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# Van Sangyan

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# Van Sangyan

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## 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:

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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 area of planted forests has been steadily growing to 7% of total global forested area in 2010 (FAO 2010). Planted forests provide ways to meet local and international demand for timber, fuel, paper, and nontimber products to respond to deforestation, forest degradation and climate change and alleviate poverty and development. Investments in responsible forestry (demonstrated by forest management certification and carbon standards), have also been increasing. Agroforestry has been for many years (and still is) promoted, particularly for small farmers and plantation. Planted forests provide products (timber, fibre, energy and food) and environmental services (carbon, land restoration and reclamation, hydrological regulation and biodiversity and genetic resource conservation). They can have multiple, positive and negative sustainability impacts (environmental, social and economic impacts), which are strongly dependent upon the context in which they are planted and how they are managed. Many of the predicted impacts from plantations in tropical areas, such as ecological and rural livelihood benefits, have not materialised, and when they do, have been unevenly distributed locally, particularly to the disadvantage of poorer and customary land users. The motives of public and private sector investors in planted forests vary significantly, and include increasing private sector economic activity, stimulating economic growth, (sustainable) profit generation, climate change mitigation and environmental benefits.*



*Sustainability measurement is both an acute and controversial topic. The World Bank's measure of genuine savings approach to inclusive wealth and genuine investment serve as measures of sustainable economic development over time. To compute the genuine savings rate, resource depletion and environmental degradation are subtracted from traditional net savings, while investment in human capital is added. A society's inclusive wealth is determined by measuring the shadow value of the economy's stock of capital assets (including manufactured capital assets, natural capital assets, human capital etc.). Genuine investment is then a measure of changes in capital assets weighted at shadow prices. Accordingly, positive genuine investment can be used as an indicator of sustainable development, and of changes in well-being. Sustainability related investment projects, such as plantations, are characterized by (1) uncertain future rewards or losses; (2) partially or completely irreversible sunk costs, and (3) flexible timing, in that waiting for better future insight is generally possible. These three features need to be considered in an impact evaluation to avoid biases. A starting point is to identify reversible and irreversible, internal and external benefits and costs, at different levels: household, community, regional, national and international.*

*This issue of Van Sangyan contains an article on Socio-economic benefits of plantations to rural communities in Sierra Leone. There are also useful articles, such as Awareness of mycotoxins infections, Botanical pesticides and its application, Non-timber forest products and utilization pattern in tribal areas of Sarguja, Ulmus wallichiana: an endangered species of north west Himalayas, India, रेडियोधर्मी पर्यावरण प्रदूषण (in Hindi), गुणकारी खारपाठा (in Hindi), Diversity of macro-fungi in central India, Ganoderma as a bio-deforesting agent, Weed diversity in agroforestry system, Management practices for conservation of biodiversity in Achanakmar-Amarkantak biosphere reserve and Biodiversity of Garrulax leucolophus and Salvia moorcroftiana.*

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

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

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

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## Socio-economic benefits of plantations to rural communities in Sierra Leone

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### Abstract

The massive economic contributions of plantations continue to improve human livelihoods, economic development of rural areas, and contribute to national and domestic incomes of developing countries. The main species grown on plantations in Sierra Leone are *Tectona grandis*, *Terminalia species*, *Azadirachta indica*, *Gmelina arborea*, *Pinus Carabaea*, *Eucalyptus camaldulensis* and *Acacia species*. Forest provide a wide variety of social and economic benefits, ranging from easily quantified economic values associated with forest products, to less tangible services and contributions to society. This research assesses the socio-economic benefits of plantations to rural communities with special emphasis on Bradford pine plantation Ribbi chiefdom, Moyamba District, Southern Sierra Leone. A well structured set of questionnaires, informal group discussions and direct observations were the main tools employed for the collection of information. The quantitative data were analyzed by statistical means and the total number of respondents interviewed was 150. Findings from the research revealed that majority of the respondents had non-formal education (70%) and about 62% of respondents were farmers mainly engaged in subsistence farming. Subsistence agriculture and product gathered/collected from plantation were the main source of

income for 80% of the respondents. The most common perceived social benefits of the plantation was using the plantation for societal purposes, spiritual fulfilment, recreation especially during festive seasons, tourist attractions and the aesthetic beauty the plantation display around the township. The community/environmental benefits of the plantation were micro climate amelioration, control of soil erosion, fuel wood and charcoal for energy, poles and timber for construction purposes. About 95% of the respondents admitted that the plantation was a blessing to the community especially with the rapid ecological change of vegetation in the chiefdom. Owing to socio economic benefits of the plantation, sustainability can be achieved when some exploitation measures are implemented by the local authorities in management and utilization of the plantation products. However, the increase in the population of the township and the uncontrolled harvesting of products and timber from the plantation threatens the long term availability of the plantation resources.

**Key words:** Plantation, Products, Forests, socio-economic, fuelwood, benefits

### Introduction

Forest plantations play an important role in environmental sustainability through mitigation of clean and reliable water supply, erosion control; soil protection; enhancement of land productivity;

protection of coastal and marine resources; provision of low cost and renewable energy; raw materials for industries; electric and telephone poles; and enhancement of urban environment (FAO, 2001). Forests produce a number of benefits including the provision of resources (e.g., timber, fruits, and medicines), the regulation of ecosystem services (e.g., air and water cycles, climate, pollination, and nutrient cycling), and a contribution to culture e.g., aesthetics and education (Millenium Ecosystem Assessment, 2005). Successful pine plantations can provide multiple economic, social and environmental benefits to a state, region, and country if properly planned and integrated into the multiple land use opportunities (McKean *et al.*, 2003). The role of plantations in providing a broader range of environmental and social benefits emerges as a major focus in plantations establishment. Plantations are also considered by some to be a potential driver of regional development and of the rejuvenation of rural communities (Keenan *et al.*, 1999).

In a developing country such as Sierra Leone, Government views plantation forestry as a means of economic development in rural communities, as it creates economic development by generating revenue (Charnley, 2003) and foreign exchange from exports of forest products and import substitution (Evans and Turnbull, 2000).

The establishment of plantations in Sierra Leone started in the late 50s with mostly exotic species viz *Tectona grandis*, *Terminalia species*, *Azadirachta indica*, *Gmelina arborea*, *Pinus Carabaea*, *Eucalyptus camaldulensis* and *Acacia*

species were planted by the Government along highways and close to local communities. Only 5% of the then established plantations country wide exist today but in a deteriorated state. The uses of plantation products include a variety of poles (mainly for construction), firewood, crafts, binding and weaving, food sources (vegetables, fruits, and meat), and traditional medicine (bark, roots and leaves). Pines are among the most commercially important tree species, valued for their timber and wood pulp production throughout the world. In addition, the increased need for wood for household and industrial energy, production of non-wood forest products, and afforestation for environmental purposes, such as windbreaks, shelterbelts, watershed rehabilitation, and, more recently, carbon sequestration call for the adoption of plantations as a viable option to meet these demands (Evans and Turnbull, 2000).

#### **Environmental benefits of plantations**

Recent research has proven that plantations constitute one out of every five hectares of world forests and that Africa hosts about 16 million hectares of plantations, which is about 4 percent of African forests, less than the global average of 7 percent. In recent years there has been an accelerated pace of planting in Africa, especially by the private sector. (AFF, 2015).

Trees influence the environment in many beneficial ways as they shade the ground, soil temperature is cooler during the summer, resulting in better retention of soil moisture and erosion control. Pine Plantation forest provides watershed protection and their influence on the watershed can benefit clean water resource

for drinking water or water based recreation. (Davidson 1995). During a rainstorm, the leaves and branches of trees break the impact of rain, causing it to drip rather than to reach the earth with a force. Upon reaching the forest floor, rain is absorbed by the ground litter and humus. African forest plantations are often more important for the environmental services they provide than for the wood and non-wood products they produce. Their role in watershed protection and in arresting land degradation is particularly significant (EL-Lankany, 2000). The benefits from plantation trees may be direct such as income derived from round wood sales or they may be more indirect such as financial security of owning a tangible asset such as a forest plantation (Farjon 1984). Forest plantation support development for the production of nonmarket benefits such as; watershed protection, improve visual appearance of the landscape, carbon sequestration, the provision of outdoor recreation opportunities and land rehabilitation or reclamation. Plantations provide logs to mills producing products ranging from pallet materials, landscaping supplies, perfect-round posts, structural/framing timber and high quality plywood products (Evans, 1992). Forest plantations are economically not different from other investment opportunities just as wood is of no difference from other commodities transacted in competitive market (La Deau and Clark., 2001). Pines and other trees are arguably America's greatest natural resource benefiting humans and wildlife in countless ways. This research therefore intends to investigate the socio-economic benefits of the Bradford plantation either

in the form of wood or non-wood forest products to local indigenes.

### **Materials and method**

#### **Description of the study area**

The study was conducted at Bradford pine plantation, Ribbi Chiefdom, Moyamba District in the Southern part of Sierra Leone. The Township is sparsely populated with three ethnic groups which are in the majority, namely Temne, Loko and Fullas. Bradford town is about 75 kilometers from the District head quarter Town of Moyamba. The climate of Sierra Leone is largely determined by its geographical location on the South West Coast of Afri (Savill and Fox, 1967). Sierra Leone has a hot tropical climate with two pronounced seasons: a rainy season from May to November, and a dry season from December to April. The rainy season has weather patterns occurring in the following order: thunderstorms and squalls for some months, steady rains then thunderstorms and squalls again. In mid-December to mid-February the study area experiences a harmattan wind which most times dries all smaller streams except the Taia River (FAO/UNDP, 1979). The pine (*Pinus caribaea*) plantation was established in 1963 with a total land area of 13.7-15.0 ha using the Taungya system of plantation establishment.

#### **Sampling procedure and sample size**

Well-structured questionnaires were administered to respondents using a purposive without replacement random sampling technique. The 2005 census of Sierra Leone stated that Bradford town has approximately 3000 inhabitants. The sample size was 5% of the total population. The targeted respondents were key stalkholders, farmers, forest guards,

family heads, women, youths and civil society workers.

### Data collection

Both primary and secondary data were collected for the study. The secondary data was collected from published and unpublished documents on socio-economic benefits of plantations. Other documents such as plantation Gazette, Magazines, local council's documents, national census documents and plantation establishment document were sought as well. The method used in the field survey was questionnaires, informal discussion, oral interview and observation. A total of 15 questionnaires were pre-tested before the actual 150 questionnaires were later administered

### Data analysis

Basic simple descriptive statistics such as percentages pie chart, bar chart frequency tables were used to summarize the result of the respondent's survey on socio-economic benefit questions. Group's discussions and observation opinions were incorporated into the result of the study.

### Results and interpretation

The socio-demographic characteristics of respondents reveals that (74%) of the respondents were male while (26%) were female. Sixty two (62%) of the respondents were farmers, (14%) were traders. About (12%) of the respondents were carpenters and (6%) were civil servants. The result further shows that greater proportion (70.%) of respondents do not have formal education while (12%) had primary school education and (10%) had secondary school education. Adult and tertiary education accounted for about 6 and 4% respectively.

### Table 1: socio-demographic characteristics of respondents

Socio-dem-characteristics of respondents	percentage
<b>Age in (Yrs)</b>	
21-30	4%
31-40	15%
41-50	30%
51-60	35%
61 and above	16%
<b>Total</b>	<b>100</b>
<b>Gender</b>	
Male	74%
Female	26%
<b>Total</b>	<b>100</b>
<b>Marital status</b>	
Married	62%
Single	38%
<b>Total</b>	<b>100</b>
<b>Educational level</b>	
No formal education	70%
Primary education	12%
Secondary education	10%
Adult education	6%
Tertiary	4%
<b>Total</b>	<b>100</b>
<b>Occupation</b>	
Farmers	62%
Civil servant	6%
Traders	14%
Carpenters	12%
Self employed	8%
<b>Total</b>	<b>100</b>
<b>Family size</b>	
1-2	10%
2-4	50%
5-9	20%
10 above	10%
<b>Total</b>	<b>100</b>

Source: Field survey, 2014.

### Sources of income of respondents

Figure 1, revealed that 40% of the respondents source of income was farming with 19% from the sale of charcoal and

fuelwood. Timber and pole sale accounted for about 10%.

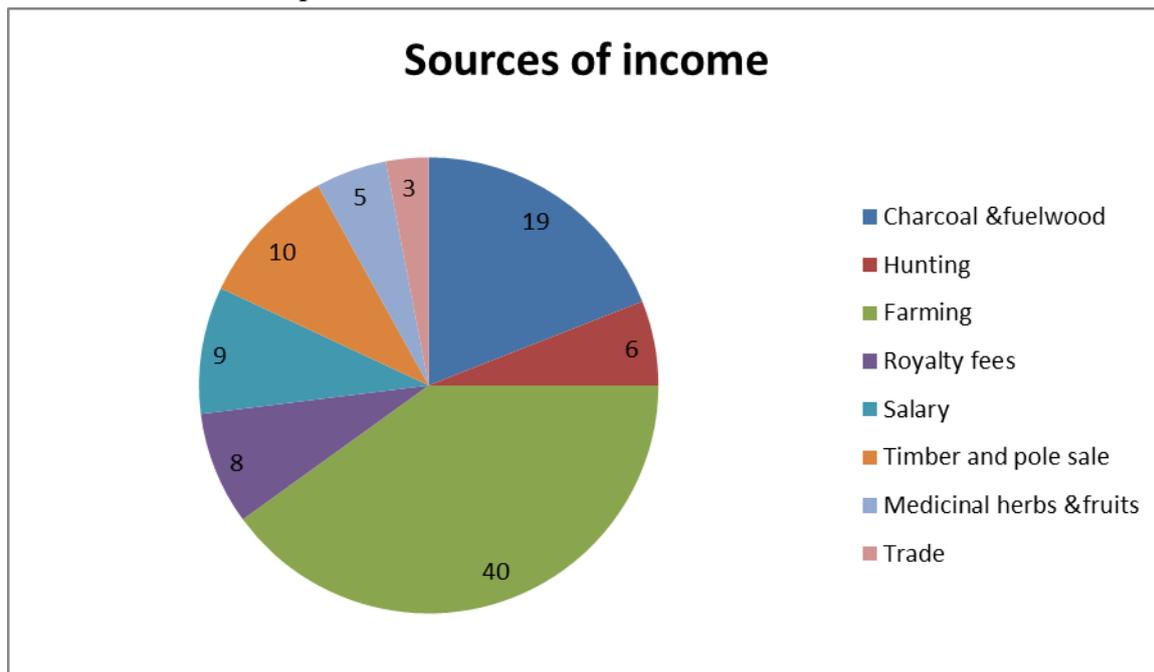


Figure 1: Sources of income of respondents (Source: Field survey, 2014.)

**Social benefits of the plantation**

About (10 %) of the respondents said the plantation was used as societal bush, 25% said source of pole and timber for building shelter while 23% said the plantation ensures their spiritual fullment and provide medicinal herbs. 15% of the respondents said the plantation provided them with self employed jobs. Tourist attraction, recreation and aesthetic accounted for 17%, 8% and 2% respectively.

**Table 2: Summary of percent respondents perception based on social benefits derived from the plantation.**

Social benefits	Percent respondents
Societal bush venue	10
Self-employment	15

Pole & Timber for shelter	25
Spiritual fulfillment & herbs reservoir	23
Tourist attraction	17
Recreation	3
Aesthetic beauty	2
<b>Total</b>	<b>100</b>

Source: Field survey, 2014.

**Gathered/harvested non wood product from the plantation**

The commonly gathered/harvested products from the plantation were honey (22%), bush yam 20%, and medicinal herbs 13%. Mushroom and snails accounted for 15% and 10% respectively. (Figure 2).



Figure 2: Gathered/harvested products (Source: Field Survey 2014)

**Environmental and community benefit from the plantation**

Respondents were asked a series of questions in order to understand their perceptions of the plantation and how they

thought it has benefited their environment and the community as a whole. About 25% of the respondents said fuelwood, 21% said charcoal and 18% said windbreak service. Only 8% accounted for timber purposed (Figure 3).

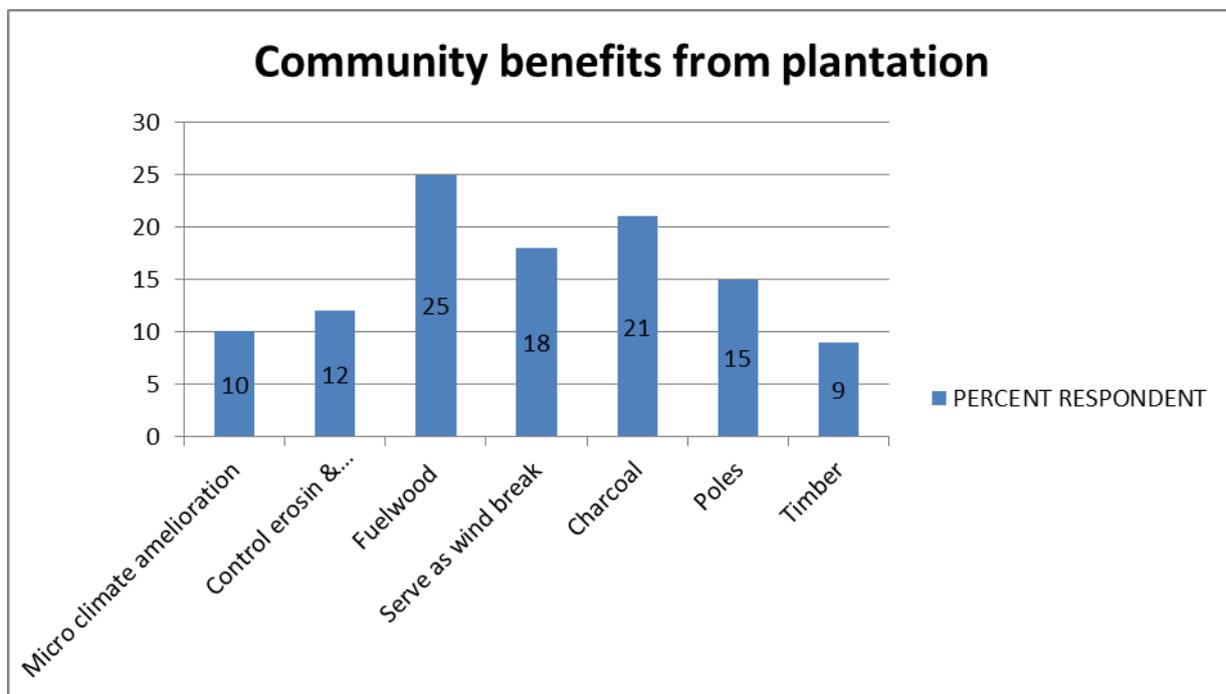


Figure 3: Summary of respondent's perception based on community benefits (Source: Field survey, 2014.)

