# Utility Value for the Sustenance of Local people in the Selection of Species for Bio-reclamation of Silica Mining Area

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## Introduction

The Shankargarh area of Allahabad District of Uttar Pradesh State in India has been gifted with huge resources of high quality Silica sand. It is one of the most versatile industrial minerals of the present century being used as glass sand, foundry sand, abrasives, fillers and hydraulic fracturing sand. In view of the good variety and soaring value of the Silica sand deposits found here, it has gained wide economic importance and recognition as a major source of Allahabad district revenues.

Mining operation, undoubtedly, has brought wealth and employment opportunity in the area but simultaneously it has also led to extensive environmental degradation and erosion of traditional values in the society. Therefore, a holistic integrated organic and socioeconomic approach is required to bioreclaim the site which involves restoration of soil health, nutrient supplementation through intelligent and optimum use of biofertilizers, judicious choice of tree species and active willing community participation.

Bioreclamation primarily aims to accelerate natural vegetation succession processes by assisting natural regeneration and artificial regeneration or plantation of selected site with specific suitable socioeconomically beneficial species, so that the entire plant community develops in the desired way over a period of time. The decision of what species to plant is, therefore, most important. Deciding what species to plant has two main aspects. The first aspect of species choice is knowledge about the purpose for which the trees are intended for viz. timber, fodder, fuelwood and softwood etc. This influences the choice because each species has specific blend of attributes and utilities to bring forth. The second aspect of species choice is identification of species which would grow well on the site in question. The selection of species should, therefore, be based on the site conditions and local populace needs. Ignoring perceptions of local people in the beginning of planning phase, which includes the selection of planting species for afforestation, is one of the major impediments for successful implementation of afforestation programmes (Maikhuri *et. al.*, 1997).

Nitrogen fixing native leguminous tree species in a mined land system can result in better soil structure and increased soil nutrient availability. For bioreclamation purposes, indigenous species are preferable to exotics because they are most likely to fit into a fully functional ecosystem and be climatically adapted too (Singh *et al.* 2002). Moreover, vegetative material used in bioreclamation should consist of trees which are consistent with site capabilities such as soil structure and composition, soil depth, pH, available nutrients, drainage and climate. Such vegetation should be so designed as to provide a protective land cover consistent with the stated land-use objectives and which does not constitute a health hazard as well. At the same time, the selected plant species must also fulfill the basic sustenance needs and multiplicity of socio-economic demands of the local people.

## Methodology

In the above backdrop, it is now very clear that the most critical element in any bioreclamation project is the cautious selection of appropriate plant species. If the plants are not adapted to the site conditions and do not provide for local inhabitants' basic daily needs and utilities, all bioreclamation efforts are bound to fail. Accordingly, a variety of factors like site conditions, knowledge of indigenous floral diversity of the site and preferential choices of

**Table 1:** Utility Value of Leguminous Tree Species in Local Forests of Shankargarh Silica Mining Area:

| Tree species | Utility Value | Ranking (according to utility value) |
|---|---|---|
| *Pongamia pinnata* | 1. Fodder, 2.Apiculture, 3.Fuelwood, 4.Paper pulp, 5.Timber (for cabinet. making, cartwheels, posts, agricultural implements, tool handles and combs), 6. Tannin and dyestuff, 7.Seed oil of commercial use (as a lubricant, varnish, water-paint binder and in soap making and biofuel), 8. Pesticidal activity, 9. Medicine, 10. In India, the tree is a host for the useful lac insect, 11. As a windbreak, 12. Shade , landscape, and moisture conservation. | 1st |
| *Albizia procera* | 1. Fodder, 2. Fuelwood, 3. Paper pulp, 4.Timber, 5.Gum and resin, 6.As Medicine, 7. Insecticidal property, 8. Acts as a wind and firebreak | 5th |
| *Pithecelobium dulce* | 1.Food, 2.Fodder, 3. Fuelwood, 4. Medicinal | 7th |
| *Acacia nilotica* | 1.Fodder ,2. Apiculture, 3. Fuelwood, 4.Charcoal, 5.Paper and pulp, 6.Timber, 7.Gum and resin, 8.Tannin and dyestuff, 9. Have Algicidal and Fungicidal activity, 10. As Medicine, 11. As ideal windbreak and firebreak | 2nd |
| *Acacia catechu* | 1. Fodder, 2. Fuelwood, 3. Charcoal, 4. Timber, 5. Tannin and dyestuff, 6. Gum and resin, 7. Fungicidal activity, 8.Medicine, 9.Extraction of katha, 10.Used for lac cultivation | 3rd |
| *Dalbergia sissoo* | 1. Fuelwood, 2. Fodder, 3. Paper pulp, 4. Timber, 5. Apiculture | 6th |
| *Prosopis juliflora* | 1. Fodder, 2.Fuelwood, 3.Charcoal production, 4.Apiculture. | 7th |
| *Acacia leucophloea* | 1.Fuelwood, 2.Charcoal production, 3.Medicinal | 8th |
| *Butea monosperma* | 1. Fodder, 2. Fuelwood, 3. Gunpowder Charcoal, 4. Fibre for making paper, 5. Gum or resin, 6.Orange-red dye , 7. Bactericidal and Fungicidal activities, 8. As Medicine, 9. Important host for Lac cultivation. | 4th |

