

CHAPTER- 5
SUGGESTIONS AND
CONCLUSIONS

5. Suggestions and conclusions

This chapter includes a discussion about the benefits derived from the plantation which can be enjoyed by mankind. It involves the necessities of promoting plantation in the mined out area. The conclusion drawn on the basis of the study has been described here. Some suggestions have been proposed which can further improve the reclamation process.

5.1. Economics of restoration

The five plant species selected in our research for restoring the OB dump, has lots of economic benefits which if commercialized; the local poor inhabitants will be enormously benefited. This will contribute towards the corporate social responsibility of the mining companies. The benefits derived from each plant species are described below.

5.1.1. Bamboo (D. Strictus)

India is the second largest producer of bamboo in the world next to China and also has the richest bamboo diversity in the world with 23 genera and 125 indigenous as well as exotic species (Verma and Bahadur, 1980). Due to its high utility, it is known as the “Poor man’s timber”, “Green gold of the forest” and “Friend of the people”. The young bamboo shoots are regularly harvested from the forest and used for food, fodder, primary construction materials and for making a variety of useful items. Traditional construction techniques of use of bamboo in flooring, roofing, as post and beam, and also in the false ceiling and fencing remain largely undocumented (Sundriyal et al., 2002). A study was conducted in Papumpare district situated in the central belt of the Arunachal Pradesh (Handique et al., 2010), a total of 20 most prominent bamboo craft products were recorded to be used by Nyishi community in the study areas. Almost all the bamboo was

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used for traditional craft works came from the individual plantation. The highest economic benefit of Rs. 2916.08 was reported. Since bamboo already offers some of the advantages of tree crops, it can be promoted to bring the status and security as tree crops. Compared to tree crops, bamboo can produce an economic return in a relatively short period of time. Furthermore, while trees grown for timber can only be harvested once, a bamboo clump can be harvested many times over (INBAR, 1995). With these advantages, overburdens must be vegetated with this species for restoration.

5.1.2. Peepal (F. Religiosa)

F. religiosa is a well-known ethnomedicinal tree used in Ayurveda. Its use in the Indian traditional folk medicine also well documented. The use of different parts of *F. religiosa* in the traditional system of medicine given in Table 5.1. Presently there is an increasing interest in herbal medicines all over the world. Numerous drugs have entered the international market through exploration of ethnopharmacology and traditional medicine (Patwardhan et al., 2005). Hence if such plants are adopted for ecological restoration, the poor human population in the vicinity of the mining area will get an alternate source of income other than coal smuggling.

Table 5.1 Ethnomedicinal uses of different parts of *F. religiosa*

Plant Parts	Traditional Uses (as/in)
Bark	Astringent, cooling, aphrodisiac, antibacterial against <i>Staphylococcus aureus</i> and <i>Escherichia coli</i> , gonorrhoea, diarrhoea, dysentery, haemorrhoids and gastrohelcosis, anti-inflammatory, burns (Warrier, 1996).
Bark Decoction	Cooling, gonorrhea, skin diseases, scabies, hiccup, vomiting (Kapoor, 1990).
Leaves and tender shoots	Purgative, wounds, skin diseases.
Leaf juice	Asthma, cough, sexual disorders, diarrhea, haematuria, toothache, migraine, eye troubles, gastric problems, scabies (Kunwar et al., 2006).
Leaf decoction	Analgesic for a toothache.
Dried fruit	Tuberculosis, fever, paralysis, haemorrhoids.
Fruit	Asthma, laxative, digestive (Warrier, 1996)
Seeds	Refrigerant, laxative (Warrier, 1996)
Latex	Neuralgia, inflammations, haemorrhages (Warrier, 1996)

5.1.3. Amla (*Phyllanthus emblica*)

This plant is an indispensable part of the ayurvedic and unani medication with remarkable remedial qualities (Singh et al., 2011). Amla is regarded as the sacred tree in India. The tree is worshipped as Mother Earth and is believed to nurture mankind by giving very nourishing fruits. Kartik Mahatma and Vrat Kaumudi orders, particularly worship this tree. The fruits, leaves, and bark are rich in tannins. Goyal et al. (2008) reported that Amla could be developed for preparing sugar based value added products i.e. jam and squash. Results of the present study clearly revealed high potential of this fruits in the field of processing and value addition. The cost of amla and ber products was found to be in the range of 18-66 Rs/Kg. So this concept can be used is also a tree of use.