**Annual income of respondents**

Figure 4, revealed that 40 % of the respondents earn one to two million

Leones (Le) (approximately USD\$ 400 at that time annually). Those earning two to

four million Leones (Le) were accounted for 20% (approximately USD 600).

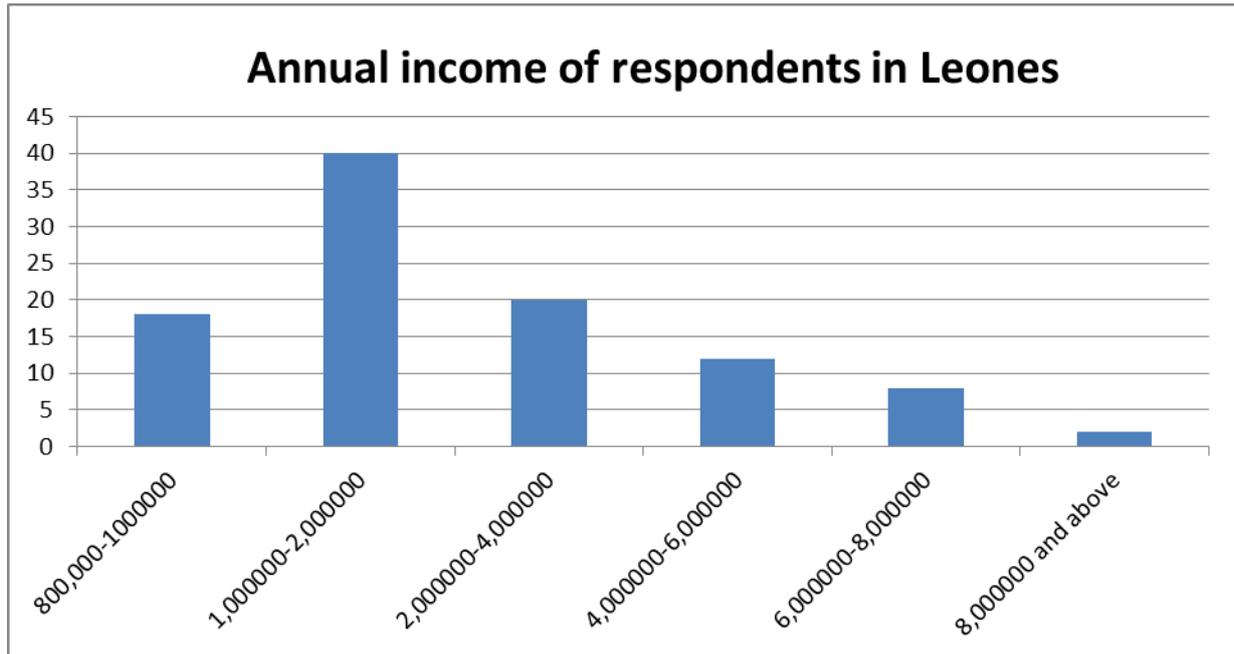


Figure 4: Annual income of respondents in Leones (Source: field Survey, 2014.)

**Discussions**

About 74 % of the respondents were male while (26%) were female with Majority of them 62% being farmers mainly engaged in subsistence farming. Subsistence farming in the study area is done primarily in the wet season with crops such as maize, beans, sweet potatoes, potatoes, cassava, nuts, garden eggs, vegetables, yams, sorghum, rice, and cassava being cultivated. Subsistence farming still remain the main type of farming practice in Sierra leone because of the lack of capital to purchase mechanized farm machineries at rural level (UNDP, 2015) report lend credence to this finding by reporting that farming, firewood collection and charcoal burning are the main sources of livelihood in Mawoma, Makolerr and Robana section Northern Sierra Leone. A greater proportion of respondents (70%) had no formal education with only 30% having some form of education. Rebecca (2015) UNDP consultancy report affirm this findings by reporting that only 15% of

respondents in three Chiefdoms in the Northern part of Sierra Leone had Junior Secondary school education with majority either having some form of primary education or not been educated at all. One reason for the high rate of illiteracy could be attributed to poverty, lack of access to schools as well as quality teachers, absence of educational motivation and inability of parents to meet the ever increasing school charges in the country. Another reason could be the norms and traditional practices of early marriage for both sexes. Teenage pregnancy and local belief that schooling is only for the rich class of people in society. About 50% of the respondents had a family size of 1-4 children while 20% had five children and above. In a country like Sierra Leone were there is no regulation on birth control having a large family is seen as social security for your old age as well as adequate labor for farm exercise. Men are free to marry as many wives as they feel and have as many children as they desire

because it is traditionally believed that having plenty children give them a better chance of one or two among the rest will be successful while the rest can join the work force to feed the family.

The economic activities in Bradford community include farming, honey production and sales, fuelwood collection, charcoal burning, timber logging, wooden furniture production, animal husbandry, hunting, fishing and traditional herbs collection. Generally, plantations are important drivers of economic development in Sierra Leone because they contribute to state revenues and provide self or casual labor employment in rural areas (Scoones 1998). The largest wood-based economic sector today is related to production, transport and sale of charcoal, which is estimated to be worth billions of USD and employing millions of people. However, since this almost invariably occurs in the informal, and often illegal, sectors of the economy, figures are uncertain. Demand is rapidly increasing and there is an enormous economic potential provided that charcoal production/sale are legalised, based on sustainably managed forest/tree resources, modernised technology and given advice (AFF, 2015). The increased in global demand of wood for domestic energy and industries, export, together with demand for an array of non-wood forest products (NWFPs), are some factors contributing to the pressure now exerted on natural forests in Africa. In many areas of Zambia, charcoal production is an important source of cash income. In 1997 alone, the Government of Zambia estimated that 41,000 rural households were full-time employed in charcoal production and an additional 4500 people involved in

transportation, marketing and distribution of the charcoal (GRZ, 1997). Few rural households specialize in one full-time activity and it is therefore likely that the total number of households benefiting financially from the charcoal industry is much higher. Approximately 9000 households, in Chongwe District alone in 2000, were involved in charcoal production, supplying the product to Lusaka (Chidumayo, 2001).

The most perceived social benefits of the plantation to the Bradford community was venue for societal activities 25%, poles and timber for building construction 25% spiritual fulfillment and medicinal herbs 23%, tourist attraction 17% with recreation and aesthetic beauty being the least benefits considered. Rural communities in Sierra Leone still holds traditions and norms with high esteem than urban areas and so having a platform that support their beliefs is considered a great blessing for them in the township. The female genital mutilation practice as well as the male initiation practice is still active and widely practice in almost every part of Sierra Leone with nearby forest in villages used as initiation venues. Bradford being a rural community, with little or no recreational facilities especially during festive periods, use the plantation site for recreational activities during holidays (Personal com, 2014). Other social benefits such as shade, micro-climate regulation and natural wind protection were being enjoyed by the local community on a daily basis. In a local community like Bradford, with less than 1% being employed, self employment is the ultimate option for young men and women who decided not to migrate to urban areas for greener pastures. In such,

some find the job of being a farmer, herbalists, blacksmith, woodcarvers, hunters, charcoal burners, fruit and snail gatherers etc. FAO (2001) reported that millions of people globally secure employment in forest based industries either formally or non formal, thereby reducing poverty in developing countries. Various forest products were obtained from the plantation both for consumption and sale. Food products such as bush yam 20%, honey 22%, bush meat 15%, snails 10% and mushroom 15% contribute greatly to local food security especially during the raining season which is the food shortage period in rural Sierra Leone. In Zambia, fresh mushrooms are another forest product for which urban demand tend to exceeds local supplies, particularly during the dry season. In 2001 alone, 25.5 tons were imported from South Africa (Puustjärvy et al. 2005). There have been several attempts at exporting wild harvested mushrooms abroad but preservation has been a great challenge for African exporters. FAO, (2011) reported that plantation forest as well as trees are a direct source of food and cash income for more than a billion of the world's poorest people, providing both staple foods and supplemental foods such as edible leaves, fruits and nuts. In addition to food stuff gathered, wild animals were also trapped and sold to supplement food stuff. Other products such as fuelwood and charcoal, poles and medicinal herbs serves both domestic and financial needs as they are sold along highways. FAO, (2011) also reported that locals within Kori Chiefdom Moyamba District in Sierra Leone, directly consumed forest fruit such as *Dialium guineense*, *Parinari exelsa*, and *Salacia senegalensis*. The potential contribution of

forests and trees to food security is also large, but often overlooked. Today, the supplementary food and income derived from wood and NWFPs is an essential part of livelihoods of rural people. The potential of trees in increasing/maintaining fertility of soils and providing fodder to domestic animals, and thereby food crop and livestock productivity and sustainability, have been given much attention in recent decades (AFF, 2015).

In the study area, locals earn less than 1USD per day while others could go without for days because of the economic situation of the country. According to the results majority of the respondents 40% earn between 1 million to 2 million Leones (Le) approximately USD 400 a year, while 20% earn between 2million to 4 million Leones approximately USD 600 a year. Sierra Leone was rated 183 out of 187 countries on the UN's 2014 human development index report ([www.heritage.org/index/country/sierraleone](http://www.heritage.org/index/country/sierraleone)). In a community like Bradford with large area of grass land, low forest regrowth, little or no white collar job facility, poor road network, frequent wildfire outbreak and high level of illiteracy, it is difficult to get money from any other source other than the sources listed below. Agricultural crop sales, plantation forest products sale, monthly wages/salary and trade are the major sources of income. Income earned from the above sources is mostly use to pay school fees, food, clothing, health, alcohol and shelter. However, the cost of living in rural areas is far less and better as compared to urban areas in Sierra Leone. Therefore, such income means alot as far as their economic life is concern.

**Conclusion**

Increased need of population, shifting cultivation, indiscriminate logging, increased areas and the difficulty in managing tropical hardwoods in fragile ecosystems in Sierra Leone, have all led to a realization among decision makers that plantation forestry is the only way to avoid shortage of wood in the near future. The plantation at Bradford has greatly influenced the livelihood pattern of locals within the Township in diverse ways. Socially their lives have improved and continue improving and economically the welfare of households have been quaranted throughout seasons. Income from mainly subsistence agriculture and the plantation settle 60% of the respondent's domestic needs as well as their non domestic needs on a daily basis. It is concluded that because Bradford is a predominant savanna grass land area, the plantation is a reservoir for diverse goods and services and help conserved biodiversity especially during the dry season when the grass land is burnt the plantation becomes the only alternative shelter for wildlife. The role of forest plantations in carbon sequestration is also increasingly acknowledged and in the current context of climate change, several carbon trade initiatives as well as REDD projects are mushrooming worldwide. In particular, rural households depend on forest and woodland resources to meet their energy needs, for construction and roofing materials, fodder for livestock, wild foods that support a healthy diet, and medicine. Moreover, forest product trade can be an important source of income (Oksanen and Mersmann, 2003). Forests and plantations can provide important provisioning, supporting, regulating and cultural services

for households and rural communities (Landry, 2009). They are often important sources of fuel wood, charcoal, food, fodder, medicines and construction materials, as well as catering for the spiritual and traditional welfare of local indigenes. Forest plantations can alleviate potential future wood shortage and provide income and wood security for the ever increasing population of the world (Ellis, 2000)

**Recommendation**

Based on the result of the findings, It is recommended that the Government of Sierra Leone through Ministry of Education Science and Technology improves on the educational status of the Bradford community by providing more school materials and infrastructure and empowering adult education learning system as well as girl child education.

From the research it was found that plantation plays a great role in alleviating rural poverty. It is therefore recommended that the Forestry Division of the Ministry of Agriculture Forestry and Food Security embark on intensive plantation establishment especially on heavily degraded rural lands in order to promote such income generation activity for local communities.

It is further recommended that urgent harvesting or plantation exploitation and reforestation policy be put in place to ensure sustainability of the resource.

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## Awareness of mycotoxins infections

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### Introduction

Mycotoxins are secondary metabolites (organic compounds that are not directly involved in the normal growth, development or reproduction of an organism) and produce by fungi (moulds) and that have adverse effects on humans, animals and crops that result in illnesses and economic losses. They can grow on a variety of different crops and foodstuffs including cereals, nuts, spices, dried fruits, apple juice and coffee etc, often under warm and humid conditions (Fig. 1).



**Fig. 1: Mycotoxin infested fruits**

These metabolites are referred to as mycotoxin, which literally means "(Myco) fungus (Toxins) poisons". In the broad sense, mycotoxins are toxic substances of fungal origins. Mycotoxins have four basic kinds of toxicity: acute, chronic, mutagenic and teratogenic. The most commonly described effect of acute mycotoxin poisoning is deterioration of liver or kidney function, which in extreme

cases may lead to death. The toxic effect of mycotoxins on animal and human health is referred to as mycotoxicosis, the severity of which depends on the toxicity of the mycotoxin, the extent of exposure, age and nutritional status of the individual and possible synergistic effects of other chemicals to which the individual is exposed. *Aspergillus*, *Alternaria*, *Claviceps*, *Fusarium*, *Penicillium* and *Stachybotrys* are the recognized genera of mycotoxigenic fungi (Milicevic et al., 2010; Reddy et al., 2010). The natural fungal flora associated with food production is dominated by the *Aspergillus*, *Fusarium* and *Penicillium* genera (Sweeney and Dobson, 1998). *Fusarium* species are pathogens that are found on cereal crops and other commodities, and they produce mycotoxins before or immediately after the harvest. Some species of *Aspergillus* and *Penicillium* are also plant pathogens or commensals, but these genera are more commonly associated with commodities and food during drying and storage (Pitt, 2000). The chemical structures of mycotoxins vary considerably but they are all relatively low molecular mass organic compounds. These toxins have caused major epidemics in man and animals during historical times.

### Outbreaks

Mycotoxins are gaining increasing importance due to their deleterious effects on human and animal health. Chronic

health risks are particularly prevalent in National and International, where the diets of the people are highly prone to mycotoxins due to poor harvesting practices, improper storage and transport coupled with high temperature and moisture. These toxins have caused major epidemics in man and animals during historical times.

The most important outbreaks of ergotism caused by ergot alkaloids from *Claviceps purpurea* which killed hundreds of thousands of people in Europe in the last millennium (Smith and Moss, 1985).

The effects of the first trichothecene toxin, T-2, was documented in the 1940s where it was associated with an outbreak of alimentary toxic aleukia (ATA). At its peak, in 1944, the population in the Orenbury District and other districts of the then USSR suffered enormous casualties, more than 10 percent of the population was affected and many fatalities occurred (Joffe, 1978). Stachybotryotoxicosis (black mold) which killed tens of thousands of horses in the USSR in the 1930s (Moreau, 1979) and aflatoxicosis, which killed 100,000 young turkeys in the UK in 1960 and has caused death and disease in other animals, and probably in man as well (Rodncks, et al., 1977). Aflatoxins act very slowly and prolonged consumption can lead to liver cancer in humans. In India, an estimated 20 million people are hepatitis B carriers. Importantly, the most commonly used cooking products are frequently contaminated. One of the major drawbacks in fighting aflatoxins is the fact that there is no awareness about these toxins in India. Western countries, on the other hand, have strict regulations governing the testing of food products for aflatoxins

(FAO, 2004). In 2004, 125 people died following a major outbreak of aflatoxicosis in the eastern and central provinces of Kenya. Three hundred and seventeen cases were reported and most were linked to aflatoxin poisoning from contaminated maize (Levis et al., 2005).

In 1974, an outbreak of hepatitis due to aflatoxicoses was reported in 200 villages in western India (Banswada and Panchamahals districts of Rajasthan and Gujarat respectively) with 106 deaths. The outbreak lasted for two months and was confined to tribal population whose staple food was maize. Analysis of *Aspergillus flavus* contaminated in maize samples showed that affected people. (Krishnamachari et al., 1975). Symptoms of the disease include rapidly developing ascites, oedema of the lower limbs, portal hypertension and higher mortality rate. Another outbreak of toxic hepatitis in India in 1974 affecting both humans and dogs (Tandon et al., 1977). Disease outbreaks due to mycotoxins continue to be problems of significant public and animal health importance in India. In a majority of the cases, such outbreaks may be missed or misdiagnosed due to paucity of information in this regard. Sufficient attention to such disease outbreaks has not been focused in view of remoteness of the areas of such outbreaks (Bhat, 1978). Fumonisin have been implicated in one incident of acute food-borne disease in India in which the occurrence of borborygmy, abdominal pain, and diarrhea was associated with the consumption of maize and sorghum contaminated with high levels of fumonisin (Bhat et al., 1997).

**Table 1: Mycotoxins producing fungai**

<b>Fungi</b>	<b>Mycotoxin</b>	<b>Effect of the body part</b>
<i>Aspergillus flavus</i> <i>Aspergillus parasiticus</i>	Aflatoxin	Liver disease and carcinogenic
<i>Aspergillus ochraceous</i> <i>Penicillium sp.</i>	Ochratoxin	Nephrotoxicity, mild liver damage, immune suppression
<i>Fusarium graminearum</i> <i>F. oxysporum</i> <i>F. solani</i> <i>F. semitectum</i>	Zearalenone	Estrogenic hormonal activity, atrophy of ovaries and testicles etc.
<i>Fusarium graminearum</i>	Trichothecenes	Immunologic effects, hematological changes and digestive disorders
<i>F.chlamydosporum</i> <i>F. moniliforme</i>	Moniformin/ Fumonisin	Oesophageal cancer, abdominal pain and diarrhea etc.
<i>Penicillium expansum</i>	Patulin	Edema, hemorrhage and possibly cancer

It has been estimated that 25% of the world's crops are affected by moulds or fungal growth (Mannon and Johnson, 1985). Fungal spoilage of crops can have serious economic consequences and commodities may be contaminated with toxic fungal secondary metabolites known as mycotoxins. Human exposure to mycotoxins may result from consumption of plant derived foods that are contaminated with toxins, the carryover of mycotoxins and their metabolites into animal products such as milk, meat and eggs or exposure to air and dust containing toxins (Jarvis, 2002). Human food can be contaminated with mycotoxins at various stages in the food chain and the three most important genera of mycotoxigenic fungi are *Aspergillus*, *Fusarium* and *Penicillium* (CAST, 2003). Mycotoxins contamination is therefore, unpredictable which makes it a unique challenge. Chronic health risks are particularly prevalent in developing countries like India. In tropical conditions such as high temperature and moisture, monsoon, seasonal rains and flash floods leads to fungal proliferation and mycotoxin production. Poor harvesting

practices, improper storage and less than optimal conditions during transport and marketing can also contribute to fungal growth and mycotoxin production. Mycotoxins poisoning is known as mycotoxicosis. There is no cure for mycotoxicosis. Antibiotics and drugs have little effect. The best treatment is to stop the exposure to mycotoxins. Mycotoxins toxicology has brought out many adverse effects in human and animal health and many outbreaks have occurred all over the world. If carefully observed, this toxication can be prevented. Mycotoxins are gaining increasing importance due to their deleterious effects on human and animal health. Chronic health risks are particularly prevalent in India where the diets of the people are highly prone to mycotoxins due to poor harvesting practices, improper storage and transport coupled with high temperature and moisture. Nearly 40% of the population in India lives below the poverty line. It is very difficult to imagine their access to complete safe and toxin free food since people are forced to consume less

expensive, poor quality food grains because of poor purchasing power.