local people should be considered in the selection of species for Bioreclamation. Site characteristics, soil properties and its fertility status are very important factors to consider while selecting plants for Bioreclamation.

Since the study site is low in soil nutrients, self-propelling Nitrogen fixing tree species are ideal candidates for afforestation of such lands. Moreover, the selected species should be able to establish themselves in poor soil and moisture stress conditions of the site. The native species possess adaptations to extreme substrate, moisture and climatic conditions of ruined mine sites resulting in fast recovery of the degraded ecosystem. Therefore, only native leguminous tree species were preferentially selected. The choice of the local people is also an important factor in the selection of species. For local needs, a tree species with several attributes or a mixture of tree species can be planted to obtain multiple utility benefits e. g., ability to enrich soil fertility, wood suitable for fuel and poles and nutritious leaves for fodder etc. The selected species should be of multiple utility value features and should also be able to ease the economics of local people especially the poor, living below poverty line (BPL). Subsistence utility benefits and preferences of tree species guided by the local people were the major acclaimed and convincing reasons in the selection of tree species. Thus, Utility Value concept was developed so as to identify species preferred and also highly valued for sustaining their enduring livelihoods by the local people.

For the above purposes, Phytosociological Study of the fringe forests and Socioeconomic Survey were carried out in the nearby villages of Silica mining area to study the existing resources of the area, social structure of the community, employment patterns, income generation, dependence on forest and species preferred by the local people along with information on other related socioeconomic aspects. The study was performed in Shankargarh area by using Participatory Rural Appraisal (PRA) exercise. The Utility Value of all the leguminous tree species reported in local forest areas of the site was prepared according to various multifarious utility needs of these species for sustaining the livelihoods of local people (Biggelaar and Gold, 1996, Kumar and Bhatt, 2006; Guerrero *et. al.*, 2008). Ranking of each of the species was done according to their Utility Value to local people, as obtained from sum total of all the constituent attributes of every species as shown in the Table 1.

## Results and Discussion

Shankargarh is a backward area despite the rich Silica sand mineral resources it has and revenues the Uttar Pradesh State receives from mining of these rich mineral resources. Mining is a capital intensive activity of the area having a rather low level of other economic activities, e.g., agriculture, horticulture and forestry etc. The socioeconomic profile of the local people was obtained from Participatory Rural Appraisal (PRA) technique. The majority of the people are Schedule Tribes (ST) by caste popularly known as Kol. Most of them are landless labourers and therefore, they are placed at the bottom of the social heap and rely mainly on mining and exploitation of available natural resources to somehow drive their household economy. For their recurrent subsistence needs of fuel wood and fodder, they mainly depend on nearby forests. The source of fuel wood is basically dry branches of *Butea monosperma, Acacia nilotica* and *Prosopis juliflora* species etc. from local forests and homemade dried up cow dung cake. The main livestock were cows and goats. Due to non availability of agriculture products, the fodder sources for livestock are wild grasses, leaves of *Zizyphus* sps. *Acacia* sps., *Carissa carandus* etc. and in dry seasons, leaves of *Pongamia pinnata* and *Butea monosperma* from nearby forest or by free grazing and browsing in the forest areas. The unrestricted collection of fuel wood, fodder and grasses is affecting the natural ecological succession and restoration. Fruits of *Emblica officinalis, Carissa carandus* and *Zizyphus mauritiana* were consumed by local people. Leaves of Butea monosperma, locally known as Dhak or Palash, were used for making country cups and plates by the local people for their daily sustenance. A bright orange coloured natural dye is prepared from the flowers of *Butea monosperma*. Its seeds were used in folk medicine. This tree is also used as host plant for lac cultivation.