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1.1.4. Ashok (Saraca asoca)

It is a small evergreen tree. Economic importances are wide. Bark astringent used in uterus infections. It has a stimulating effect on endometrium and ovarian tissue and is useful in menorrhagia due to uterine fibroids, in leucorrhoea and internal bleeding haemorrhoids, and hemorrhagic dysentery. Bark also contains oxytoxin. Flowers are used as uterine tonic and also to cure biliousness, hemorrhagic dysentery and diabetes. In general, it is considered as the best female tonic. Fruits are used as a substitute for areca nuts. Pods make good forage. The seeds are strengthening and the ash of plant is beneficial in external application in rheum-arthritis. The wood used for making plough and shafts. Though in the present study this plant did not show good growth, but if it is hardened before, it can be promoted well in the harsh conditions at the mining area.

5.1.5. Neem (Azadirachta indica)

Azadirachta indica has immense therapeutic properties. It is an evergreen tree found in India, Africa, and America. It is widely used to treat various viral and bacterial diseases. It has shown to have potential to cure AIDS (Bhowmik et al., 2010). Neem is a large evergreen tree as high as 15 to 20 meters with semi-straight and straight trunk 30 to 80 cm in diameter and spreading branches forming a broad crown. It has a long life of 100 years. Neem tree has several economic advantages over other multi-purpose tree species grown in India. Although the main use of the tree is for the production of seeds for extracting oil, the tree can be harvested for timber after 35 to 40 years of planting. The sapwood of Neem is grayish white and heart wood is red to reddish brown resembling *Mahogany*. The wood is fragrant, moderately heavy with uneven grains, robust and not easily attacked by insects. It is effortless to work with the timber but does not take a good polish.

Wood is used for building houses, as posts, beams, door/window frames, furniture, carts, axles, yorks, naves, ship and boat building, helms and oars, oil mills, cigar boxes, carved images, toys and agricultural implements. Among the forest produce, Neem is perhaps the only tree that has the potential of producing several items that can be exported, besides of course few medicinal plants obtained from the forest. That is why many developed countries like USA, Japan, Germany, France, and Netherlands have developed research laboratories exclusively for Neem, in spite of lacking in actual Neem resource. On the contrary, India has very high resources of Neem wealth with millions of trees scattered throughout the country, but most of it is yet to be explored commercially to the fullest. Hence this plant requires special attention in the reclamation process.

5.2. General economics of plantation

The benefits of trees can be grouped as social, communal, environmental, and economical. Under Social benefits, aesthetic aspect of trees is not enough. One feels tranquil, peaceful and restful in a grove of trees. Trees give homely warmth, a feeling of belongingness to nature. The calming effect of nearby trees can appreciably reduce workplace stress levels and fatigue. It can calm traffic and even decrease the recovery time needed after surgery. A very unique finding suggests that trees can also reduce crime (Troya et al., 2012). Apartment buildings with high levels of green space have lower crime rates than nearby apartments without trees. The stature, vigor and endurance of trees give them a holy quality. Because of their long life, trees are normally planted as living memorials. We often become personally attached to trees that we have planted. The strong tie between people and trees is often evident when community residents

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protest against the felling of trees to widen streets or rally to save a particularly large or historic tree.

Benefits to the community are innumerable. When located on a private lot, the benefits provided by trees can reach well into the surrounding community too. With proper selection and maintenance, trees can function on one property without disturbing the rights and privileges of neighbors. City trees often serve several architectural and engineering functions. They provide privacy, highlight views, and screen out objectionable views. They lessen glare and reflection. They direct pedestrian traffic. Trees also provide background to and soften, complement, or enhance architecture. Trees bring natural elements and wildlife habitats into urban surroundings, all of which improve the quality of life.

Trees alter the environment live by creating micro-climate, improving air quality, increasing storm water infiltration, and harboring wildlife. Local climates are protected from extreme heat, wind, and rain. Radiant energy from the sun is absorbed or deflected by tree leaves during summer and is filtered by branches of trees in winter. The larger the tree, the greater the cooling effect. By afforestation in the cities, the heat-island effect caused by concrete pavement and buildings can be decreased. Wind speed and direction is affected by trees. The more compact the foliage on the tree or group of trees, the more effective the windbreak. Rainfall, sleet, and hail are absorbed or slowed by trees, providing some protection for people, pets, and buildings. Trees intercept water, store some of it, and reduce storm water runoff. Air quality is improved through the use of trees, shrubs, and turf. Leaves filter the air we breathe by removing dust and other particulates. Rain then washes the pollutants to the ground. Leaves absorb the greenhouse

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gas carbon dioxide during photosynthesis and store carbon for growth. Leaves absorb other air pollutants such as ozone, carbon monoxide, and sulfur dioxide and release oxygen. By planting trees and shrubs, developed areas become more eco-friendly that can harbour wildlife. Ecological cycles of plant growth, reproduction, and decomposition are again present, both above and below ground.