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## Botanical pesticides and its application

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### Introduction

In India, the importance of trees has been recognized from the times immemorial. Derivatives of plants have traditionally been used by farmers to ward off insect pests of household, agricultural, forestry and medicinal importance. The plant biochemicals exhibit various properties such as insecticidal, repellent and growth disrupting activities against various pests and target a broad range of insects. The chemical pesticides are hazardous in environmental pollution, leave toxic residue and disturb the microbial activity in the soil. The use of biopesticides strategy seemed to be a potential measures due to their harmless and pollution free implications. The naturally occurring pesticides thus appear to have a prominent role in the development of future commercial pesticides not only for forestry crop productivity but also for the safety of the environment and public health. The harmful environmental implications of the synthetic chemicals like the development of insect resistance, distribution of natural enemy complex and increased contamination have compelled to search for some alternative methods. This lead to increased development of compounds based on the models of natural occurring toxins of biological origin, having various biological activities. This includes plants extract and microbes which are now known because they are environmentally harmless, host specific and less residual.

Pest management is facing economic and ecological challenge worldwide due to human and environmental hazards caused by majority of the synthetic pesticide chemicals. Identification of novel effective insecticidal compounds is essential to combat increasing resistance rates.

Botanical pesticides have long been touted as attractive alternatives to synthetic chemical pesticides for pest management because botanicals reputedly pose little threat to the environment or to human health. The body of scientific literature documenting bioactivity of plant derivatives to arthropod pests continues to expand, yet only a handful of botanicals are currently used in agriculture in the industrialized world, and there are few prospects for commercial development of new botanical products. Pyrethrum and neem are well established commercially, pesticides based on plant essential oils have entered the market place and the use of rotenone appears to be waning. A number of plant substances have been considered for use as pest antifeedants, repellents and toxicants, but apart from some natural mosquito repellents, a little commercial success has ensued for plant substances that modify arthropod behavior. Several factors appear to limit the success of botanicals, most notably regulatory barriers and the availability of competing products (newer synthetics and fermentation products) that are cost-effective and relatively safe compared with

their predecessors. In the context of agricultural pest management, botanical pesticides are best suited for use in organic food production in industrialized countries but can play a much greater role in the production and postharvest protection of food in developing countries. Botanicals have been in use for a long time for pest control. The compounds offer many environmental advantages. However, their uses during the 20<sup>th</sup> century have been rather marginal compared with other bio-control methods of pests and pathogens. Improvement in the understanding of plant allelochemical mechanisms of activity offer new prospects for using these substances in crop protection. Botanical insecticides are naturally occurring chemicals (insect toxins) extracted or derived from plants or minerals. They are also called *natural insecticides*. Organic gardeners will choose these insecticides, in some cases, over synthetic organic materials.

In general, they act quickly, degrade rapidly and have, with a few exceptions, low mammalian toxicity. Products containing ingredients derived from plants are considered pesticides.

#### **Pyrethrum and Pyrethrins**

**Structure:** C<sub>21</sub>H<sub>28</sub>O<sub>3</sub>; C<sub>22</sub>H<sub>28</sub>O<sub>5</sub>

**Source:** Pyrethrum is the powdered, dried flower head of the pyrethrum is daisy, *Chrysanthemum cinerariaefolium*. Most of the world's pyrethrum crop is grown in Kenya. The term "pyrethrum" is the name for the crude flower dust itself, and the term "pyrethrins" refers to the six related insecticidal compounds that occur naturally in the crude material, the pyrethrum flowers. They are extracted from crude pyrethrum dust as a resin that

is used in the manufacture of various insecticidal products.

#### **Mode of action**

Pyrethrins exert their toxic effects by disrupting the sodium and potassium ion exchange process in insect nerve fibers and interrupting the normal transmission of nerve impulses. Pyrethrins insecticides are extremely fast acting and cause an immediate "knockdown" paralysis in insects. Despite their rapid toxic action, however, many insects are able to metabolize (break down) pyrethrins quickly. After a brief period of paralysis, these insects may recover rather than die. To prevent insects from metabolizing pyrethrins and recovering from poisoning, most products containing pyrethrins also contain the synergist, piperonyl butoxide (PBO). Without PBO the effectiveness of pyrethrins is greatly reduced.

#### **Mammalian toxicity**

Pyrethrins are low in mammalian toxicity and few cases of human poisonings have ever been reported. Cats, however, are highly susceptible to poisoning by pyrethrins and care must be taken to follow label directions closely when using products containing pyrethrins to treat cats for fleas. When ingested, pyrethrins are not readily absorbed from the digestive tract, and they are rapidly hydrolyzed under the acid conditions of the gut and the alkaline conditions of the liver. Pyrethrins are more toxic to mammals by inhalation than by ingestion because inhalation provides a more direct route to the bloodstream. Exposure to high doses may cause nausea, vomiting, diarrhea, headaches, and other nervous disturbances. Repeated contact with crude pyrethrum dusts may cause skin irritation or allergic reactions. The allergens that cause these

reactions are not present in products containing refined pyrethrins. Tests indicate that chronic exposure to pyrethrins does not cause genetic mutations or birth defects. There is no single antidote for acute pyrethrin poisoning. Treatment of poisoning is symptomatic, i.e., the various symptoms of poisoning are treated individually as they occur because there is no way to counteract the source of the poisoning directly.

### Rotenone

**Structure:**  $C_{23}H_{228}O_6$

**Source:** Rotenone is insecticidal compound that occurs in the roots of *Lonchocarpus* species in South America, *Derris* species in Asia, and several other related tropical legumes. Commercial rotenone was at one time produced from Malaysian *Derris*. Currently the main commercial source of rotenone is Peruvian *Lonchocarpus*, which often is referred to as cube root. Rotenone is extracted from cube roots in acetone or ether. Extraction produces a 2-40% rotenone resin which contains several related but less insecticidal compounds known as rotenoids. The resin is used to make liquid concentrates or to impregnate inert dusts or other carriers. Most rotenone products are made from the complex resin rather than from purified rotenone itself. Alternatively, cube roots may be dried, powdered and mixed directly with an inert carrier to form an insecticidal dust.

### Mode of action

Rotenone is a powerful inhibitor of cellular respiration, the process that converts nutrient compounds into energy at the cellular level. In insects rotenone exerts its toxic effects primarily on nerve and muscle cells, causing rapid cessation

of feeding. Death occurs several hours to a few days after exposure. Rotenone is extremely toxic to fish and is often used as a fish poison (piscicide) in water management programs.

### Mammalian toxicity

Although rotenone is a potent cell toxin, mammals detoxify ingested rotenone efficiently via liver enzymes. As with pyrethrins, rotenone is more toxic by inhalation than by ingestion. Exposure to high doses may cause nausea, vomiting, muscle tremor, and rapid breathing. Very high doses may cause convulsions followed by death from respiratory paralysis and circulatory collapse. Direct contact with rotenone may be irritating to skin and mucous membranes. Treatment of poisoning is symptomatic. Chronic exposure to rotenone may lead to liver and kidney damage. Rotenone is one of the more acutely toxic botanicals. As a matter of comparison, pure, unformulated rotenone is more toxic than pure carbaryl (Sevin) or malathion. In the form of a 1% dust, rotenone poses roughly the same acute hazard as the commonly available 5% Sevin dust. Commercial rotenone products have presented little hazard to man over many decades.

### Sabadilla (veratrine alkaloids)

**Structure:** Cevadine:  $C_{32}H_{49}NO_9$

### Source

Sabadilla is derived from the ripe seeds of *Schoenocaulon officinale*, a tropical lily plant which grows in Central and South America. Sabadilla is also sometimes known as cevadilla or caustic barley. When sabadilla seeds are aged, heated, or treated with alkali, several insecticidal alkaloids are formed or activated. Alkaloids are physiologically active compounds that occur naturally in many

plants. In chemical terms they are a heterogeneous class of cyclic compounds that contain nitrogen in their ring structures. Caffeine, nicotine, cocaine, quinine, and strychnine are some of the more familiar alkaloids. The alkaloids in *sabadilla* are known collectively as veratrine or as the veratrine alkaloids. They constitute 3-6% of aged, ripe *sabadilla* seeds. Of these alkaloids, cevadine and veratridine are the most active insecticidally. European white hellebore (*Veratrum album*) also contains veratridine in its roots.

#### **Mode of action**

In insects, *sabadilla*'s toxic alkaloids affect nerve cell membrane action, causing loss of nerve cell membrane action, causing loss of nerve function, paralysis and death. *Sabadilla* kills insects of some species immediately, while others may survive in a state of paralysis for several days before dying.

#### **Mammalian toxicity**

*Sabadilla*, in the form of dusts made from ground seeds, is the least toxic of the registered botanicals. Purified veratrine alkaloids are quite toxic, however, and are considered on a par with the most toxic synthetic insecticides. *Sabadilla* can be severely irritating to skin and mucous membranes, and has a powerful sneeze-inducing effect when inhaled. Ingestion of small amounts may cause headaches, severe nausea, vomiting, diarrhea, cramps and reduced circulation. Ingestion of very high doses may cause convulsions, cardiac paralysis, and respiratory failure. *Sabadilla* alkaloids can be absorbed through the skin or mucous membranes. Systemic poisoning by *sabadilla* preparations used as insecticides has been very rare or nonexistent.

#### **Ryania**

**Source:** *Ryania* comes from the woody stems of *Ryania speciosa*, a South American shrub. Powdered *Ryania* stem wood is combined with carriers to produce a dust or is extracted to produce a liquid concentrate. The most active compound in *ryania* is the alkaloid ryanodine, which constitutes approximately 0.2% of the dry weight of stem wood.

#### **Mode of action**

*Ryania* is a slow-acting stomach poison. Although it does not produce rapid knockdown paralysis, it does cause insects to stop feeding soon after ingesting it. Little has been published concerning its exact mode of action in insect systems.

#### **Mammalian toxicity**

*Ryania* is moderately toxic to mammals by ingestion and only slightly toxic by dermal exposure. Ingestion of large doses causes weakness, deep and slow respiration, vomiting, diarrhea, and tremors, sometimes followed by convulsions, coma, and death. Purified ryanodine is approximately 700 times more toxic than the crude ground or powdered wood and causes poisoning symptoms similar to those of synthetic organophosphate insecticides. (Depending on exposure, organophosphate poisoning symptoms may include sweating, headache, twitching, muscle cramps, mental confusion, tightness in chest, blurred vision, vomiting, evacuation of bowels and bladder, convulsions, respiratory collapse, coma, and death.)

#### **Nicotine**

##### **Structure**



##### **Source**

Nicotine is a simple alkaloid derived from tobacco, *Nictiana tabacum*, and other

Nicotiana species. Nicotine constitutes 2-8% of dried tobacco leaves. Insecticidal formulations generally contain nicotine in the form of 40% nicotine sulfate and are currently imported in small quantities from India.

#### **Mode of action**

In both insects and mammals, nicotine is an extremely fast-acting nerve toxin. It competes with acetylcholine, the major neurotransmitter, by bonding to acetylcholine receptors at nerve synapses and causing uncontrolled nerve firing. This disruption of normal nerve impulse activity results in rapid failure of those body systems that depend on nervous input for proper functioning. In insects, the action of nicotine is fairly selective, and only certain types of insects are affected.

#### **Mammalian toxicity**

Despite the fact that smokers regularly inhale small quantities of nicotine in tobacco smoke, nicotine in pure form is extremely toxic to mammals and is considered a Class I (most dangerous) poison. Nicotine is particularly hazardous because it penetrates skin, eyes, and mucous membranes readily both inhalation and dermal contact may result in death. Ingestion is slightly less hazardous due to the effective detoxifying action of the liver. Symptoms of nicotine poisoning are extreme nausea, vomiting, excess salivation, evacuation of bowels and bladder, mental confusion, tremors, convulsions, and finally death by respiratory failure and circulatory collapse. Poisoning occurs very rapidly and is often fatal. Treatment for nicotine poisoning is symptomatic, and only immediate treatment, including prolonged artificial respiration, may save a victim of nicotine poisoning. Nicotine has been responsible

for numerous serious poisonings and accidental deaths because of its rapid penetration of skin and mucous membranes and because of the concentrated form in which it is used.

#### **Neem**

##### **Structure**

Azadiractin

##### **Source**

Neem products are derived from the neem tree, *Azadirachta indica* that grows in arid tropical and subtropical regions on several continents. The principle active compound in neem is azadirachtin, a bitter, complex chemical that is both a feeding deterrent and a growth regulator. Meliantriol, salannin, and many other minor components of neem are also active in various ways. Neem products include teas and dusts made from leaves and bark, extracts from whole fruits, seeds, or seed kernels, and oil expressed from the seed kernel. The product known as "neem oil" is more like vegetable or horticultural oil and acts to suffocate insects. Neem and neem oil are often confused.

##### **Mode of action**

Neem is a complex mixture of biologically active materials, and it is difficult to pinpoint the exact modes of action of various extracts or preparations. In insects, neem is most active as a feeding deterrent, but in various forms it also serves as a repellent, growth regulator, oviposition (egg deposition) suppressant, sterilant, or toxin. As a repellent, neem prevents insects from initiating feeding. As a feeding deterrent, it causes insects to stop feeding. As a feeding, either immediately after the first "taste" (due to the presence of deterrent taste factors), or at some point soon after ingesting the food (due to secondary hormonal or physiological

effects of the deterrent substance). As a growth regulator, neem is thought to disrupt normal development interfering with chitin synthesis. Susceptibility to the various effects of neem differs by species.

### **Citrus Oil Extracts: Limonene and Linalool**

#### **Source**

Crude citrus oils and the refined compounds d-limonene (hereafter referred to simply as limonene) and linalool are extracted from orange and other citrus fruit peels. Limonene, a terpene, constitutes about 90% of crude citrus oil, and is purified from the oil by steam distillation. Linalool, a terpene alcohol, is found in small quantities in citrus peel and in over 200 other herbs, flowers, fruits, and woods. Terpenes and terpene alcohols are among the major components of many plant volatiles or essential oils. Other components of essential oils are ketones, aldehydes, esters, and various alcohols. Essential oils are the volatile compounds responsible for most of the tastes and scents of plants. Many of the essential oils also have some physiological activity.

#### **Mode of action**

The modes of action of limonene and linalool in insects are not fully understood. Limonene is thought to cause an increase in the spontaneous activity of sensory nerves. This heightened activity sends spurious information to motor nerves and results in twitching, lack of coordination, and convulsions. The central nervous system may also be affected, resulting in additional stimulation of motor nerves. Massive over stimulation of motor nerves leads to rapid knockdown paralysis.

#### **Mammalian toxicity**

Both limonene and linalool were granted GRAS (Generally Regarded As Safe)

status by the United States Food and Drug Administration in 1965, and are used extensively as flavorings and scents in foods, cosmetics, soaps, and perfumes. Both compounds are considered safe when used for these purposes because they have low oral and dermal toxicities. At higher concentrations, however, limonene and linalool are physiologically active and may be irritating or toxic to mammals. When applied topically, limonene is irritating to skin, eyes, and mucous membranes. Both limonene and linalool may be allergenic. Limonene acts as a topical vasodilator and a skin sensitizer; it was also shown to promote tumor formation in mouse skin that had been previously sensitized to tumor initiation. Linalool is more active as a systemic toxin than as a skin irritant. Both compounds affect the central nervous system, and moderate to high doses applied topically to cats and other laboratory animals cause tremors, excess salivation, lack of coordination, and muscle weakness. Even at the higher doses, however, these symptoms are temporary (lasting several hours to several days), and animals recover fully. Some cats may experience minor tremors and excess salivation for up to one hour after applications of limonene or linalool at recommended rates. Crude citrus peel oils and products prepared with the crude oils may be more toxic to animals than products containing purified limonene or linalool. Adequate research on the toxicity of crude citrus oils has not been conducted, and they are not recommended for use on animals.

#### **Other Essential Plant Oils: Herbal Repellents and Insecticides**

Essential oils are volatile, odorous oils derived from plant sources. Although they

are used mainly as flavorings and fragrances in foods, cosmetics, soaps, and perfumes, some of them also have insect repellent or insecticidal properties. Many essential oils have GRAS (Generally Regarded As Safe) status; however, when applied topically at high concentrations they tend to be irritating to skin and mucous membranes. They are sometimes used as topical counterirritant to relieve or mask pain. Many of the essential oils that have low dermal toxicity may be toxic by ingestion. The most common essential oils used as repellents are the oils of cedar, lavender, eucalytus, pennyroyal, and citronella. They are used mostly on pets and humans to repel fleas and mosquitoes. With the exception of pennyroyal, these essential oils are thought to pose little risk to people or pets, though they should not be used above recommended rates. Some herbal pest products that contain essential oils recommend use daily or “as often as needed.” These products should be used moderately and with careful observation of the pet to spot early signs of skin irritation or possible toxic effects. Oil of pennyroyal contains pulegone, a potent toxin that can cause death in humans at doses as low as one tablespoon when ingested. At lower internal doses it may cause abortion, liver damage, and renal failure. Although the dermal toxicity of pennyroyal is fairly low, some cats are susceptible to poisoning by topical application of oil of pennyroyal, possibly because they ingest it during grooming. Citronella is sold mainly in the form of candles to be burned outdoors to repel mosquitoes from back yards or other small areas. It is also contained in some “natural” mosquito repellent lotions. Before the development of synthetic repellents, citronella was the most

effective mosquito repellent available. Despite its wide usage, there is little scientific information available regarding its efficacy or mammalian toxicity.

