two in number. Leaves are broad, ovate, cordate, lobed and toothed, shortly stacked or sessile amplexicaule. Lower leaves are long petioled while upper cauline leaves are sessile, amplexicaule. Flowers bright blue usually in lax spike like cluster with very variable bracts greenish purple conspicuously dark veined. Corolla is hairy. Carpels are five in number and containing 10–18 follicles. Seeds are pyramidal, 3-4 mm long and dark brown. Flowering and fruiting period is July-October.

Although it generally prefers sub-alpine and alpine climate, cultivation up to 2000 m altitude has been recommended in sandy soils (10 cm deep) with rich organic matter. In Garhwal Himalayas, altitudes above 2000 m above mean sea level have been found to be suitable for the cultivation of atees. Sandy loam and slightly acidic soil, with pH about 6, has been found to be the best for seed germination, survival, better growth, and yield. Addition of humus or leaf litter to the soil increases survival rate and growth of seedlings at all altitudes. Forest leaf litter also helps in retaining moisture content in the soil. The plant prefers open, sunny sites, and abundant air and soil moisture during summer months.

Due to the presence of alkaloids, carbohydrates, proteins and amino acids, saponins, glycosides, quinones, flavonoids, terpenoids etc. its roots and stems are used in traditional healing system of India, i.e., Ayurveda. It is reported to have use as an anthelminthic, anti-inflammatory, antipyretic, analgesic, astringent and febrifuge. It is useful in treating coughs, diarrhoea indigestion and reproductive disorders. It is a valuable drug for infants in dentition, diarrhoea, fever and vomiting. Traditionally it has been used as an antidote against poisoning due to scorpion or snake bite. The aqueous extract of the root induces hypertension through action on the sympathetic nervous system and its higher dose become lethal. The roots are used as an astringent in bleeding piles, amenorrhea and leucorrhoea and also used as ingredient in Yunani medicines.

Due to immense medicinal importance and high price in the market have lead to an indiscriminate harvesting from the wild region and the species is now categorised as critically endangered by IUCN. *Aconitum heterophyllum* is a highly traded medicinal plant among all *Aconitum* species and is prohibited for export in India if the plants have been collected from the wild. Cultivated specimens can be exported from India and it has vast potential in improving the socio-economic conditions of the locals in high hill temperate areas as this species is suitable for intercropping with apple and cherry. Hence along with the sustainable harvesting and conservation of natural habitats, intensive studies on the population trend, reproductive biology and propagation techniques need to be carried out along with conservation programs.

Moschus leucogaster

Moschus leucogaster is commonly known as Himalayan musk deer. It differs from other deer in not having antlers and facial glands. It belongs to order Cetartiodactyla and family Moschidae. They reside in the Himalayan mountain range, particularly within the countries of Bhutan, India, Afghanistan Nepal, and a small part of China. In India, they found in Jammu and Kashmir, Sikkim, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Uttar Pradesh and Assam. It inhabits sub-alpine and alpine vegetation at an altitude of 2500 to 4800m.

Musk deer are mostly seen feeding in open alpine grasslands. It feed on a variety of food viz. leaves of woody plants, forbs, lichen, moss, ferns and grasses. During the winter time they also feed on lichens and mosses. Himalayan musk deer are preyed on by leopard, lynx, yellow-throated marten, red fox, grey wolf, and wild dogs.

It is a shy, brownish yellow, dog sized, mountain ruminant and can be easily differentiated from the alpine musk deer in having dark legs and chest with no chest stripe. Himalayan musk deer weight is around 11 to 18 kg and 86 to 100 cm in length. The coat of is brownish yellow with weak striations. The head is grey-brown, and the ears are brown while the rim and inside are greyish white. The eye-ring is a poorly expressed grey. The throat, legs and rump are dark. The bases of dorsal hairs are pure white. Although both sexes have long upper canines, the males' grow longer, up to 7 to 10 cm. The canines break easily, but tooth growth is continuous. In addition, male Himalayan musk deer have a musk sac and a caudal gland at the base of their tail, both of which play a role in communication.

The musk gland attracts females during mating season, and the caudal gland is also used to mark territory. They are fairly sedentary occupying a small home range of up to 22 hectares. Male are fiercely territorial, only allowing females to enter their range. Himalayan musk deer mate between November and January and the gestation period is 185 to 195 days. Average life span of Himalayan musk deer is 10 to 14 years.

Himalayan musk deer is listed as endangered in IUCN Red List. Population existence of Musk deer is threatened across its habitat due to deforestation, habitat fragmentation and anthropogenic activities viz. poaching. Musk deer is hunted for its meat, fur and musk glands. The musk produced by Musk deer is considered highly valued for its cosmetic and alleged pharmaceutical properties. Around 25 g of musk can be extracted from a single musk sac and can fetch U.S. $45,000 per kilogram (2.2 pounds) on the international market. China is the largest exporter (>200 kg/annum) of musk and Japan is the largest importer. Estimates on the probable number of musk deer killed in the Himalaya during the 1970s and 1980s vary between 5350 and 16,000 every year (Green 1985, 1989).

Beside anthropogenic activities, habitat degradation due to increasing human pressure on the musk deer's habitat is another major reason for the decline in their numbers. About 70 per cent of potential musk deer habitat on the southern side of the Greater Himalaya has already been lost (Green 1985, 1986). Despite several nations making musk deer trade illegal, poaching and subsequent smuggling still continues due to high market demand. Hence conservation of musk deer and its natural habitat coupled with anti-poaching awareness is urgently required for the conservation of this species.

References

Paramanick, D., Panday, R., Shukla, S. and S, Sharma, V. (2017). Primary pharmacological and other important findings on the medicinal plant "*Aconitum heterophyllum*" (Aruna). *Journal of Pharmacopuncture,* 20(2):089-092.

Buddhadev, S.G. and Buddhadev, S.S. (2017). Acomplete review on Ativisha- *Aconium heterophyllum, An International Journal of Pharmaceutical science,* 8(1): 111-114.

Dendup, P., Namgay and Lham, C. (2018).Winter distribution and poaching of Musk deer, *Moschus chrysogaster* and *Moschus leucogaster* in Gigme Dorji National Park, Bhutan. *International Journal of Conservation Science*, **9**(1): 193-198.

Chauhan, N.S. (1999). Medicinal and aromatic plants of Himachal Pradesh. Indus Publishing Company, New Delhi, India. 632 pp.

www.vikaspedia.in/agriculture/crop-production/package-of-practices/medicinal-and-aromatic-plants/aconitum-heterophyllum-2

https://www.researchgate.net/profile/Gopal_Rawat/publication/271693635_Order_Artiodactyla_Family_Moschi dae_Evolution_Taxonomy_and_Distribution/links/54cf42580cf24601c09320dc/Order-Artiodactyla-Family-Moschidae-Evolution-Taxonomy-and-Distribution.pdf

https://www.nmpb.nic.in/sites/default/files/publications/Agro_techniques_of_selected_medicinal_plants_Vol-I.pdf

www.bioinformaticssikkim.gov.in

www.indianmedicinalplants.

www.iucnredlist.org

www.animaldiversity.org

www.eol.org

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