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# Reclaiming Degraded Land in India Through the Cultivation of Medicinal Plants

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**Abstract:** Despite having only about 2.4% of the total land area India accounts for nearly 8.0 % of the biodiversity of the world. Though having great biodiversity, a very large part (20.16%) of total geographical area of the country is occupied by the degraded land. Adoption of inappropriate soil and crop management practices following grassland cultivation exacerbated processes of land degradation resulting in rapid expansion of land desertification in semi arid region of the world including India. Indigenous plant species have proved successful in environmental rehabilitation because of their adaptation to local conditions. Furthermore, many medicinal plant species have spread globally both via intentional and carefully planned transfer and as the unintentional outcome of people's movements. The demand of Indian medicinal plants has increased over the years in the international market. To meet out the demand of medicinal plants at international market we should use degraded lands of the country, this practice will help to save the crop land from overburden, different researches explain that the cultivation of various medicinal plants helps to reclaim the degraded lands.

**Key words:** Degraded land · Reclamation · Medicinal plants

## INTRODUCTION

Land, a non-renewable resource, is central to all primary production system. Over the years, the country's landmass has suffered from different types of degradations. In the widest context, land not in its original undisturbed state is referred as degraded or damaged land. In the utilization context, land degradation means loss of biological agricultural productivity or erosion in the land's capacity to support desirable vegetation (i.e. crops, forests, pastures) and to maintain the yield level over the years of use. Man induced environmental stresses change the pattern of nutrient cycling, primary productivity and biodiversity. Land degradation may also result from population growth, industrial development, deforestation, mining and grazing, environmental pollution changes in agriculture and forestry practices, overgrazing, over-exploitation and soil erosion and solicitation land degradation can assume different levels viz; partial or complete destruction of vegetation or loss of soil mantle by erosion.

The initial step in ecosystem rehabilitation projects is to identify the most important constraints to crop or tree productivity, as well as defining the specific land restoration objectives some soils can be recovered through the use of fertilizers; others need more drastic rehabilitation of extreme degradation where soil cannot be recovered at all. In the developing countries like India due to high population rate there is extreme pressure on crop lands and simultaneously in recent years the demand of Indian medicinal plants species is increasing day-by-day therefore we will have to explore the methods of implanting medicinal plants in degraded land, most of the studies reveal that plantation of medicinal plants in degraded lands also help in reclaiming the degraded lands.

**Reclamation of Degraded Land Through Cultivation of Medicinal Plants:** India accounts for nearly 8% of the biodiversity of the world despite having only about 2.4% of the total land area. This makes it as one among 12 mega diverse countries of the world. In spite of having great biodiversity, a very large part (i. e. 20.16 % of total geographical area) is occupied by degraded land [1].

Land degradation may be defined "alteration to all aspects of the natural (or biophysical) environment by human actions, to the detriment of vegetation, soils, landforms and water (surface and subsurface, terrestrial and marine) and ecosystems". Soil degradation is defined as a loss or reduction of soil energy [2,3].

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The effects of land use change on soil degradation or restoration can be evaluated by comparing changes in some selected soil properties such as organic C and nutrients. Generally, cultivation of grassland is accompanied by losses of soil organic C and nutrients, which indicated land degradation. A glove analysis of soil C loss following cultivation of grasslands indicated a 20% reduction of the initial organic C. Similar analysis estimated a 30% soil organic C from the entire soil column with in 20 years following cultivation, with the majority of this loss occurring with in the first 5 year . Adoption of inappropriate soil and crop management practices following grassland cultivation exacerbated processes of land degradation resulting in rapid expansion of land desertification in the semiarid region of north China [4-7]. About 85% of plantation forestry in the tropics is dominated by three genra: *Pinus, Eucalyptus and Tectona,* while there may be thousands of indigenous species suitable for similar purposes . The increase in land cover of natural vegetation areas in addition to the appearance of new land uses, as well as the abandonment of grazing and pine aforestation in old fields, has favored the increasing widespread nature of wildfires. This drift in human activities could lead to the degradation of dry lands [8-12].