Botanical pesticides derived from some parts or whole plants having ability of insect killing, sterilization, weed control and plant growth regulating activities. The application of botanical pesticides for the crop and stored products protection from insect pests has been become a part of traditional agriculture for generations. The development of biopesticides has promoted the modernization of agriculture and will, no doubt, and gradually replace chemical pesticides. A large number of products have been released, some of which have played a leading role in the market. Over 6000 plant species have been identified that possessing insecticidal properties. In insect pest management, a number of plant products derived from neem, custard apple, tobacco, pyrethrum, etc. have been used as safer insecticides . Botanical pesticides have environmentally friendly characteristics such as volatile nature, low environmental risk compared to current synthetic pesticides. Due to minimal residual activity; predation, parasitism, and the number of pollination insects would affect smaller and compatible with IPM programs. Azadirachtin compounds derived from the neem tree is sold under various trade names, can use on several food crops and ornamental plants for controlling whitefly, thrips, scale and other pests.

#### **Application of botanicals**

For protection of crops, most of the botanicals like neem, its products or commercial 0.5% to 1% are used in agricultural and forestry crops against insect pests and diseases. 5 per cent boil

extract of custard apple leaves(50 g dried powder in 1 lit of water + emulsifier) can protect the seedlings from the attack of defoliators by inhibition of feeding. Application of crude extract and petroleum ether extract of garai (*Cleistanthus collinus*) can be used against bark eating caterpillar, *Indarbela quadrinotata* on aonla (*Emblica officinalis*) in plantations.

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## Non-timber forest products and utilization pattern in tribal areas of Sarguja

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### Abstract

In the present study an attempt has been made to investigate the non-timber forest products (NTFPs) and their utilization pattern in the tribal region of Sarguja. Two blocks viz., Ambikapur and Sitapur were purposively selected for the study. In each of the block three villages were selected for the collection of data. From the observation it was found that in Sitapur block respondents are actively involved in the gathering of variety of NTFPs for deriving their livelihood as compare to Ambikapur block. In an overview the major NTFPs collected by respondents in study sites are mahua (51.67%), ber (50.0%), bidi leaves (46.66%), char (40.0%), tamarind (30%) and sal seeds (18.33%) beside mushroom and bamboo shoots/karil and honey. The utilization pattern reflected that the respondents were engaged in collection of NTFPs for deriving their own needs as well as for cash income through trade. There is great opportunity to improve the socio-economic status and livelihood of the tribals through joint cooperation and participation of local community stakeholders and forest department which may facilitate ample collection, marketing and trade of these resources.

**Keywords:** NTFPs, livelihood, socio-economic status, tribals, utilization

### Introduction

Forests have been playing key role in the socio-economic development and tribal's

cultural life and traditions. Tribal livelihood varies substantially between various regions as well as ethnic groups, rely on ecological, historical and cultural constituent. Tribal communities which largely occupy the forest regions from time immemorial have lived in isolation from the mainstream of national life but in harmony with nature. Tribal people living in and around forests for centuries have recognized NTFPs as important forests resources. NTFPs comprise all biological materials other than timber, which are collected from natural forests for human use. NTFPs may provide local job opportunity to two million people every year and contribute significantly to rural economy as more than half of the products are consumed by the tribals living in and around the forest area to meet their basic needs (Jana, 2008). Thus, the NTFPs play a significant role in the livelihood of forest dwellers, communities living in forest fringe areas etc.

NTFPs have attracted considerable global attention due to the significant role played in benefiting people and industries. Forest is an important renewable, natural resource, which greatly influences the socio-economic status and development in any rural community (Ghosal, 2011). In addition, they have also formed an important source of forest revenue in the country and, therefore, remained under the control of the forest department. However, over the last few decades, NTFPs have

attracted the interest of both the public and private sectors. The National Forest Policy of 1988 and subsequent government resolutions on JFM (joint forest management) are paradigm shifts towards forest management in India, which reflect a shift in emphasis from 'Forests as source of State Revenue' to 'local needs' and 'environmental concerns'.

In India the central government came with legislation named as the scheduled tribes and other traditional forest dwellers (Recognition of Forest Rights) Act 2006 popularly known as Forest Rights Act (FRA) 2006 to recognize the tenure and occupational rights of forest dwellers. The forest rights act was the first act enacted in independent Indian that addressed the question of community ownership of MFP (minor forest produces) and rights and management/governance of forest at the legislative level. Hence, the preservation of forests is vital for sustaining ecological balance and is the most important factor to protect the environment as well as the forest communities living in and around the forest.

### **Materials and methods**

The present investigation on non-timber forest products was carried out in Sarguja district of Chhattisgarh state. The state is wealthy in terms of natural resources such as forests, rivers, wildlife, minerals etc. The state Chhattisgarh enjoy sub-humid climate with rainfall of 1200-1500 mm annually. In northern part of the state Sarguja district is located (Yadav et al., 2015). The Sarguja is located between 22<sup>0</sup>58' to 23<sup>0</sup>49' North latitude and 81<sup>0</sup>33' to 82<sup>0</sup>45' East longitudes. The climate of

Sarguja is tropical which characterized by a hot summer and well distributed rainfall during the monsoon season. The mean monthly temperature ranges between 15.34<sup>0</sup>C (January) and 31.54<sup>0</sup>C (May) and the mean annual temperature averages 23.31<sup>0</sup>C. The average annual rainfall is 1161.42 mm (Sinha et al., 2014, 2015).

The present study was conducted during 2015-16 into two blocks viz., Ambikapur and Sitapur. After a preliminary reconnaissance three villages in each block were selected (Kanthi, Shivpur, Sohga, Kathbura, Dhodagaon and Kariyakhar) and surveyed for the assessment and to record the NTFPs and its utilization in concerned sites. Thus, in all 6 villages were selected and within each village 10% sampling was done for collecting information from the households. Preliminary discussion with local people was done to identify the key informants. The selected informants were interviewed and the conversation followed was documented (Painkra et al., 2015) so as to record the NTFPs in the study sites. Data collected on various aspects from different blocks were compiled and analyzed after getting opinion and expression of the respondents (Thakur et al., 2015, 2016a, b; Raj et al., 2016; Toppo et al., 2016a, b; Chandel et al., 2017).

### **Result and discussion**

#### **Major NTFPs collected by respondents**

The findings revealed that the respondents of Sitapur block are more engaged in the collection of different types of NTFPs (mahua, char, sal seed, bidi leaves and ber), while in the Ambikapur block (Table 1) maximum collection was concentrated on gathering of tamarind (33.33%).

**Table 1:** Major NTFPs collected by respondents in the study sites

NTFPs	Ambikapur	Sitapur	Average
Mahua	6.67	96.67	51.67
Char	0.0	80.0	40.0
Sal seed	0.0	36.67	18.33
Bidi leaves	0.0	93.33	46.66
Ber	26.67	73.33	50.0
Tamarind	33.33	26.67	30.0

### Scenario of NTFPs collection by respondents

In study sites the respondents are involved in collection of some NTFPs like mahua, ber, bidi leaves, tamarind, sal seed, char and mushroom etc. It was found that females, children and male involved in NTFPs gathering (Table 2).

#### Mahua

Mahua is a multipurpose tree; it yields both flowers and seeds. Mahua has high value in the life of tribal population of these areas. Mahua provides great livelihood opportunities to the villagers. During the peak season (March-April), the villagers collected the fallen flowers of these trees and dry them. The mahua flower collection period varied from 15-30 days in a year. The riped fruits shed from trees during June-July. More than half of the total respondents (51.67%) used to collect the mahua flower and fruits of economic values.

#### Tendu leaves

Tendu leaves are the lifeline of almost the rural tribes from economic point of view. During the peak season, ladies and/or other family member of the household can be found to engage in collecting these leaves. Once collected, they are dried and used to make bidi. Generally bidi leaves are collected during the month of May and this

operation takes place about 15 days or more depending upon the availability of the resources. In the present findings a sum of 46.66% respondents are involved in this operation.

#### Char

Char is another tree that is a source of valuable NTFPs and its importance in the forests as a source of NTFPs cannot be neglected. Seeds can be used for medicinal purposes besides other uses. Its seeds fetch a very good price in the market. The availability of char varied from the month of April-May. 40.0% of the total concerned respondents were found to collect the char seeds.

#### Ber

Ber fruits available in the month of December-January. A total of 50.0% respondents were benefited from its collection/plucking and the duration of its collecting varied from 10-15 days.

#### Sal seeds and leaves

Mostly tribals depend on the sal seeds and leaves for their livelihood. Sal seeds are crucial because people collect them in May-June at a lean period when other sources of income are scarce or limited. The sal leaves are also collected to prepare the leaf plates and dona for various purposes. It can fetch cash values in short period of time.

### Mushroom

Mushroom is available mostly in the rainy season in forest areas and it mostly collected by female's member, and utilized for consumption as a food. It has medicinal and nutritive values. The tribal land of Sarguja has wide variety of mushroom availability and its marketing/selling directly add much share of livelihood in a short spell depending upon type of mushroom collected, its demand, availability, choice, quantity of collection, etc.

### Tamarind

Tamarind collection is mainly done during the month of April-May. Ripe fruit of tamarind is collected about 10-15 days or up to one month in a year. 30.0% respondents of the study area were involved in collection of tamarind.

### Bamboo (Karil/ Shoots)

The usage of bamboo young shoots as a food that can be consumed fresh, fermented and caned. The juvenile shoots are not only delicious but are rich in nutrient components mainly proteins, carbohydrates, minerals and fiber and are low in fat and sugars. The shoots are free from residual toxicity and grow without the application of fertilizers. The bamboo shoots have a number of health benefits: improve appetite and digestion, weight loss and curing cardiovascular disease and cancer. Bamboo shoots is one of the most preferred traditional food items i.e., vegetable and pickle. The collection of bamboo karil was mainly done during the rainy season.

**Table 2:** NTFPs Collection in the Study Sites

NTFPs		Season/Period of availability
Mahua	Flowers	March 2 <sup>nd</sup> Week – April 3 <sup>rd</sup> Week
	Fruits	June-July
Tendu	Leaves	May
	Fruits	March-April
Sal	Seeds	May- June
	Leaves	All season
Ber		December-January
Tamarind		May
Char		April 4th Week - May 1st Week
Mushroom		June-September
Bamboo Karil		Rainy season

### NTFPs utilization pattern in Sarguja

NTFPs continue to be an important source of household's income security, nutrition and health. The NTFPs are a vital source of livelihood for a large population of forest dwellers or tribals. People are dependent upon natural sources for

meeting large number of their basic necessities of life. The collected NTFPs sales in nearby market for generating the cash income besides the consumption utility. Utilization pattern of different NTFPs showed below in the table 3.

**Table 3:** NTFPs utilization pattern in the study sites

NTFPs		Consumption	Sales
Mahua	Flower	Food, Alcohol licquor uses	Sale
	Seeds	Oils	Sale
Tendu	Leaves	-	Sale
	Fruits	Eating	Sale
Sal	Seeds	-	Sale
	Leaves	Dona-pattal home uses	Sale
Ber		Fruit eating	Sale
Tamarind		Eating	Sale
Char		Eating	Sale
Mushroom		Food	Sale
Bamboo(karil)		Food	Sale

Great variations are found in respect to NTFPs collected, their choice, time, utilization and participation or involvement in gathering of these resources in the concerned study sites. It was found that in Sitapur block most of the respondents or households are actively engaged in the collection of various NTFPs for generating income than the Ambikapur block. It was due to fact that Sitapur block is much far away from the urban area or district as compare to Ambikapur block, therefore more dependancy on the various kinds of forest resources. They harvest these resources for own consumption and for direct sale. Marshall et al. (2005) reported that NTFPs have very supportive role for forest dwellers or communities' needs, poverty alleviation and improvement in socio-economic status as well as livelihoods of tribals. Therefore, sustainable harvesting, utilization and commercialization along with trade are the key concerns towards promotion of NTFP's for betterment of community in all respects (Beer and Mcdermott, 1989; Shiva and Verma, 2002).

### Conclusion

NTFPs collection and its marketing by

forest dwellers facilitated a good source of income and contributes a substantial share to the total income generated by the respondents in the study area. These sources not only generate direct cash benefit but also avail food and medicinal values to rural peoples which influence the tribal's or forest dwellers economy. Conservation of forest resources, its proper management and sustainable harvesting practices are important perspectives for maintaining ecological balance which protect the environment and forest dwellers or forest communities residing inside or fringe areas of the forests.

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## *Ulmus wallichiana* Planch.: An endangered species of north west Himalayas, India

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### Introduction

*Ulmus wallichiana* Planch., commonly known as Elm and locally called as “Bren” is one of the commonly grown broad leaved tree species in Kashmir valley and is the best known representative of family *Ulmaceae* and genus *Ulmus*. The genus has numerous species viz., *Ulmus wallichiana*, *U. villosa*, *U. lancifolia*, *U. parvifolia*, *U. campestris*, etc. and is most widely distributed of all the genera in the tribe *Ulmeae*. It is essentially a north temperate assemblage though three species extend into tropics. It occurs throughout Europe as far as north as Scotland, southern Finland and northern central Asia, Turkey, Lebanon, Israel, Afghanistan and Himalayas. In the far east, it is widespread in china, Korea and Japan, on the Asian main lands, it extends to northwards to the Soviet far east. The southern Kurile islands are its northern limits in the islands of far east. In the south east Asia, it extends through Malaya to Sumatera, Sulawesi and Flores. In North America, Elms are native in eastern states (Anon, 1976, 1983).

Elm is commonly distributed in western Himalayas, Indus to Nepal at an altitude of 900 m-3000 m (Anon, 1976). This species is scattered from central Nuristan (Afghanistan) along the Himalayas through Kashmir and into Nepal. In India, the species is reported to occur in H.P, U.P, Uttrarakhand and Jammu & Kashmir. In H.P. the species is found in Nichar,

Narkanda and Sidpur Nalla, Western Himalaya National Park, Kullu, old Manali villages and Kangari jangal near solang Nalla. In U.P. it is found in Deota, Konain and Khandra etc. In Uttrarakhand, it is



Fig. 1: Elm tree in rainy season



Fig. 2: Elm tree in winter season

found in Pangot and Kailakhan (Nanital), Yamnotri Forest Divisions, Nanital (Melville and Heybroek, 1971; Sing and Mehra, 1997). In Kashmir, the tree species is predominantly found in Dachigam, Tangmarg, Babareshi, Pahalgam, Chandanwari and Verinag (Melville and Heybroek, 1971).

### Socioeconomic importance

Elm is a deciduous tree growing upto 33m tall and 2.7m in girth. The tree has spreading crown having very rough bark, exfoliating in diamond shaped flakes. Branches sub-erect, roughly pubescent leaves elliptic, 6-15 cm long, serrulate, acuminate. Fruit is winged flat, rounded peppery, 10-13mm across, with a seed in centre. The perfect flowers are usually borne in spring before the leaves. The samara (fruit) ripens few weeks later in April-May (Anonymous, 1976). Elm is grown for its multifarious uses and has become preferred tree species in traditional agroforestry system of Kashmir. The tree is often planted around villages, along banks of streams, on dry ridges, around boundaries of fields and on sloppy lands *etc.* Elm has been found to be suitable under moisture stress conditions of Kandi (sloppy) areas in Kashmir valley. Elm timber is suitable for light construction, planking, packing cases, furniture, tool handles, *etc.* (Gamble, 1922; Pearson and Brown, 1932). The leaves are valued as good fodder and bark for sandals and ropes (Anonymous, 1976). The bark contains 0.76 percent of tannin (Singh, 1958). The branches are used as firewood. Elm bark is also used as ingredient for an ointment to heal broken bones and has been reported to be used for treatment of cuts in Mussoorie (Melville and Heybroek, 1971). Considering its multifarious uses, the tree has been heavily exploited for various uses; as a result it become endangered (IUCN, 1978). In nature the Elm is propagated through seeds, however seeds of Elm are scarcely available for afforestation due to high incidence of empty seeds.

### Reasons of endangerment

The population of tree in Kashmir valley is declining day by day and some of its reasons are:

- Heavy lopping for fodder and fuel wood, thereby making the fruit setting in the tree difficult.
- It is hard to root and so cannot be regenerated easily through stem cuttings.
- Absence of natural regeneration because of high incidence of empty seeds.
- Seeds being low in viability cannot be stored for long time and as such artificial regeneration through seed is difficult.
- Steady increase in the concisions, rights, privileges on the forest without any responsibility towards the well being of the forest by the beneficiaries.

### Status of elm in Kashmir valley

The tree is growing in all districts of the valley, although its concentration varies from place to place. The tree is naturally growing along river banks, streams and nallas besides farmers grow these trees on the boundaries of their fields, sloppy lands and wastelands *etc.* The average numbers of Elm trees on ha basis in various districts of valley *viz.*, Anantnag, Pulwama, Budgham, Baramulla, Kupwara and Srinagar were 78.0, 49.75, 30.0, 3.0, 3.0 and 2.33 respectively which indicates that they are grown in every district of valley, although their concentration was more in southern districts as compared to others. In addition to this thirty eight (38) trees were identified as oldest growing Elm trees and were located in different parts of valley. The average age of these trees ranged between 200 to 400 years, with

approximate average height and girth of 20 to 33.84 m and 3.0 to 5.0 m respectively. Most of these trees were found on *Ziyarat Sharifs* (Shrines) of religious saints but five of them were found on private land of Haji Bashir Ahmad Beigh at Dooru village of Sopore Teshil. Thus, these trees have been grown in the valley since ages but have survived in selected religious places only, obviously because of people being superstitious (Bhat *et al.*, 2007b).

### Propagation technique

The Elm tree comes into flowering in early spring. Flowers are found born on leafless twigs in the spring season in valley of Kashmir. They were minute, reddish in colour, fruit was winged, rounded and peppery, 9-13 mm in diameter with a seed in centre. Most of the seeds were unfilled. Most suitable time for collection of Elm seeds in the valley is 3<sup>rd</sup> to 4<sup>th</sup> week of March depending upon environmental conditions particularly, temperature. The seeds when subjected to germination tests under laboratory conditions started germination from 2<sup>nd</sup> day of sowing, thereby indicating that the seeds of Elm don't have any kind of dormancy (Bhat *et al.*, 2007a). Seeds collected at maturity weigh 7 to 10.14 g/1000 seeds. Due to high incidence of empty seeds and scarcely availability, the artificial regeneration of Elm tree is very difficult while in nature the Elm is propagated through seeds. This has resulted in decline in the population of Elm in the valley.