Economic Benefits are as follows. Property values of landscaped homes are 5 to 20 percent higher than those of non-landscaped homes. Individual trees and shrubs have value, but the variability of species, size, condition, and function makes determining their economic value difficult. The economic benefits of plantation are both direct and indirect. Direct economic benefits are usually associated with energy costs. Air-conditioning costs are lesser in a tree-shaded home. Heating costs are less when a home has a windbreak. Trees increase in value as they grow. The indirect economic benefits of trees are even better. People pay lower electricity bills when power companies build fewer new facilities to meet peak demands, use reduced amounts of fossil fuel in their furnaces, and use fewer measures to control air pollution. Communities can also save money if facilities are built to control storm-water in the region. To the individual, these savings may seem little, but to the community as a whole, reductions are often considerable.

Trees provide abundant aesthetic and economic benefits, but also incur some costs. Investing in a tree's maintenance will help to return the benefits, one desires. The costs associated with large tree removal and replacement can be considerable. In addition, the economic and environmental benefits produced by a young replacement tree are minimal when compared to those of a mature specimen. Extending the functional lifespan of large,

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mature trees with routine maintenance can delay these expenses and maximize returns. Corrective pruning and mulching give young trees a good start.

5.3. Conclusions

As observed during the survey, the lifestyle of the people was directly related to the resources of nature. As the natural resources deteriorated so did their lifestyle. Jharia coalfields also suffer from anti-social activities. The poor inhabitants exposed to risks and poverty are compelled to get involved in the illegal selling of coal. Land degradation is so massive (due to coal fire and other demands) that land degradation is at its highest level. Due to this agriculture and forestry are highly neglected as soil has low productivity.

The present study was done to find some solution to this rapid land degradation. Short-term studies were preferred to conclude quick results. As an outcome of this research, four plant species namely *A. indica*, *P. emblica*, *F. religiosa* and *D. strictus* were found as good growers in stressed sites of Jharia Coalfields. Bamboo showed good association with the VAM which proves that it is a good grower in such sites. *S. asoca* needed some care before exposure to the hostile soil environment.

All the five plants have their different utilities. If the plantation is commercialized, these areas can be used to uplift the standard of the local inhabitants. This research also indicated that soil amendments were required to boost up the soil fertility. However, agriculture soil though commonly used as amendments should not be preferred as its storage needs huge space and is a valuable asset which should be transferred to the agriculture plots directly rather than using it on overburden dumps. Maintenance of top

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soil also requires money which is another discouragement towards its usage. Cow dung was a very good alternative. The addition of cow dung improved the enzymatic activity namely Dehydrogenase and Catalase in the plant rhizosphere. Also cow dung is very economical and easily available. The mycorrhizal association can be promoted by using tablets which can be procured easily and cost effectively without wasting time on culturing them.

The cost of procuring these plants and labor charges were approximately Rs. 20,000, which is so less for a mining company to invest in restoring the disturbed sites. Maintenance and labor charges can serve as another alternative source of livelihood for the poor inhabitant. Aesthetics can be developed along with the economics in Bastacola dump. Also, investment on bamboo will be encouraged because then it will be very cheap and harvesting is also desirable as the area suffers from the coal fire. So exploitation of the underlying coal seam will be preferred. Bamboo litter decays rapidly which makes it further suitable for restoring such infertile soil.

Restoration of coalmines is a big issue due to the involvement of money, time and labor. However, the present study has been able to handle these problems effectively. This study is of global importance and significance. Most of the aspects have been covered here, which are useful tools to decide plant species for restoration. Also, the poor people living in such degraded landforms will be benefited by this research in terms of economics and aesthetics. Its finding can be used throughout when any restoration proposal is made for the collieries.

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Most importantly, the age of the plant species should be taken into consideration while drawing any conclusion. Plant age has lots of significance in deciding the behavior towards abiotic factors. With growing age plants require more nutrients which is a well-documented plant nutrition principle described by Mengel and Kirkby (1987). So the nutrients taken up from the soil may lead to addition of amendments in later stages. The microbial counts and communities also change a lot with the influence of root growth (Martin, 1971). There will also be non-uniformity in the microbial growth and pattern. The plants which will grow fast will have high microbial population at their rhizosphere. With these factors in mind it is proposed that the present study was on saplings and the results found can be extrapolated in future. However, due to change in plant developmental stages, their behaviors as seen in sapling stages may change in adult stages. All the five plant species that were used in our study, would take 10-20 years to attain maturity. A plant's response and behavior towards the environment may change after attaining maturity, but, for us the response of sapling stage towards the harsh environment was required to be studied because if at this stage the plants cannot survive, then they will never attain maturity. Their behavior may change after attaining maturity. Thus our present finding may vary with their response in future. Also they may never attain adulthood and may be uprooted to exploit the coal seam lying underneath the restored dump. However, if they attain maturity then economic benefits to the localities and stake holders will be considerable. To get short and long term benefits these robust species were selected.