In arid and semi-arid lands of Spain rainfall and soil water availability for plants has been described as one of the most decisive factors controlling productivity and heterogeneity in plant distribution and life-forms . The initial step in ecosystem rehabilitation projects is to identify the most important constraints to crop or tree productivity, as well as defining the specific land restoration objectives. Some soils can be recovered through the use of fertilizers, others need more drastic rehabilitation techniques and there are situations of extreme degradation where soils can not be recovered [13-15]. The effect of land abandonment on soil restoration may be dependent on the soils and climatic conditions of the area. Soils under favorable climatic conditions that sustain plant cover may improve with time by accumulating organic material, increasing floral and faunal activity and decreasing erosion potential. Where vegetation recovery is slow and erosional processes may be active, the soil restoration of the abandoned lands may be a very slow process or irreversible the restoration time of degraded ecosystem is also related to how serious and how much it has been disturbed [16-18]. In recent years the concept of high density plantation system has gained immense interest in order to efficiently combine and utilize the land, labour and water resources for meeting immediate requirements of rural communities for wood fuel, fodder and timber, including other minor forest produce. High density plantations of tropical species had been under taken in a few species such as Eucalyptus, Mesquite, L*eucaena leucocephala* and *Terminalia arjuna* [19-25].

Indigenous species have proved successful in environmental rehabilitation because of their adaptation to local condition. In the Thar Desert and Sahel regions the low successes of tree planting trials for the rehabilitation of these ecosystems have been attributed to the poor performance of exotic species in comparison to the indigenous species [26, 27]. Improvement of soil water by appropriate water-harvesting methods, careful selection of tree and shrub species that tolerate saline soils is important in the rehabilitation of saline soils in arid range lands, for increased productivity. The potential of some leguminous trees for rehabilitation of degraded environments. A marked improvement in biogeochemical characteristics was reported, including that of the mycoflora of sodic wastelands. The use of trees for rehabilitating marginal sites is a well- known forestry practice. Techniques for rehabilitating such sites in the temperate zone have been described by many workers [28-34].

The reintroduction of native plant species is a widely used practice for reclaiming degraded lands in semi arid Mediterranean areas. Revegetation programs based on the planting of native to shrubs help conserve biodiversity and prevent erosion and desertification of arid and semi arid landscapes. There is a long history of research on the reclamation of degraded and disturbed land and although few of these studies have focused on the effects of amendments on C budgets there is reason to believe that new C management strategies could enhance C sequestration on such lands worldwide, for example, nearly $2 \times 10^9$ ha of lands are considered to be degraded to some degree and may be capable of sequestering as much as 3 PgC $yr^{-1}$ [35-41]. Medicinal plants represent by the number of species used, the widespread nature of their use and their contribution to human health, perhaps one of the most significant ways in which humans directly reap the benefits provided by biodiversity . Most of the people depending on traditional medicine live in developing countries and it has been estimated that between 60 and 80% of people worldwide rely mainly on traditional herbal medicine to meet their primary health care need. Since ancient times medicinal plants have been harvested from the wild and cultivated in home gardens across the world. Furthermore, many

medicinal plant species have spread globally both via intentional and carefully planned transfer and as the unintentional outcome of people's movements [42-48]. Out of 17,000 plant species the classical systems of medicines like Ayurveda, siddha and unani make use of only about 2,000 plants in various formulations. About 400 plants are used in regular production of Ayurvedic, Unani, Siddha and tribal medicine. About 75% are from tropical and 25% from temperate forests. 30% of preparations are roots. 14% bark, 16%, whole plants, 5% flowers, 10% fruits, 6% leaves, 7% seeds , 3% wood, 4% rhizomes and 6% stems. Only less than 20% (including spices) are cultivated [49].Though India is endowed with a rich wealth of medicinal and aromatic plants, but despite the rich heritage of knowledge on the use of plants drugs, little attention had been paid to grow them as field crops in the country [50].The demand of Indian medicinal plants has increased over the years in the international market. World Health Organization (WHO) has estimated the present demand for medicinal plants is approximately US $ 14 billion per year according to an estimate of WHO , the demand for medicinal plants is likely to increase more then US $ trillion in 2050 . To meet out the demand of medicinal plants at international market we should use degraded lands for their cultivation. This practice will help to save the crop lands from overburden different researches explain that the cultivation of various medicinal plants helps to reclaim it. Therefore this practice will be solving two purposes [51]. 'Prospects of cultivation of aromatic crops on salt affected wastelands' selection of suitable crops is of great economic impotence in exploiting sodic lands and put them to use under proper management. The experiments carried out at CIMAP research farm, Lucknow as well as Banthara research station of NBRI, Lucknow and demonstration trials on cultivation to some of the crops under wasteland development programs are Achramau farm of U.P. Bhumi Sudhar Nigam, Lucknow confirm the prospects of cultivation of some of the aromatics crops on sodic lands.*Palmorosa (Cymbopogon martini), Lemmon grass (Cymbopogon flexuosus) and Vetiver (Vetiveria zizanioides)* among aromatic grasses and also the *German chamomile (Matricaria chamomilla)* are the promising crops for cultivation on such soils [52]. 'Degradation of land in Raniganj coal field' selected plants species for vegetation / aforestation. Recommended species of plantation such as *Acacia auriculiformis, Acacia nilotica, Azadirachta indica, Bauhania purpurea, Butea superba, Dalbergia sissoo, Gmelina arborea, Eucalyptus eretocorus, Madhuca indica, Saraca asoka, Tamarindus indicus, Terminalia arjuna, Aegle marmelos, Carica papaya, Terminalia bellerica, Terminalia arjuna,* etc [53].Biological diversity and soil quality under plantations on degraded land was evaluated through. The plantation of *Phyllanthus emblica* L. and *Azadirachta indica* A. Juss. was done at 2X2 $m^2$ spacing during 1982 and 1989 respectively and was during found the present investigation that number of ground flora species, diversity index, population of bacteria, fungi, nematodes, micro arthropods and vesicular - arbuscular mycorrhizal fungi spores are more under plantation than that of unplanted open Bhata land. The soils under plantation have significantly better fertility status. Available N, P and K increased up to a magnitude of 116.66, 110.47 and 95.73 percent respectively [54].