Elm is spring seeded species and its seeds are ready for collection in third week of March onwards in plain areas of valley and may prolong one – two weeks in higher altitudes. As the seeds are very minute (1000 seeds weigh 7 to 10 gm), the time of collection plays an important role. It is

better to collect the seeds from the standing trees. After collection of the seeds they should be sown immediately in well prepared nursery beds of size 1m x 1 m.



**Fig. 3: Elm nursery raised through seeds**



**Fig. 4: Elm in traditional agroforestry**

The nursery beds should be given pre-sowing irrigation and after that the seeds should be sown through broadcasting method. The seeds should not go deep in the soil, as being very small they start germinating within 48 hours of sowing. Light irrigation as per needs with fountain bucket from time to time, weeding, hoeing and thinning in 1<sup>st</sup> year to retain desirable number of seedlings promotes growth and seedlings attain average height of 0.50 to 0.75 m. After second year the saplings are uprooted and taken to planting site. They can be planted in degraded lands, on boundaries of fields, road side plantation *etc.* at a spacing of 3m x 3m having 1111 number of plants in one ha of land. As it is

hard to root species but the studies undertaken from time to time by different workers showed that lower concentration of plant growth regulators enhance the rooting percentage as compared to control. Among the different PGRs IBA @ 200 ppm has enhanced rooting percentage of dormant hard wood cuttings upto 27.27 percent as compared to 3.0 percent in the control. (Bhat et al., 2007c).

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## रेडियोधर्मी पर्यावरण प्रदूषण

रेखा अग्रवाल

शासकीय आदर्श विज्ञान महाविद्यालय

जबलपुर (म.प्र.)- 482 001

आज विकास की गति के लिहाज से उर्जा की माँग लगातार बढ़ती जा रही है। उर्जा के तमाम स्रोतों



जैसे जल, कोयला, तेल और सौर उर्जा या तो सिकुड़ते जा रहे या फिर पर्यावरणीय दृष्टि से घातक है। ऐसी स्थिति में उर्जा की आपूर्ति की सततता के लिए परमाणु उर्जा की ओर सबकी नजरें हैं। परमाणु उर्जा का उत्पादन रेडियोधर्मी पदार्थों से होता है। रेडियोधर्मी तत्व उर्जा के असीमित स्रोत होते हैं तथा इनसे प्रचुर मात्रा में उर्जा प्राप्त की जा सकती है। परमाणु उर्जा का प्रमुख स्रोत यूरेनियम है और इसके आइसोटोप यूरेनियम-235 की एक टन मात्रा से उतनी ही उर्जा पैदा की जा सकती है, जितनी कि 30 टन कोयले से अथवा 1 करोड़ 20 लाख बैरल पेट्रोलियम पदार्थों से। रेडियोधर्मी पदार्थों से उर्जा का असीमित भण्डार तो मिला है, परन्तु साथ ही भयावह रेडियोधर्मी प्रदूषण की सौगात भी मिली है। नब्बे के दशक में तात्कालीन सोवियत संघ के चेरनोबिल परमाणु संयंत्र से हुए रेडियोधर्मी

रिसाव से लाखों लोग प्रभावित हुए थे। 2011 में जापान के फुकुशिमा संयंत्र में हुई दुर्घटना ने भी तबाही मचाई थी। वर्तमान समय में समूचे विश्व में लगभग 300 परमाणु संयंत्र काम कर रहे हैं। और इन परमाणु संयंत्रों से रेडियोन्यूक्लाइड्स का रिसाव बराबर हुआ करता है, जो कि पर्यावरण को प्रतिकूल रूप से प्रभावित करता है। परमाणु संयंत्रों से निकलने वाला कचरा भी एक बड़ी समस्या है। इस रेडियोधर्मी कचरे की सुरक्षित निस्तारण की कोई कारगर विधि आज तक विकसित नहीं हो पाई है। या तो इस कचरे को समुद्र में फेंक दिया जाता है या फिर जमीन में गाड़ दिया जाता है। ये दोनों ही विधियाँ सुरक्षित नहीं हैं और इस निस्तारण से पर्यावरणीय क्षति के साथ मानव के लिए हानिकारक जहरीला वातावरण बन रहा है।

रेडियोधर्मी विकिरण के रूप में प्रदूषण फैलने का माध्यम बनती हैं। इनसे अल्फा, बीटा, व गामा किरणें उत्सर्जित होती हैं। अल्फा किरणें वे हीलियम नाभिक होते हैं जिनका घनत्व हाइड्रोजन की अपेक्षा चार गुना अधिक होता है। इनका विकिरण काफी घातक होता है, यदि मनुष्य काफी लंबे समय तक इनके संपर्क में रहता है तो मानव त्वचा को गला देती है। बीटा किरण

नकारात्मक रूप से आवेशित कण होते हैं और इनका दीर्घकालिक संपर्क भी मानव की त्वचा को घातक रूप से झुलसा देता है। गामा किरणें विद्युत चुम्बकीय प्रकृति की तरंगें होती हैं तथा सर्वाधिक शक्तिशाली भेदक होती हैं जिससे ये जैविक तंतुओं पर तीव्र प्रहार करती हैं और उन्हें नष्ट कर देती हैं। रेडियोधर्मी पदार्थों से होने वाला विकिरण जीवित अवयवों के शरीर में आयनीकरण उत्पन्न करता है, जिससे अवयवों को भारी क्षति पहुंचती है। यह अवयवों के आनुवांशिक स्तर में भी परिवर्तन लाता है जिससे न केवल उस अवयव को बल्कि उसकी आगामी पीढ़ियों के स्वास्थ्य पर भी प्रतिकूल असर डालता है। स्वास्थ्य को होने वाली यह क्षति विकिरण के साथ होने वाले संपर्क की अवधि और मात्रा पर निर्भर करती है। उतक, कोशिकाओं, क्रोमोसोम और डीएनए के स्तरों पर रेडियोधर्मी विकिरण असमान्यताएं पैदा करता है। लंबे समय तक विकिरण के संपर्क में रहने वाली माँ एक अपाहिज बच्चे को जन्म दे सकती है। विकिरण लसिका, तिल्ली व अस्थि मज्जा के लिए खतरनाक साबित होते हैं और दीर्घकालिक संपर्क के कारण ये शरीर की प्रतिरक्षा प्रणाली को ध्वस्त कर देते हैं। अस्थि मज्जा पर विकिरण के प्रभाव से ल्यूकेमिया सा रक्तकैंसर की बीमारी हो सकती है। रेडियोधर्मी यौगिक खाद्य श्रृंखला द्वारा सजीवों के शरीर में एकत्र होकर जैविक बहुगुणन की प्रक्रिया से बढ़ते हैं जो कि अपने

खतरनाक असर को तेजी से बढ़ाते हैं। विकिरण से होने वाली जैविक हानियों को मापने के लिए रेम्स नामक इकाई प्रयुक्त होती है और यदि विकिरण की मात्रा 0 से 25 रेम्स तक होती है तो इसका प्रभाव अवलोकनीय नहीं होता है। यदि इसकी मात्रा 25 से 100 होती है तो श्वेत रक्त कणिकाओं में कमी आने लगती है। यदि 100 से 200 होती है तो बालों का झड़ना, उल्टी आना शुरू हो जाता है। यदि विकिरण की मात्रा 200 से 500 होती है तो रक्त की नसें फट जाती हैं। 500 रेम्स से ज्यादा मात्रा मौत का कारण बन जाती है।



रेडियोधर्मी कचरा पर्यावरण के लिए बेहद खतरनाक होता है। लंबे समय तक इससे घातक किरणें निकलती रहती हैं। परमाणु रिएक्टरों से निकलने वाले कचरे में रेडियम, थोरियम व प्लूटोनियम होते हैं। ये तीनों पदार्थ अत्यंत जहरीले होते हैं, रेडियम का अणु 32000 साल, प्लूटोनियम 500000 तथा थोरियम कई लाख साल तक वातावरण को खतरनाक ढंग से दुष्प्रभावित कर सकता है। रेडियोधर्मी प्रदूषण से तापमान में 7 से 30 डिग्री सेल्सियस तक की कमी आ सकती है, ओजोन परत की क्षय दर तीव्र

हो सकती है और परमाणु विस्फोट की स्थिति में एक मीटर की गहराई तक पृथ्वी पूरी तरह जमकर बंजर हो सकती है। हड्डियों के फेक्चर के निदान के लिए एक्स- रे का उपयोग किया जाता है लेकिन ये एक्स रे सेंटर भी रेडियोधर्मी प्रदूषण के कारक बन रहे हैं। देशभर में एक्स रे सेंटर को नियमित करने वाली संस्था आर. पी. एण्ड ए. डी., बार्क मुम्बई द्वारा निर्धारित सुरक्षा मानकों की अनदेखी इन सेंटर के आसपास रहने वाली आबादी को कैंसर जैसे रोग से ग्रसित कर रही है। अभी समय है हम रेडियोधर्मी प्रदूषण के खतरों से सचेत हो जाएं।

रेडियोधर्मी पदार्थों से निकलने वाले मैग्नेटिक तरंगों से न केवल हमारे स्वास्थ्य पर बुरा असर पड़ रहा है वरन् परमाणु संयंत्रों से फैलने वाले विकिरण से गंभीर बीमारियों की आशंका दिखाई देने लगी है।

यू तो रेडिएशन को मुख्यतः परमाणु संयंत्र से ही जोड़कर देखा जाता रहा है, लेकिन आपको यह जानकर आश्चर्य होगा कि हम रोजमर्रा की जिंदगी में कहीं ज्यादा रेडिएशन झेल रहे हैं। मोबाइल, माइक्रोवेव, सिगरेट, सीटी स्कैन और एक्सरे के जरिए हम विकिरण के शिकार हो रहे हैं। यहां तक कि केला खाने से भी हम विकिरण को अपने शरीर पर झेल रहे हैं।

रेडिएशन यानी रेडियोधर्मी पदार्थों से निकलने वाली मैग्नेटिक तरंगों से होने वाला विकिरण है। यह विकिरण हमारे शरीर के लिए खतरनाक है।

जापान में सुनामी के चलते जब परमाणु संयंत्रों से विकिरण फैला तो कई दिनों बाद उसका प्रभाव कैलिफोर्निया में पाया गया। इससे पहले दिल्ली के मायापुरी इलाके में भी रेडिएशन से एक व्यक्ति की मौत हो गई थी और कई बीमार हो गए थे।

आज हम सभी के हाथ में एक अदद मोबाइल रहता है। लेकिन मोबाइल फोन और उसके टॉवर्स से निकलने वाला रेडिएशन शरीर की कोशिकाओं के डिफेंस मैकेनिज्म को नुकसान पहुंचाता है। चूहों पर मोबाइल के रेडिएशन का स्तर जानने के लिए जो शोध किया गया तो पता चला कि मोबाइल के रेडिएशन से चूहों में कैंसर, आर्थराइटिस, अल्जाइमर और हार्ट डिजीज का खतरा बढ़ गया।

रेडिएशन की लगातार ज्यादा मात्रा स्वास्थ्य को गंभीर रूप से खराब कर सकती है। इसके दुष्प्रभावों में कैंसर से लेकर तो बांझपन और गर्भपात तक होने के प्रारंभिक सबूत हैं। भारत जैसे घनी जनसंख्या वाले देश में अगर सख्त नियम नहीं हैं तो इसका अर्थ है कि हम बड़ी आबादी को खतरे में डाल रहे हैं। गलत ढंग से लगे मोबाइल टॉवर्सों से जुड़े और भी खतरे हैं, जिनमें दुर्घटना से लेकर तो घटिया किस्म के जनरेटर की वजह से वायु और ध्वनि प्रदूषण भी शामिल हैं। मोबाइल ने भारत में बहुत बड़ा बदलाव लाया है, इसमें कोई शक नहीं, लेकिन अब वक्त आ गया है कि हम इससे होने वाले खतरों से बचने का भी उपाय करें।

अनुसंधानकर्ताओं के अनुसार जिस तरह माइक्रोवेव ओवन में पकाए जाने वाले भोजन में मौजूद पानी इस विकिरण के असर से सूख जाता है, उसी तरह मोबाइल फोन का रेडिएशन खून की गुणवत्ता और दिमाग की कोशिकाओं को प्रभावित करता है। यही नहीं मोबाइल टॉवरों के नजदीक रहने वाली गर्भवती महिलाओं के होने वाले बच्चों पर भी रेडिएशन का गहरा असर पड़ता है और बच्चे मानसिक रूप से अपंग पैदा होते हैं।

हम आमतौर पर अपनी बीमारी या उसके इलाज की प्रगति जानने के लिए आए दिन एक्स रे और सी.टी. स्कैन कराते हैं लेकिन ये एक्स रे और सी.टी. स्कैन ही सबसे ज्यादा रेडिएशन फैला रहे हैं। दरअसल एक्स रे और सी.टी. मशीन से भारी मात्रा में रेडियो एक्टिव किरणें निकलती हैं, जो शरीर के लिए नुकसानदेह होती हैं। बार-बार एक्स रे और सीटी स्कैन कराने से शरीर की प्रतिरोधक क्षमता तो कम होती है, साथ ही कैंसर जैसी खतरनाक बीमारी की संभावना बढ़ जाती है। इसीलिए एक्स रे टेक्नीशियन और सी.टी. स्कैन करने वाले रेडियोग्राफर लैड एप्रिन पहनते हैं।

एक्सरे और सीटी स्कैन कराते समय लैड एप्रिन का डिजाइन व साइज बिल्कुल आम एप्रिन की तरह ही होता है, लेकिन इसके अस्तर के बीच में लैड की एक परत लगी होती है। लैड की यह परत एक्स-रे मशीन से निकलने वाली रेडियो

एक्टिव किरणों को सोख लेती है, जिससे यह किरणों रेडियोग्राफर तक नहीं पहुंच पाती हैं और वह विकिरण के खतरे से बच जाता है। यदि रेडियोग्राफर लंबे अंतराल तक इन किरणों के संपर्क में बना रहता है, तो उसे कैंसर होने की संभावनाएं काफी बढ़ जाती हैं, इसीलिए परमाणु ऊर्जा नियामक परिषद ने लैड एप्रिन का उपयोग अनिवार्य कर रखा है।

मोबाइल के अलावा वॉशिंग मशीन, डिश वॉशर, वैक्यूम क्लीनर, लैपटॉप से लेकर साधारण से दिखने वाले हेयर ड्रायर से भी इलेक्ट्रिक मैग्नेटिक तरंगें निकलती हैं। ये बात अलग है कि किसी एक उपकरण के प्रयोग से बहुत ज्यादा डी.एन.ए. परिवर्तन नहीं होता। लेकिन इन तरंगों से गंभीर खतरों का सामना करना पड़ सकता है। रेडिएशन के कारण सेल्स और टिश्यूज़ का विकास प्रभावित होता है और इसका सबसे ज्यादा असर गर्भवती महिलाओं, नवजात और बढ़ते बच्चों पर पड़ता है।

फुकुशिमा परमाणु संयंत्र में मौजूद रेडियोधर्मी जल को प्रशांत महासागर में बहाया जा रहा है। इस कारण जापान के समुद्र जल में विकिरण का स्तर और बढ़ गया है। हालांकि जापानी अधिकारी इसे स्वास्थ्य के लिए बड़ा खतरा नहीं मान रहे हैं। समुद्र जल में रेडियोधर्मी आयोडीन का स्तर सामान्य से लाखों गुना अधिक पाया गया है। जापान की परमाणु एवं औद्योगिक सुरक्षा एजेंसी ने कहा, समुद्र में प्रदूषण का कारण

संयंत्र से बहाया जा रहा पानी ही है। उसके मुताबिक अब तक लगभग 60 हजार टन प्रदूषित जल समुद्र में बहाया जा चुका है। टेपको द्वारा साढ़े ग्यारह हजार टन निम्न स्तर का प्रदूषित जल समुद्र में बहाया गया। टेपको के मुताबिक अब तक लगभग साढ़े तीन हजार टन प्रदूषित जल समुद्र में बहाया जा चुका है।

दिल्ली के मायापुरी इलाके में दुर्घटनावश हुई रेडिएशन उत्सर्जन की घटना यह बताती है कि रेडियो-एक्टिव पदार्थों की देखरेख में जरा सी लापरवाही के परिणाम भी कितने गंभीर हो सकते हैं। कबाड़ी की दुकान पर अत्यधिक रेडियो-एक्टिव कोबाल्ट-60 कैसे पहुंचा, किस बंदरगाह और किस चैनल से पहुंचा, किस देश से आयात किया गया, ये सवाल अभी तक सुलझ नहीं पाए हैं। हालांकि इस पदार्थ को स्क्रेप के रूप में बेचना निषिद्ध है। उच्च रेडियोएक्टिविटी के कारण इसे लेड (सीसे) के कंटेनरों में रखना पड़ता है। शुरू से आखिर तक इसका इस्तेमाल कहां-कहां हुआ, इसका पूरा ब्यौरा रखना पड़ता है।

परमाणु ऊर्जा नियमन बोर्ड इस बात का ध्यान रखता है कि ऐसे रेडियो-एक्टिव पदार्थों के बारे में सुरक्षा नियमों का ठीक से पालन हो रहा है या नहीं। मायापुरी में जो कोबाल्ट-60 मिला है, वह दुकान पर पहुंची किसी कबाड़ की खेप का हिस्सा था। इसके मूल स्रोत का पता लगाने की कोशिश चल रही है। हालांकि इसे लाने वाले सारे सबूत मिटाने का प्रयास कर रहे होंगे।

कोबाल्ट एक लोहे से मिलती-जुलती धातु है और कोबाल्ट-60 इसका मानव निर्मित आइसोटोप (एक अलग रूप) है। इसकी रेडियोएक्टिविटी बहुत ज्यादा होती है और इसका इस्तेमाल रेडिएशन थेरपी, औद्योगिक रेडियोग्राफी और खाद्य पदार्थों को रोगाणु रहित करने में होता है। कोबाल्ट-60 से निकलने वाले गामा विकिरण का शरीर पर धीरे-धीरे असर होता है। शरीर इसको ज्वब करता रहता है। इससे शरीर की कोशिकाओं में म्यूटेशन होते रहते हैं, जो आगे चलकर कैंसर का रूप ले सकता है। इसका विकिरण लोहे की अलमारियों और कंक्रीट की दीवारों के आर-पार आसानी से चला जाता है। इसे रोकने के लिए लेड की बहुत मोटी परत की जरूरत पड़ती है। शरीर में विकिरण जनित बीमारी के लक्षण प्रकट होने से पहले ही शरीर के भीतर रेडिएशन की मात्रा सुरक्षित स्तर से ऊपर पहुंच चुकी होती है।