Despite a natural wealth of Non Timber Forest Produces (NTFPs) in the adjoining forests, people were generally found to be ignorant of their utilization values. They were not satisfied with the availability of fuel wood, fodder and small timber. Therefore, fulfillment of people's daily basic requirements of fuel, fodder and small timber were highlighted as the most important considerations among the respondents for taking up any plantations and vegetation establishment in the area. So, the species meeting these subsistence requirements were preferred by most of the people. Acacia nilotica locally known as Desi Babool was accepted by local people as a good source of tree based fodder, fuel wood and small timber. Its seeds have commercial value. *Acacia catechu*, locally known as Khair, was preferred because of its economic importance of NTFPs. *Pongamia pinnata*, locally known as Karanj or Kanji, was preferred for bio fuel, fuel wood, fodder, small timber, shady nature and as lac host etc. Local people typically narrated all these several utility criteria in Socioeconomic Survey interviews and discussions conducted for Bio-reclamation so as to choose and select people's preferential tree species for planting. Almost all tree species found in nearby village areas were rated as basically preferred species for firewood, fodder as well as for small timber values only, because of little or no choice available for any viable timber yielding species in the study area. This is also supported by the findings of Grundy et. al. (1993), Lykke (2000) and Kala (2007).

The local floristic composition is an important deciding factor in the selection of species to be planted. In the local forest area, a total of nine leguminous species were reported which were *Butea monosperma* with highest predominance, followed by *Acacia leucophloea, Prosopis juliflora, Dalbergia sissoo, Acacia catechu, Acacia nilotica, Pithecelobium dulce, Albizia procera* and *Pongamia pinnata*. These leguminous tree species may be selected for bioreclamation depending on their site suitability, NTFP values and preferential choices of the local people. The Use Value of each of the nine leguminous species was portrayed as per their local uses and commercial values and ranked according to their utility values as shown in Table 1. Accordingly, *Pongamia pinnata* has maximum local utility value followed by *Acacia nilotica, Acacia catechu, Butea monosperma, Albizia procera, Dalbergia sissoo, Prosopis juliflora, Pithecelobium dulce* and *Acacia leucophloea*.

These species are native, ecologically viable, environmentally suitable symbiotic Nitrogen fixing tree species and, since these species are important part of the livelihood of local populace, socially acceptable also. Their high use value has an added socioeconomic advantage to competently support the livelihoods of the local community too. All these species are having fuel wood, fodder and small timber values which are most important subsistence forest products for most of those local people who predominantly depend on forests. They use dry branches of these species as fuel wood. *Acacia catechu* is considered to be a good fodder tree and is extensively lopped by local people to feed their livestock. Branches of *Acacia nilotica* are also commonly lopped for fodder and its dry pods are used as a supplement to animal diet. Young leaves of *Butea monosperma* are good fodder and green leaves of *Pongamia pinnata* were used as fodder in scarce dry seasons. Being symbiotic leguminous trees, they have the capacity to enrich soil with Nitrogen and help in the establishment of natural biological systems that cycle important mineral nutrients of soil which is extremely critical to the development of permanent vegetation and stable forest ecosystems on mined sites. Leguminous trees are being suggested for reclamation programmes due to their ability to develop associations with Rhizobia and Mycorrhizal fungi (Marques *et al.* 1997). Moreover, selecting the native species has certain unique advantages as these are well adapted to the local environment and thus may be less susceptible to site stresses, serious disease and pest damage. Local people are more familiar with their native plants and have more use values from them also (Hoskins, 1979). Similarly, the timber of native species is likely to be known to local wood based industries too. Further, use of native trees contributes to the conservation of native flora and fauna (Evans, 1982). Local native species are the best options for reclamation as they are adapted to

the low soil fertility and variable climatic conditions of the degraded site and persist during summers and droughts too (Windsor *et al.* 2000). Moreover, native species may also be preferred in support of restoration for ecological and economic reasons, as they may require less long term maintenance (Kramer *et al.* 2000). Kala (2007) studied ethno-botanical species of local preferences in the Indian Himalayas for a holistic environment around human settlements and re-vegetation of degraded lands through community involvement in the selection of key species and their conservation.

It is now a well-known recognized fact that environment, ecology and development must be optimally harmonized and balanced in order to meet the progressive Socioeconomic and ever increasing safe Environmental Subsistence needs of the society. Involvement of the local people in the beginning of the planning stage itself is a key step for the successful implementation of Bio-reclamation programmes for any degraded land rehabilitation. Therefore, Sustainable Bio-reclamation of mined areas invariably needs a participatory community approach and without involving the local people, it is very difficult to reclaim such degraded mining sites. Selection of native Nitrogen fixing leguminous species, with high utility value i.e. the Utility Value Index (UVI), will also be much helpful for sustainable bio-reclamation of such Silica mining sites. Local community should also be properly informed about all the characteristic utility values of these species, so that Bio-reclamation objectives and socioeconomic development of people inhabiting nearby mining areas can be achieved simultaneously.

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