मायापुरी में हुई रेडिएशन की घटना की कई कोणों से पड़ताल जरूरी है। जैसे यह कि इस घटना से पहले यह स्क्रेप किसे बेचा गया था और खरीदार ने किस उद्देश्य के लिए इसे खरीदा था। दूसरा अहम सवाल यह है कि इसका स्रोत देसी है या विदेशी। यदि इस स्क्रेप का आयात किया गया तो इसे भारत में निर्यात करने वाला देश कौन सा था। यह पता लगाना भी जरूरी है कि प्रदूषित स्क्रेप का इस्तेमाल कहीं स्टील बनाने में तो नहीं किया गया।

कोबाल्ट-60 से होने वाले रेडिएशन के परिणाम कितने भयंकर हो सकते हैं, उसका अंदाजा 1983 में मैक्सिको में हुई एक घटना से लगाया जा सकता है। वहां एक बेकार रेडियोथेरेपी मशीन से स्रावित होने वाला कोबाल्ट-60 करीब 600 टन स्टील में जा पहुंचा। इस स्टील का इस्तेमाल मैक्सिको, कनाडा और अमेरिका के 23 राज्यों में हुआ। नतीजा यह निकला कि रेडियोधर्मी प्रदूषण को रोकने के लिए मैक्सिको के करीब 100 मकान नष्ट करने पड़े। अमेरिका के परमाणु नियमन आयोग को हर साल रेडियो-ऐक्टिव पदार्थों के गायब होने, चुराए जाने या लावारिस छोड़े जाने की 200 रिपोर्टें मिलती हैं। कड़े नियम-कानूनों के बावजूद वहां इतने बड़े पैमाने पर रेडियो-ऐक्टिव पदार्थों का गुम होना सचमुच आश्चर्यजनक है।

अंतरराष्ट्रीय परमाणु ऊर्जा एजेंसी (आई.ए.ई.ए.) की बैठकों में रेडियो-ऐक्टिव पदार्थों के 'अनाथ स्रोतों' के बारे में कई बार चर्चा हो चुकी है। एजेंसी की प्रारंभिक रिपोर्ट के मुताबिक 110 से अधिक देश ऐसे हैं, जिनके पास रेडियो-ऐक्टिव पदार्थों को नियंत्रित करने के लिए न्यूनतम साधन भी नहीं हैं। 1990 से अब तक जॉर्जिया में 300 रेडियो-ऐक्टिव स्रोत बरामद किए जा चुके हैं। कृषि अनुसंधान में इस्तेमाल होने वाले रेडियो-ऐक्टिव पदार्थों के लावारिस पाए जाने के भी कई उदाहरण मिले हैं। अमेरिकी परमाणु नियमन आयोग के अनुसार 1983 से 20 स्रोतों को

दुर्घटनावश विभिन्न स्टील कारखानों में पिघला दिया गया है। कुछ अन्य रिपोर्टों के मुताबिक दुनिया में इस तरह की 65 घटनाएं हो चुकी हैं।

भारत में औद्योगिक रेडियोग्रफी स्रोतों को हैंडल करने में सुरक्षा नियमों के उल्लंघन के कारण पहले भी कुछ ऐसी घटनाएं हो चुकी हैं, जिनमें लोगों को रेडिएशन की उच्च मात्रा के उत्सर्जन का शिकार होना पड़ा था। सबसे गंभीर मामला एक रेलवे गैंगमैन था, जिसने एक गामा स्रोत को बहुमूल्य वस्तु समझकर अपनी जेब में रख लिया था। पौने दो साल के इलाज के बाद ही उसकी जान बच पाई थी। मायापुरी की घटना ने सबसे पहले तो यह बताया है कि हमारी पुलिस रेडिएशन के खतरों को भांपने में तकनीकी रूप से सक्षम नहीं है। यही हाल अस्पतालों का है। दिल्ली के अधिकांश अस्पतालों को यह समझने में काफी वक्त लग गया कि मायापुरी का मामला रेडिएशन से जुड़ा है। हमारे प्रमुख बंदरगाहों तक पर अभी रेडिएशन मॉनिटर नहीं लगे हैं।

कुछ सुरक्षा विशेषज्ञों ने आशंका जताई है कि आतंकवादी संगठन रेडियो-ऐक्टिव पदार्थों का इस्तेमाल 'डर्टी बम' बनाने के लिए कर सकते हैं। जाहिर है, सरकार को 'अनाथ' रेडियो-ऐक्टिव पदार्थों का पता लगाने और उन्हें गलत हाथों में पहुंचने से रोकने के लिए अपनी चौकसी बढ़ानी होगी। ऐसे मामलों को पकड़ने के लिए पुलिसकर्मियों, एयरपोर्ट स्टाफ और बंदरगाह कर्मियों को तकनीकी तौर पर सक्षम बनाने के

साथ-साथ अस्पतालों को भी रेडिएशन-जनित बीमारियों के उपचार में समर्थ बनाना होगा। इसके अलावा शहरों में अस्पताल से निकलने खतरनाक किस्म के कचरे के संग्रह और निपटान की कारगर व्यवस्था होनी चाहिए।

परमाणु ऊर्जा नियमन बोर्ड को भी अब अधिक सतर्कता बरतनी होगी। उद्योगों, अस्पतालों और प्रयोगशालाओं में इस्तेमाल होने वाले रेडियो-सक्रिय पदार्थों का समय-समय पर निरीक्षण आवश्यक है। बोर्ड या उसके द्वारा अधिकृत संस्था की अनुमति के बगैर किसी भी रेडियो-ऐक्टिव पदार्थ युक्त उपकरण की कबाड़ में बिक्री नहीं की

जानी चाहिए। स्कैप डीलरों को अपनी दुकानों में आने वाले सामान के बारे में ज्यादा चौकसी बरतने की हिदायत दी जानी चाहिए। संदिग्ध वस्तुओं में लेड कंटेनर भी हो सकते हैं, जिनमें रेडियो-ऐक्टिव पदार्थ रखा जाता है। रेडियो-ऐक्टिव पदार्थों के संबंध में जवाबदेही तय करने के अलावा हमें परमाणु पदार्थों की सुरक्षा और नागरिकों के स्वास्थ्य की हिफाजत के लिए भी कड़े उपाय करने होंगे।

## गुणकारी ग्वारपाठा

ममता पुरोहित, एस. एल. मीणा एवं राजेश कुमार मिश्रा

उष्णकटिबंधीय वन अनुसंधान संस्थान

(भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार)

मण्डला रोड, ज़बलपुर – 482021 (म.प्र.)



जंगलों में पाया जाने वाला लिलिएसी कुल का ग्वारपाठा अपने औषधीय गुणों के कारण अब खेतों में उगाया जा रहा है। इसकी सबसे पहले पैदावार उत्तरी अफ्रीका, कैनेरी द्वीप, केप वेरडे, उत्तरी अमेरिका एवं स्पेन में देखी गयी। यह शुष्क जलवायु में वृद्धि करने वाला बहुवर्षीय मरुदभिद् शाक है। यह तना रहित अथवा बहुत ही छोटे तने वाला, 60 से.मी. से 5 फुट तक ऊँचा होता है। इसकी पत्तियाँ मोटी, गूदेदार, भालाकार, 1 से 5 फुट लम्बी, 3 से 4 इंच चौड़ी कंटकित एवं हरे रंग की होती हैं। परिपक्व पौधे के मध्य भाग में सफेद-पीले अथवा नारंगी रंग के पुष्प जनवरी-फरवरी माह में निकलते हैं। पुष्पों को गंदल भी कहते हैं। इसकी लगभग 300 प्रजातियाँ हैं जिनमें से 4 प्रजातियाँ औषधीय

गुणों से भरपूर हैं। ऐसा कहा जाता है कि प्राचीन काल में मिश्र की महारानी क्लियोपेट्रा ग्वारपाठा को अपने सौन्दर्य प्रसाधन के रूप में इस्तेमाल करती थी। सिकन्दर महान ने सोकोत्र द्वीप को जीतने के लिए युद्ध किया था क्योंकि इस द्वीप में ग्वारपाठा बहुत मात्रा में उगता था जो सिकन्दर के सैनिकों के इलाज में काम आता था।



### नामावली

पूरे विश्व में ग्वारपाठा एलोय के नाम से प्रसिद्ध है। हिन्दी में इसे ग्वारपाठा, घी कुआंर संस्कृत में घृतकुमारी तथा अंग्रेजी में एलो वेरा कहते हैं। इसका वानस्पतिक नाम *एलो बर्बेडेन्सिस* है।

### प्राप्ति स्थान

यह सम्पूर्ण भारतवर्ष में प्राकृतिक रूप से पाया जाता है। भारत के अतिरिक्त यूरोप, उत्तरी

अमेरिका, स्पेन, उत्तरी अफ्रीका, थाईलैण्ड, चाइना, वेस्ट इंडीज आदि देशों में भी पाया जाता है।

#### रासायनिक संगठन

गूदेदार पत्तियों में लगभग 95 प्रतिशत पानी तथा शेष भाग में 20 से अधिक अमिनो एसिड, कर्बोहाइड्रेडस, पॉलीसेकराइडस, मिनरल्स,



एन्जाइम्स, प्रोटीन्स, विटामिन्स, एलोन नामक ग्लूकोसाइड समूह, नाइट्रोजन, कैल्शियम, सोडियम, मैग्निशियम आदि, राल एवं सुगंधित तेल सहित 70 से अधिक अत्यावश्यक औषधीय तत्व पाये जाते हैं। ग्लूकोसाइड समूह में हल्के पीले रंग का बारबोलिन नामक मुख्य ग्लूकोसाइड होता है। इसमें पायी जाने वाली गंध मौजूद तेल के कारण होती है।

#### औषधीय उपयोग

ग्वारपाठा की पत्तियों का अर्क तथा गूदा (जैल) व पौधों की जड़ों का सेवन एवं लेपन भीतर तथा बाहर से प्राकृतिक रूप से उपचार करता है। यह विभिन्न रोगों के उपचार में प्रभावकारी है जैसे:

1. पाचन तंत्र की गड़बड़ी - भूख कम लगना, एसिडिटी, अपच, कब्ज आदि।
2. पेटदर्द
3. पेट में अल्सर होने पर

4. यकृत तथा प्लीहा की कमजोरी तथा सूजन
5. मधुमेह
6. पथरी तथा डायलिसिस होने पर
7. चर्मरोग
8. जलने एवं झुलसने पर
9. हृदय विकारों में
10. कोलस्ट्रॉल एवं रक्तचाप नियंत्रण में
11. रक्त शोधक एवं रक्त परिभ्रमण में
12. बढी हुई रक्त वसा के उपचार में
13. फोडा-फुंसी के घाव होने पर
14. आंतों में कृमि होने पर
15. नेत्र रोगों में
16. खांसी व कफ के उपचार में
17. घुटनों की सूजन एवं दर्द में
18. बाल संबंधी समस्याओं के उपचार में
19. दर्द निवारक के रूप में

#### घरेलु उपचार

ग्वारपाठा की पत्तियों के कुछ घरेलु उपचार इस प्रकार हैं:

1. शहद के साथ इसके भुने हुए पत्ते का रस लेने से खांसी व कफ में आराम मिलत है।
2. पानी के साथ 3-4 चम्मच ताजा गूदा नियमित रूप से लेने से गटिया, कमर दर्द व जोड़ों के दर्द में आराम मिलता है।
3. पत्तियों का तजा गूदा बच्चों की आंत से कृमि निकालने में सहायक है।

4. जल जाने पर पत्तियों का ताजा रस एवं गूदा लगाने से दर्द में आराम एवं ठंडक मिलती है तथा घाव के दाग शीघ्र साफ हो जाते हैं।
5. नियमित रूप से गूदा लगाने से कील मुहांसे ठीक होने लगते हैं एवं झुर्रियां दूर हो जाती हैं।

#### खाद्य व्यंजन बनाने में

पौष्टिक एवं स्वास्थ्य वर्धक ग्वारपाठा का उपयोग विभिन्न व्यंजनों के बनाने में किया जाता है जैसे:

1. मठरी
2. रोटी
3. हलवा
4. लड्डू
5. शर्बत
6. जूस आदि

#### नियमित सेवन से लाभ

1. ग्वारपाठा के नियमित सेवन से मैटाबोलिक प्रक्रिया सुचारु रूप से होने लगती है जिससे शरीर को पोषक तत्व अधिक मात्रा में उपलब्ध होते हैं फलस्वरूप रोग प्रतिरोधक क्षमता एवं शारीरिक शक्ति बढ़ती है।
2. जठराग्नि ठीक रहने से पाचन तंत्र उचित रूप से कार्य करता है।
3. त्वचा मुलायम एवं तेजस्वी बनी रहती है।

4. हृदय गति एवं रक्तचाप सामान्य बना रहता है।
5. रक्त में हीमोग्लोबिन और डब्ल्यू. बी. सी. कोशिकाओं की मात्रा बढ़ने लगती है।
6. हार्मोन्स संतुलित रहते हैं।
7. हड्डियों एवं मांसपेशियाँ मजबूत बनती हैं।
8. घाव आदि जल्दी भर जाते हैं।

#### सौन्दर्य प्रसाधनों के निर्माण में

ग्वारपाठा की पत्तियों का उपयोग विभिन्न सौन्दर्य प्रसाधनों के निर्माण में किया जा रहा है। जैसे:

1. क्रीम
2. पेस्ट
3. लोशन
4. शैम्पू
5. माइश्वराइजर आदि में



#### ग्वारपाठा की खेती

ग्वारपाठा की खेती के लिए आवश्यक बातें इस प्रकार हैं:

#### भूमि एवं जलवायु

ग्वारपाठा की खेती के लिए हल्की से मध्यम किस्म की दोमट, बालुई दोमट तथा कछारी मिट्टी वाले खेत अधिक उपयुक्त होते हैं। खेत में जल निकास की उचित व्यवस्था होना चाहिए। ऐसी

भूमि जहाँ पानी भर जाता है वहाँ पौधों की जड़ों के सड़ने का खतरा बना रहता है।

### खेत की तैयारी

चयनित खेत की 2-3 बार गहरी जुताई कर लेना चाहिए। जुताई के बाद पाटा लगाकर खेत को समतल करना चाहिए। इसी समय प्रति एकड़ 4-5 क्विंटल गोबर की पकी खाद खेत में बिखेर देना चाहिए। कम्पोस्ट खाद भी उचित दूरी पर ढेर बनाकर फैला सकते हैं। दराती चलाकर खाद को मिट्टी में अच्छी तरह से मिला देना चाहिए।

### रोपण

ग्वारपाठा के छोटे पौधों या बलबिल्लस का रोपण जुलाई-अगस्त माह में किया जाना चाहिए। डेढ़ से दो फुट की दूरी पर 9 से 12 इंच ऊँची मेढ व नालियाँ बनाकर पंक्तियों में पौधे लगाना चाहिए। पौधे से पौधे की दूरी एक फुट रख सकते हैं।



इस अनुसार एक एकड़ में 20 से 22 हजार पौधे लग सकते हैं। अधिक उपजाऊ भूमि होने पर पंक्तियों के बीच की दूरी 2 फुट व पौधों के बीच की दूरी डेढ़ फुट रख सकते हैं। इस तरह प्रति एकड़ 15 हजार पौधों की जरूरत होगी।

### सिंचाई

ग्वारपाठा की खेती के लिए बहुत सिंचाई की जरूरत नहीं पड़ती है लेकिन खेत में पर्याप्त नमी

रहना जरूरी है। यदि पौधरोपण ग्रीष्म ऋतु में किया जाता है तो रोपण पश्चात हल्की सिंचाई करना चाहिए। बरसात के दिनों में खेत से पानी निकालते रहना चाहिए अन्यथा पानी के लगातार सम्पर्क में रहने से पौधों पर काले रंग का चिकना पदार्थ एकत्रित हो जाता है जिससे पौधे गलने लगते हैं। शुष्क मौसम होने पर पौधों की वृद्धि अच्छी होती है।

### उर्वरक

रोपण के 20-25 दिन बाद प्रति एकड़ 25 किलोग्राम यूरिया, 50 किलोग्राम सुपर फास्फेट व 30 किलोग्राम म्यूरेट ऑफ पोटाश मिलाकर नालियों में डालकर गुड़ाई तथा हल्की सिंचाई कर देना चाहिए।

### निंदाई-गुड़ाई

खरपतवार नियंत्रण के लिए रोपण के एक माह पश्चात व उसके बाद आवश्यकतानुसार निंदाई-गुड़ाई की जानी चाहिए तथा समय-समय पर पौधों पर मिट्टी चढ़ाते रहना चाहिए।

### रोग एवं कीट रोकथाम

प्रायः ग्वारपाठा पर किसी भी प्रकार के रोग एवं कीट का प्रभाव नहीं पड़ता है। यदि कीट प्रकोप दिखाई दे तो 2 प्रतिशत मोनोक्रोटोफास का छिड़काव करना चाहिए।

### पौध सुरक्षा

ग्वारपाठा को कोई भी पशु नहीं खाता है परन्तु यदि खेत में पशुओं का आवागमन है तो पत्ते टूटने से फसल को नुकसान होता है।

**दोहन एवं संग्रहण**

ग्वारपाठा को पूरी तरह परिपक्व होने में 12 से 15 माह लग जाते हैं। प्रत्येक पौधे की 3-4 पत्तियों को छोड़कर शेष समस्त परिपक्व पत्तियों को तेज धार वाले हँसिया/चाकू आदि से काटकर संग्रहित कर लेते हैं। इस तरह नये कल्ले फूटने लगते हैं। एक बार ग्वारपाठा लग जाने पर उससे 3 से 5 साल तक उपज ली जा सकती है। पत्तियों का संग्रहण एवं भंडारण करते समय यह ध्यान रखना चाहिए कि पत्तियों को कम से कम क्षति पहुँचे। आवश्यकतानुसार पके हुए गूदे या सूखे हुए ग्वारपाठा को रख सकते हैं।

**उत्पादन**

अनुभव के अनुसार किसानों के प्रति एकड़ खेत में लगे 15 से 20 हजार पौधों से 6 से 7 हजार किलोग्राम गूदा मिल सकता है।

**बाजार मूल्य**

ग्वारपाठा की पत्तियों का वर्तमान बाजार मूल्य रु. 3/- से रु. 6/- प्रति किलोग्राम तक है।

**लाभ**

प्रति एकड़ खेती में लगभग रु. 25, 000/- का व्यय होता है तथा लगभग रु. 75, 000/- की प्राप्ति होती है। इस प्रकार किसान को लगभग रु. 50, 000/- प्रति एकड़ का लाभ मिल सकता है।

**सावधानियाँ**

किसी भी किसान को ग्वारपाठा की खेती शुरू करने से पहले बाजार व्यवस्था की समुचित

जानकारी एकत्र कर लेना चाहिए। यदि विपणन व्यवस्था खेती किये जाने वाले स्थान से अधिक दूर है तो इसकी पत्तियों के परिवहन में कठिनाई आती है तथा खर्च भी अधिक होता है जिससे किसान को उपज का उचित मूल्य नहीं मिल पाता है।

## Diversity of macro-fungi in central India-V: *Tremella fuciformis*

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### Introduction

*Tremella fuciformis* is a species of macro-fungi; it produces white, frond-like, gelatinous basidiocarps (fruiting bodies). It is widespread, especially in the tropics, where it can be found on the dead branches of broadleaf trees. This fungus is commercially cultivated and is one of the most popular fungi in the cuisine and medicine of China (Paul, 2000). *T. fuciformis* is commonly known as snow fungus, silver ear fungus, and white jelly mushroom. *T. fuciformis* is a parasitic yeast, and grows as a slimy, mucous-like film until it encounters its preferred hosts, various species of *Annulohyphoxylon* (or possibly *Hyphoxylon*) fungi, whereupon it then invades, triggering the aggressive mycelia growth required to form the fruiting bodies (Huei-Mei et al., 2005). Common name of these fungi is Yin Er, White Jelly Fungus, White Jelly Leaf ("Shirokikurage"), Silver Ear Mushroom, Snow Mushroom and Chrysanthemum Mushroom. It is reported on logs of *Shorea robusta* from WB (Banerjee, 1947). Three other species of this genus namely *Tremella foliacea* Pers. = *Ulocolla foliacea* (Pers.) Bref., *Tremella mesenterica* Retz. = *Tremella lutescens* Pers., and *Tremella protensa* Berk., were reported from Sikkim (Berkeley, 1856), Madhya Pradesh (Saksena and Vyas, 64) and West Bengal (Berkeley, 1854)

### Materials and methods

#### Collection of samples

The mushroom was collected on wood of *Shorea robusta* from Jagdalpur, CG, 21.8.2011 collected by C.K. Tiwari, Jagrati Parihar and R.K. Verma and *Pterocarpus marsupium*, Keshkal, CG, 18.8.2011, collected by Jagrati Parihar. The specimen were deposited in the mycology herbarium of Forest Pathology Division, Tropical Forest Research Institute, Jabalpur, India under accession Numbers, TF 3282 and TF3151.

#### Identification of fungus

Identification of fungal fruiting bodies has done with help of relevant literature (Acton and Sandler, 2001; Banerjee, 1947; Barrett, 1910; Boa, 2004; Harding 2008; Lowy, 1952; Mohanan, 2011; Sterry and Hughes, 2009; Tiwari et al., 2013; Verma et al., 2008; Young and Smith, 2005) and internet.

#### Results and discussion

##### Taxonomic description

##### *Tremella fuciformis* Berk. (Fig. 1, a-b)

(Tremellaceae, Tremellales, Incertae sedis, Tremellomycetes, Agaricomycotina, Basidiomycota)=*Tremella fuciformis* f. *corniculata* (Kobayasi, 1939)=*Tremella fuciformis* Berk. (Berkeley, 1856)

The fruiting body is a mass of white, translucent gelatinous fungal material. It may form convoluted or lobed folds, on drying it shrinks, surface smooth and shiny. It is usually 3-15cm across. The spores are borne on the upright lobes. There is no pileus and stipe.



Figure 1 (a): *Tremella fuciformis* fruitbody

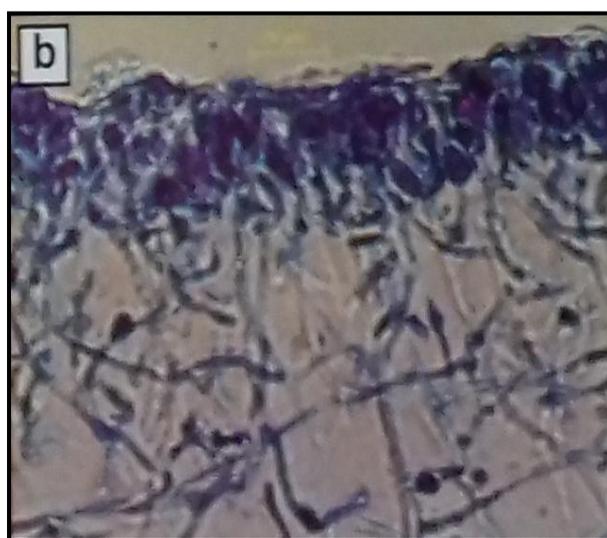


Figure 1 (a-c): *Tremella fuciformis* (b) basidia with hyphae

**Distribution**

The species is mainly tropical and subtropical, but extends into temperate areas in Asia and North America, also observed in South and Central America, the Caribbean, parts of North America, sub-Saharan Africa, southern and eastern Asia, Australia, New Zealand, and the Pacific Islands, Brazil, India (CG, WB), China, Japan, Korea and the Slav regions.

**Nutrition Value**

S. No.	Nutritional value per 100 g dried fruit body	Nutritional value estimated by different worker		
		Hu (1932)	Tang (1933)	Zhou et al. (1937)
1	Water	15.2 %	18.76 %	12.55
2	Crude fiber	2.4%	2.75%	2.58%
3	Carbohydrate	71.2 %	64.92 %	69.14 %
4	Protein	6.7%	7.02%	8.96%
5	Fat	0.6%	1.28%	1.38%
6	Ash	-	5.44%	5.39%
7	Inorganic salt	4.5%	-	-

**Cultivation methods**

The species is cultivated by two types of inoculation methods (1) spore inoculation (2) artificial inoculation. Spore inoculation includes the spore releasing in the air, it is major means of inoculation, but the yield is very poor. According to Xiong (1941), only 31% of wood could be used for mushroom cultivation, while the other wood (69%), contaminated by microorganisms, and could substantially reduce the yield of *T. fuciformis*. Artificial inoculation includes spore suspension, fresh fruiting body (the weight on own experience) put into cool boiled water, stirred, poured into watering can and sprayed on the wood (Xiong, 1941). Wei (1934) reported that fresh fruiting body was washed with clean water and spore suspension syringed and poured onto grinded bark. Filamentous strains are also introduced to artificial inoculation (Pan, 1947; 1948). The wood containing mycelium could be cut down, ground into powder, sieved, and then used for inoculation (Shi, 1935).

The above methods were used in cultivation of this fungus. The branches of trees were cut every February or March and used by spore release method (Tauler, 1940). Zheng (1934) found *Quercus sarrata* and *Q. dentata* species suitable for cultivating *T. fuciformis* in Wanyuan County. Wood was cut in spring rather than winter, substrate was mixed with the leaves of *Quercus glauca*, sand, gravel and yellow soil; wood was 60 cm in length, and the inoculation time was done in mid-June (Chen and Yang 1945).

#### **Production and marketing**

*Tremella fuciformis* has been cultivated in China since at least the nineteenth century. Initially, suitable wooden poles were prepared and then treated in various ways in the hope that they would be colonized by the fungus. This haphazard method of cultivation was improved when poles were inoculated with spores or mycelium. Modern production only began, however, with the realization that both the *Tremella* and its host species needed to be inoculated into the substrate to ensure success. The "dual culture" method, now used commercially, employs a sawdust mix inoculated with both fungal species and kept under optimal conditions.

Commercial production was started in Tongjiang County, China in 1932 (Huang, 1993) followed by Longhai County, Zhangzhou city, Fujian province. In the meantime, *T. fuciformis* had also been widely cultivated in many places, including Nanjing, Zhao'an, Yunxiao, Pinghe, Zhangpu, Changtai and Hua'an. The most popular species to pair with *T. fuciformis* is its preferred host, *Annulohyphoxylon archeri*. Estimated production in China in 1997 was 130,000 tonnes. *T. fuciformis* is also cultivated in

other East Asian countries, with some limited cultivation elsewhere.

#### **Economic usage**

*Tremella fuciformis* is used as a beauty product by women in China and Japan as it reportedly increases moisture retention in the skin and prevents senile degradation of micro-blood vessels in the skin, reducing wrinkles and smoothing fine lines. Other anti-ageing effects come from increasing the presence of superoxide dismutase in the brain and liver; it is an enzyme that acts as a potent antioxidant throughout the body, particularly in the skin (Chen, 1998). In Chinese cuisine, *T. fuciformis* is traditionally used in sweet dishes. While tasteless, it is valued for its gelatinous texture as well as its supposed medicinal benefits. Most commonly, it is used to make a dessert soup called 'luk mei', often in combination with jujubes, dried longans, and other ingredients. It is also used as a component of a drink and as an ice cream. Since cultivation has made it less expensive, it is now additionally used in some savour dishes (Shu-Ting and Philip, 2004). *T. fuciformis* is regarded as Chinese delicacy and has been long utilized as a "herb" to cure many ailments like tuberculosis, high blood pressure and common cold (Ghorai et al. 2009).

#### **Acknowledgement**

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## *Ganoderma* as a bio-deforesting agent

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### Abstract

*Ganoderma lucidum* is a type of root pathogen, generally enters a tree through wounds, tears, cuts or damaged roots. Most trees in forests can be affected by this disease. The DNA of the disease is slightly different between hardwood trees and palm trees. This means that neither strain of *Ganoderma* is transferrable between the two types of plants. So the *Ganoderma* all the species like to slaughter the trees alive. So this is called wood decaying fungi of the living trees. It is mainly effects roots of trees. The species has been separated into multiple phylogenic groupings based on DNA analysis. This fungus it is well adapted as a saprophyte and often fruits on stumps or roots for many years after a tree have been removed. The medicinal importance and other biological significances with special references to pharmaceutical properties, active components also isolated. But although it is necessary to document the species in the forest, it results the percentage of live trees loss.

### Introduction

*Ganoderma* is a genus of polypore mushrooms that grow on wood, and include about 80 species, many from tropical regions (Kirk et al., 2008). Because of their extensive use in traditional Asian medicines, and their potential in bioremediation, they are a very important genus economically. *Ganoderma* can be differentiated from

other polypore because they have a thicken layer. They are popularly referred to as shelf mushrooms or bracket fungi. The name *Ganoderma* is derived from the Greek *ganos* "brightness, sheen", hence "shining" and *derma* "skin" (Liddell, 1980). *Ganoderma* are characterized by their appearance that are large, perennial, woody brackets also called "conks". They are in light brownish and leathery either with or without a stem. The fruit bodies typically grow in a fan-like or hoof-like form on the trunks of living or dead trees. They have double-walled, truncate spores with yellow to brown ornamented inner layers. The genus was named by Karsten (Karsten, 1881). Members of the family Ganodermataceae were traditionally considered difficult to classify because of the lack of reliable morphological characteristics, the over-abundance of synonyms, and the widespread misuse of names (Smith, 2003; Ryvarden, 1985). Until recently, the genus was divided into two sections – Section *Ganoderma* with a shiny cap surface and *Elfvigia*, with a dull cap surface, like *Ganoderma applanatum*. Phylogenetic analysis using DNA sequence information derived from mitochondrial genome, have helped to clarify our understanding of the relationships amongst *Ganoderma* species (Hibbett, 1995; Hibbett, 2001). The genus may now be divided into six monophyletic groups (Hong, 2004; Murrill, 1905; Furtado, 1965). Like *G.*

*colossus* group, *G. applanatum* group, *G. tsugae* group, Asian *G. lucidum* group, *G. meredithiae* group, *G. resinaceum* group. The *Ganoderma* infected trees with *G. lucidum* often are showing decline type symptoms including increasing larger branch death, sparse crowns, slow growth, and sometimes wilting of leaves and other symptoms of root death or impact. More rapid decline is reported on some species such as honey locust.

It is necessary to document the species in the forest, it results the percentage of live trees loss. Besides of wood decaying, trees destroying nature it is also showing the other biological significances with special references to novel drug properties, active components. The outcome of the article also gives the awareness to the upcoming researchers.



Figure 1: *Ganoderma lucidum*, *Ganoderma* species.

### ***Ganoderma* as slaughterer of trees**

The root pathogen, *Ganoderma lucidum* generally enters a tree through wounds, tears, cuts or damaged roots. Most trees in forests can be affected by this disease. The DNA of the disease is slightly different between hardwood trees and palm trees. This means that neither strain of *Ganoderma* is transferrable between the two types of plants. A young hardwood can be planted near the site of an old hardwood that had *Ganoderma* with very little risk of transferring the disease from the old tree to the new one. However, *Ganoderma* which kills palm trees is different, and newly planted palms near the site of a palm that had *Ganoderma*

will contract the disease. Some studies suggest that the fungus infests a trees root system slowly and may take as many as 10-20 years to kill the tree. Other studies have concluded that *Ganoderma* is a natural occurring element of many mature trees. New information has found that *Ganoderma* may be quite a bit more aggressive in killing trees than originally thought. This information makes this disease quite dangerous considering that *Ganoderma* attacks the structural root system.

Trees have two primary root systems. The fibrous root system uptakes the water and nutrients. The structural root system of a tree holds the tree into the

ground preventing it from tipping over. Once *Ganoderma* has begun to degrade the structural roots of the tree it quickly becomes unstable. This makes the tree very susceptible to a complete tree failure.

One major issue with *Ganoderma* is many trees with this disease often appear to be healthy to the untrained eye. Many trees have a decent looking canopy, dieback with dead wood in the canopy and no fungal conks on the trunk. Some trees have many fungal conks on the trunk or other tree parts, and no signs of dieback in the canopy. If a tree is showing any signs of *Ganoderma*, further investigation should be done to determine the extent of the damage to the structural roots and heartwood of the tree.

Unfortunately, *Ganoderma* is incurable. Once this fungus has begun to colonize the trees systems there is no treatment or cure for the disease. The best preventative measure for ensuring this fungus to set it is to avoid root injury. This isn't all that likely in an urban forest, but fortunately after some sleuthing, many trees with *Ganoderma* don't need immediate removal.

*Ganoderma lucidum*, commonly known as the lingzi mushroom, is frequently used in Traditional Chinese Medicine. Its popularity extends to Japanese and Korean medicine, and it has been making its way west. *Ganoderma lucidum* has anti-oxidative effects when supplemented. It also has a therapeutic effect on insulin resistance, reduces the risk of prostate cancer, and can help treat a variety of conditions associated with metabolic syndrome. The lingzi mushroom is well known for its anti-cancer effects. It is able

to activate natural killer cells, increasing their activity and the body's ability to fight tumors.

Supplementing *Ganoderma lucidum* reduces the chances of metastasis, which is when cancer spreads to another part of the body. *Ganoderma lucidum* has a variety of mechanisms, but they are focused on moderating the immune system. The lingzi mushroom is able to reduce immune system activity when the system is overstimulated, and bolster the immune system when it is weakened. In general, *Ganoderma lucidum* increases the amount of active immune system cells. Though further research is needed to confirm these effects, *Ganoderma lucidum* shows promise for a wide variety of cancer-related therapies. It has been shown to be an effective adjunct therapy, which means it improves health when taken alongside other medications, for breast cancer, hepatitis, fatigue syndrome, and prostate cancer. There are not many promising supplements with anti-cancer properties available over-the-counter but *Ganoderma lucidum* appears to be one of them.

#### **Common species**

*Ganoderma applanatum* - Also known as the artist's conk. An infestation of this species was the main factor in the loss of the Anne Frank Tree (Taichi, 1983).

*Ganoderma lucidum* - Also known as reishi or lingzhi. A very valuable medicine in Asian herbal medicine, known as the "King of Herbs". *Ganoderma multipileum* - A genomic study in 2009 discovered that populations of *G. lucidum* in Tropical Asia are actually a separate species. *Ganoderma philippii* - A plant pathogen.

*Ganoderma pseudoferreum* - Responsible for the root rot of cacao, coffee, rubber and tea trees.

*Ganoderma tsugae* - A polypore which grows on conifers, especially hemlock; thus the common name, hemlock varnish shelf. Similar in appearance to *Ganoderma lucidum*, which typically grows on hardwoods (SGC, 2011).

#### **Recognizing features of *Ganoderma***

Single or clusters of round to half-moon shaped conks attached to woody roots or the base of the tree. Top of the conk is “varnished” (shiny when young) red to mahogany, sometimes *ocherous* (varying from light yellow to brown or red) with or without a white margin.

#### **Important character for field identification**

Only root and butt decay fungus on hardwoods that has a shiny red to mahogany top.

#### **Other biological benefits of *Ganoderma***

##### **Industrial significances**

*Ganoderma* are wood-decaying fungi with a cosmopolitan distribution. They can grow on both coniferous and hardwood species. They are white-rot fungi with enzymes that allow them to break down wood components such as lignin and cellulose. There has been significant research interest in trying to harness the power of these wood-degrading enzymes for industrial applications such as bio pulping (FBRI, 2008) or bioremediation (Matos, 2007; Rigas, 2007; Joo, 2008).

##### **Bioactive compounds**

*Ganoderma lucidum* and its several species contains many bioactive compounds (~400), such as triterpenoids and polysaccharides.

Collectively, the *Ganoderma* species are being investigated for a variety of potential therapeutic benefits (Yuen, 2005; Xu Z, 2011; Sliva D, 2004; Sanodiya, 2009).

Anticancer effects, immune-regulatory effects, antioxidant activities, liver-protecting effects, hypoglycemic effects, antibacterial effects, antiviral effects, antifungal effects, reducing blood cholesterol. *G. lucidum* is one of the most important root and butt decay fungi in the urban forest. The pathogen can kill roots, and decay roots and butts leading to tree failure. The root killing and decay usually progress slowly but trees often show decline symptoms when fruiting appear. Trees with *G. lucidum* conks should be tested for decay and monitored if they are to be retained in the urban environment. The decay may be entirely in the roots and testing with decay detecting tools in the butt may produce a negative result. Oaks seem to tolerate the infection better and may persist for longer periods of time with the infection.

*G. lucidum* is a complex of species that will not be sorted on field characteristics. The species has been separated into multiple phylogenetic groupings based on DNA analysis. There are other varnished red *Ganoderma* species but they are found on dead hemlock and other conifers. One of the “Big Four” that I recommend professional arborists know on site because of its ease of identification and important to tree health and stability. In many cases (except for oak) the trees are declining in vitality such that removal for that reason is the usual course. On beech and oaks the trees can be tested and evaluated over time, but I have seen both species fail with *G. lucidum*. The fungus is well adapted as a saprophyte and often fruits on stumps or roots for many years after a tree has been removed (Sinclair, 2008).

## Conclusion

It is obligatory to certify the number species in the forest, it consequences the fraction of live trees forfeiture. Moreover of wood decaying, trees extinguishing nature it is also presenting the other biological implications with special orientations to novel drug possessions, active components. The consequence of the article also provides the cognizance to the future investigators.

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## Weed diversity in agroforestry system

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Generally herbaceous species which are undesirable, growing with the agricultural crops are known as weeds. Weeds are fast growing plants, create competition for soil nutrients, water and light and space with the associate crop and affect the crop yield besides promoting insect pest attack on crop. Some of these weeds are ornamental and some of beneficial too. To control these weeds, various mechanical and chemical control methods are existing which are costly measures.

Agroforestry has potential to control this weeds depending upon the intercrops in the field condition. *Gmelina arborea* Roxb. is a fast growing, short rotation timber tree, strong light demander, drought tolerant but sensitive to the waterlogged condition. Many researchers have worked on *G.arborea* based silvi-agri system to improve the biomass production, enhance income of farmers besides fulfilling their basic needs of firewood and fodder.(Swamy *et al*,2008). The productivity of crops under agri-silviculture system is affected due to competition of light, water, nutrients from weeds in tree-crop component. The competition for resource sharing will increase gradually with the expansion of canopy and root system of trees. Site resources availability in agroforestry systems can be altered through managerial interventions. One of the important silvicultural management tools that can be alter competitive interactions in intercropping system is weed management.

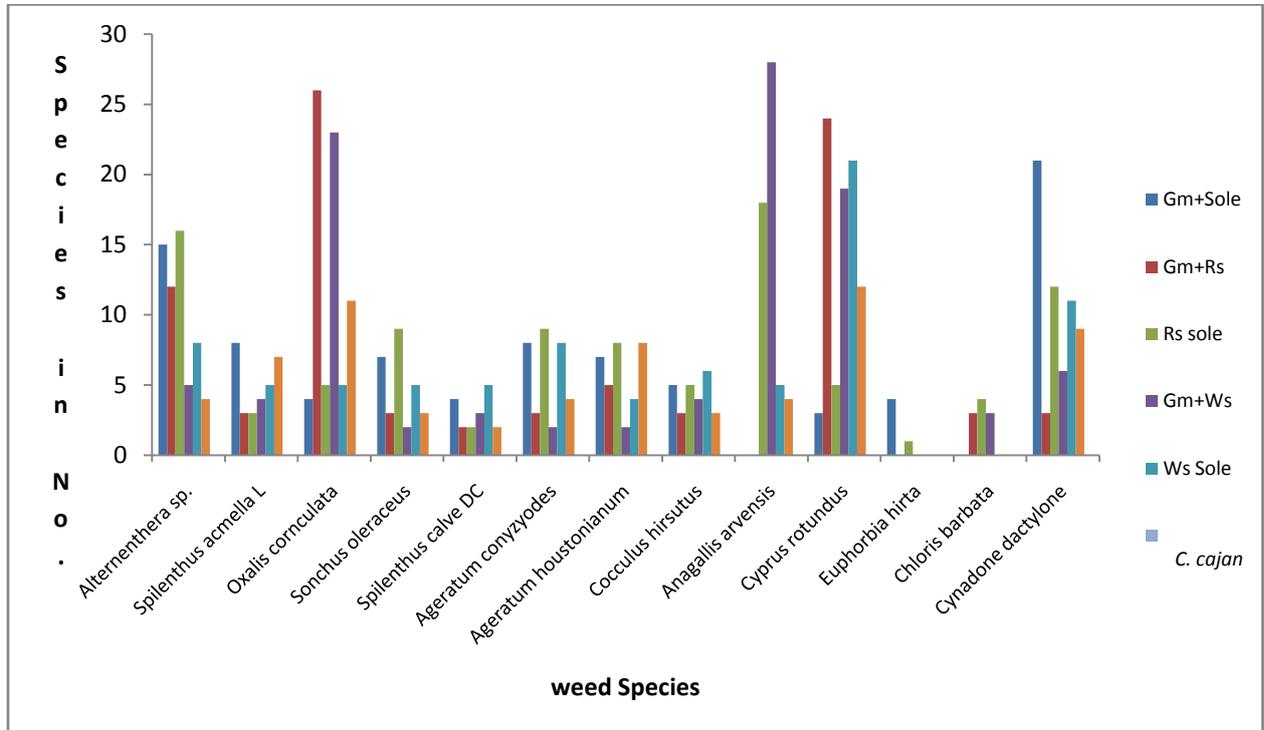
The effectiveness of intercropping for weed control depends on the type of crops chosen, their relative proportion and planting geometry.

A field study was carried out to calculate the weed diversity in *Gmelina* based silvi - agri medicinal system and in sole crop during the year 2015 at Tropical Forest Research Institute, Jabalpur (M.P.) which is having normal pH (6.96), rich in Organic matter (0.65% ), sandy loam soil and low in available Nitrogen (225.84 kg/ha) with Electrical conductivity (0.21  $\mu\text{s cm}^{-1}$ ). *Gmelina* based silvi-agri medicinal system with seven treatments viz. *G.arborea* + *Cajanus cajan*, *G.arborea* (sole), *G.arborea*+ *Ravoulfia serpentina*, *R.serpentina* (sole) , *G.arborea* + *Withania somenifera*, *W.somenifera* (sole), *C.cajan* (sole) were established. Weed abundance in 1x1 m<sup>2</sup> plot in each treatments of *Gmelina* based silvi -agri medicinal system were recorded.

The diversity of weeds was observed and species wise population was enumerated in different treatments of the system as shown in the Fig. 1 . A total of 13 weed species viz. *Alternanthera sessilis* L., *Ageratum houstonianum* *Ageratum conyzoides* L., *Anagallis arvensis*, *Chloris barbata*, *Cocculus hirsutus*, , *Cynadone dactylone* *Cyprus rotundus*, *Euphorbia hirta*, *Oxalis corniculata* ,*Spilenthus acmella* L, *Sonchus oleraceus*, *Spilenthus calve* DC was recorded in sole crop, out of which maximum of *Cyprus rotundus* (29) followed by *Oxalis corniculata* (28)

and *Anagallis arvensis* (26) while minimum density was recorded in the intercropped conditions. The intercropping of agri-crop with *Gmelina* based silvi-agri-

medicinal system not only controlled the weed infestation but also enhance the overall productivity of land base.



**Weed diversity in *Gmelina* Based Silvi -Agri-Medicinal System**



*Alternanthera sessilis* (Joyweed)



*Ageratum conyzoides L.* (goat weed) white flower



*Ageratum Houstonianum L.* (goat weed) purple flower



*Anagallis arvensis* (Blue pimpinell or jonkmari)



*Cocculus hirsutus L.*(Jaljamni)



*Spilanthus acmella L*(Akarkara)



*Chloris barbata* (finger grass)



*Oxalis corniculata* Yellow sorrel



*Cynodon dactylon* (dūrvā grass)



*Sonchus oleraceus* (common sowthistle)



*Cyperus rotundus* (nut grass)



*Spilanthus calve DC* Akarkara



*Euphorbia hirta* (asthma-plant)

Although weed is considered as obnoxious plant species but they may be useful in Ayurvedic drug due to its medicinal properties as shown in table 1.

**Table 1. Major weed species observed in the *Gmelina* based silvi-agri-medicinal system**

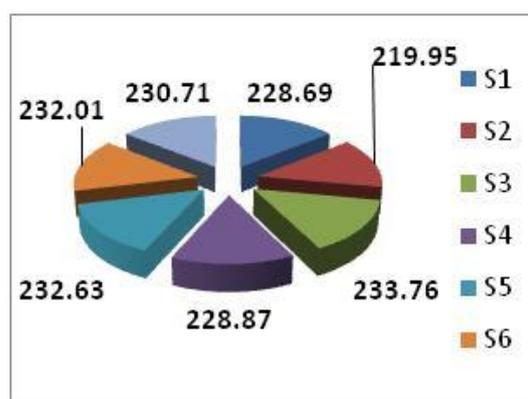
Scientific name	Family	Medicinal use
<i>Alternanthera sessilis</i> (Joyweed)	Papilionaceae	Night blindness
<i>Ageratum houstonianum</i> L. (Goat weed) purple flower	Asteraceae	Blood purifier, healing wound
<i>Ageratum conyzoides</i> L. (Goat weed) white flower	Asteraceae	
<i>Anagallis arvensis</i> (Blue pimpernel or jonkmari)	Scrophulariaceae	Leprosy, hydrophobia and epilepsy
<i>Cocculus hirsutus</i> L. (Jaljamni)	Menispermaceae	Fever and cooling for eyes
<i>Chloris barbata</i> (Finger grass)	Poaceae	Skin disorder, antibacterial
<i>Cynodon dactylon</i> (Dürvā grass)	Poaceae	Diarrhea and healing wounds
<i>Cyperus rotundus</i> (Nut grass)	Cyperaceae	Essential oil
<i>Spilanthus acmella</i> L. (Akarkara)	Asteraceae	Stammering
<i>Sonchus oleraceus</i> (Common sowthistle)	Asteraceae	-
<i>Spilanthus calve</i> DC (Akarkara)	Asteraceae	Toothache
<i>Oxalis corniculata</i> (Yellow sorrel)	Oxalidaceae	Skin disorder, fever
<i>Euphorbia hirta</i> (Asthma-plant)	Euphorbiaceae	Anti cancer, anti bacterial

Source: Bisen and Kunukanan, 2000

**Soil characteristics of the system**

Samples of the soil was collected, processed and analysed and tabulated during the period and data indicates the nitrogen level was maximum in S3 i.e. 233.76 kg/ha closely followed by S5 232.63 kg/ha and minimum was in S2 i.e. 219.95 kg ha<sup>-1</sup> of the system (Fig. 2).

In this silvi-agri-medicinal system , crop rotation and intercropping positively affects on weeds provides considerable evidence of the utility of these approaches for farmers who wish to maintain or increase crop yields by minimizing the use



**Fig.2. Status of Nitrogen (Kg/ha) under *Gmelina* based silvi-agri-medicinal system**

of herbicides and other agricultural chemicals. While it cannot be assumed that

increases in crop diversity will automatically improve weed control.

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## Management practices for conservation of biodiversity in Achanakmar-Amarkantak biosphere reserve

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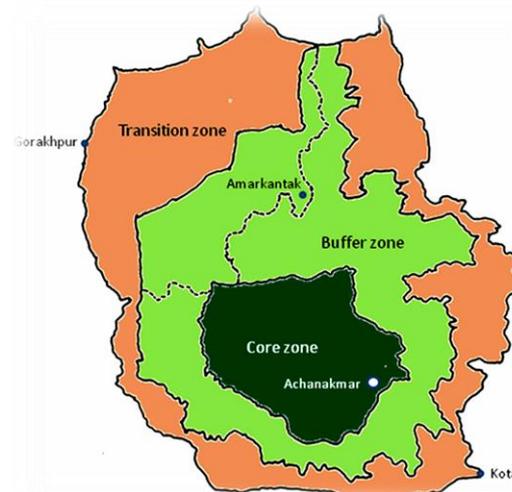
(Indian Council of Forestry Research & Education, Ministry of Environment, Forests and Climate Change, Govt. of India)

Jabalpur – 482021, Madhya Pradesh, India

Achanakmar-Amarkantak biosphere is a paradise of biodiversity. The forest area is about 63.19% and the vegetation of the Achanakmar-Amarkantak biosphere reserve is tropical deciduous type. The biosphere reserve is very rich with high density of flora and fauna. It comprises of 1734 species of identified flora, 389 species of identified fauna and many more undescribed floral and faunal taxa. Around 184 species of plants identified for their ethno-botanical uses. Plant species like the lichen, *Caloplaca amarkantakana*, fern, *Isoetes bilaspurensis* and an angiosperm, *Bothrichloa grahamii* are endemic to this region. Twenty eight threatened species of flora and 55 threatened species of fauna belonging to various groups have been identified and grouped into different threat categories regionally as well as globally as per IUCN criteria.

Management practices for conservation of biodiversity have directed towards developmental activities, such as habitat improvement, eco-tourism, eco-development, in-situ and ex-situ conservation of plant species, promotion of conventional energy, crop production, socio-economic upliftment of local peoples, social welfare activities, awareness and education, skill development and monitoring and evaluation. Development of grass meadows, construction of ponds/check dams and rehabilitation of degraded forests have increased the biodiversity of the area, both flora and fauna, including wild life.

Habitat improvement also reduces forest fire due to increase in soil water contents and rise of water table. Due to habitat improvement, regeneration of tree species, especially sal (*Shorea robusta*) and other medicinal plants is increasing every year. Ecotourism provided jobs to the inhabitants. The number of persons visiting the biosphere is increasing day by



**Total area – 3835.51 sq km**

**Core zone – 551.55 sq km**

**Buffer zone - 1955.87 sq km**

**Transition zone – 1328.09 sq km**

day. Income generation activities, such as mahul leaves collection, lac cultivation, honey collection, pisciculture, mushroom cultivation, vermi composting, collection of medicinal plants through SHG, training on driving, wood work, electric work, cooking etc. have changed the societal status of tribes. All the beneficiaries are happy to get additional income. This has resulted in better coordination among local people, forest officials and scientists of lead institute, TFRI, Jabalpur.

## Know Your Biodiversity

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### *Garrulax leucolophus* Hardwicke



*Garrulax leucolophus* also known as the White-Crested Laughing-Thrush. It is a member of the order Passeriformes and family Leiothrichidae. The White-Crested Laughing-Thrush is common resident of North East India, Bangladesh and Himalayas mostly between 760 m and 1500 m from about Shimla to the Assam Hills and down through the Myanmar into Tennasserim, Siam etc. There are total four races are recognized on difference in the extent of the white breast, grey in the crest, and other details.

The White-Crested Laughing-Thrush is large, with white crest and black mask. They also have contrast white throat and upper breast, grey nape, chestnut mantle and band across lower breast, and dark olive-brown wings and tails. It is Olive-brown from above with pure white head, crest. Broad black band are present through eyes to ear coverts and there is rich rufous nuchal collar, continuing around breast. They habitat around dense forest undergrowth and both the sexes are almost alike.

It keeps in flocks or 'sisterhoods' of six to ten birds which rummage amongst the mulch on the ground, flicking aside or turning over the dry leaves in search of insects. They also clamber up into the undergrowth and branches of trees. In many of their ways they are typical babblers. Their food consists of insects, but berries are also eaten. They are likewise fond of flower nectar. *Woodfordia* bushes, so characteristic of the steep-sided ravines they frequent, are in regular attendance when in blossom. The birds hop along the branches, and from branch to branch, probing into the flower tubes. They are noisy birds and keep up a harsh cackling conversation. From time to time, especially when disturbed, the 'sisterhood' burst into chorus of peculiar loud discordant laughter, which has earned the family name. One bird begins, and then one by twos, the other quickly chime in until the forest resounds with the tumult of the discord. The birds dance around and flap their wings in accompaniment.

Nesting season is from April to June. The nest is a large, shallow cup of coarse grass and bamboo and other leaves, wound round with creepers and pliant twigs, and lined with fine roots. It is placed in shrubs and small trees, from a few inches to 20 feet off the ground- usually low down- in forested ravines, open bamboo jungle or in overgrown forest clearings. The normal clutch is four to six eggs. They are broad ovals, sometimes almost round in shape,

pure white, very glossy but finely pitted over the surface. Both sexes share in incubation, which takes about fourteen days.

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km<sup>2</sup> combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). Despite the fact that the population trend appears to be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size has not been quantified, but it is not believed to approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

***Salvia moorcroftiana* Wall. ex Benth.**



*Salvia moorcroftiana* is native to Himalayan mountains. It is distributed from Pakistan to western Nepal, and common in the Kashmir Valley. In Himachal Pradesh it is found in Chamba,

Kinnaur, Kullu, Shimla and Solan districts. It grows between 1500-2700 m elevations on open slopes and wasteland. It belongs to order Lamiales and family Lamiaceae. It is commonly known by many names as Moorcroft's Sage, Kashmir Salvia, Gurgumma, Halu, Kallijarr, Papra, Shobri Thut and Tuth.

It is perennial herb covered with white, woolly or cottony hairs. Stems are of about 0.45-0.9 m in size. Leaves are thick, long-stalked, ovate or oblong, sinuately and irregularly lobed, crenate or sharply toothed. Upper surface is nearly glabrous or cottony tomentose, closely wrinkled while lower surface is white-tomentose.

Flowers are 2.5 cm long, pale blue, lilac or nearly white, in distant whorls. Bracts are large, pale green-veined, orbicular, abruptly pointed. Calyx are bristly, bell-shaped and teeth are spinous, upper lip is 3-toothed. Corolla tube is much longer than calyx; upper lip is long, curved, flattened and concave. The flowers are held in a hairy calyx, with showy green-veined bracts adding to the plant's charm. Flowering period is from May to June.

In Punjab and Himachal Pradesh most parts of the plants are used medicinally. Roots yield an essential oil and mucilage. It is used in cold and cough and locally it is used in stomach pains. Leaves are applied to the skin in case of itch and poultice in boils and wounds and chronic skin infections. It is also used for extraction of guinea-worm.

Seeds are used as an emetic and in case of haemorrhoids, colic and dysentery and applied to wounds. These are edible after peeling. The leaves are commonly used medicinally in Kashmir. The leaves are warmed with mustard oil and applied on the swollen skin to release puss, while the

inner part of the stem is chewed which is considered as an aphrodisiac agent. Edible part of *Salvia moorcroftiana* is peeled stem and local people occasionally eat them.

In cultivation, it prefers full sun, loose soil, good drainage, and regular watering. Although population of *Salvia moorcroftiana* seems stable but human settlements, grazing, mining, constructions of highways, drainage, dam building, etc are also affecting its natural habitat and its population. Due to such activities this species is moving elsewhere from its habitat and disappearing from its natural habitat. Hence protection of its natural habitat is very important for its conservation.

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