'Reclamation of degraded soil through tree plantation-litter and fertility change' was evaluated forthe relative efficacy of plantation of different tree species in improvement of high pH soil. The 12 tree species studied in general were effective in bringing about improvement in the soil properties as reflected by the changes in pH, EC, organic carbon, available nitrogen, phosphorus and potassium. Higher available N, $P_2O_5$ and $K_2O$ as well as higher organic carbon percentage were noted under canopy of *Albizia procera* followed by *Leucaena leucocephala*. The pH and EC were lowest under *Albizia procera* and changes were observed from 8.7 to 7.7 and 0.76 to 0.40 dS $m^{-1}$, respectively in the span of 12 years. *Albizia procera* produced maximum litter fall (13.95 t $ha^{-1}$ $year^{-1}$) followed by Leucaena *leucocephala* (13.25 t $ha^{-1}$ $year^{-1}$) plantation. The nutrients returned through litter fall followed the order N>K>P in all the tree species and was helpful in reclamation of high pH soils [55].

Table 1: Category wise percentage of degraded land as on 2000 as percentage of total degraded land in India.

| | |
|---|---|
| Gullied and or ravenous land | 3.22 |
| Upland with or without scrub | 30.40 |
| Water Logged and marshy Land | 2.58 |
| Land affected by Salinity / Alkalinity - Coastal / Inland | 3.22 |
| Shifting Cultivation Area | 5.50 |
| Under Utilized Degraded Notified Forest Land | 22.02 |
| Degraded Pastures / Grazing Land | 4.07 |
| Degraded Land under Plantation Crops | 0.90 |
| Sands - Inland / Coastal | 7.84 |
| Mining and Industrial Wastelands | 0.20 |
| Barren Rocky / Stony Waste / Sheet Rocky Area | 0.12 |
| Deep Slopping Area | 1.20 |
| Now covered and or glacial Area | 8.73 |

Note: Total wasteland as a percentage of geographical area is 20.16
Source: 1: 50000 scale wasteland maps prepared from Landsat [60]

Table 2: Land use classification -All India

| | 1990-91` | 1997/98 (P) |
|---|---|---|
| Classification | Million Hectares (%) | MillionHectares (%) |
| Geographical area | 328.73 | 328.73 |
| Reporting area or land | 304.86 | 304.92 |
| Utilization statistics (1 to 5) | | |
| 1. Forests | 67.80-22.2 | 68.85-22.6 |
| 2. Not available for cultivation (A+B) | | |
| (A) Area under non agricultural uses | 21.09-6.9 | 22.53-7.4 |
| (B) Barren and uncultivable land | 19.39-6.4 | 19.03-6.2 |
| 3. Other uncultivable land excluding fallow land (A+B+C) | | |
| (A) Permanent pastures and other grazing lands | 11.40-3.7 | 10.91-3.6 |
| (B) Land under miscellaneous tree crops and groves not including in net area sown | 3.82-1.3 | 3.57-1.2 |
| (C) Culturable wasteland | 15.00-4.9 | 13.88-4.5 |
| 4. Fallow lands (A+B) | | |
| (A) Fallow land other then current fallow | 9.66-3.2 | 9.76-3.2 |
| (B) Current fallows | 13.70-4.5 | 14.36-4.7 |
| 5. Net area sown (6-7) | 143.00-46.9 | 142.02- 46.6 |
| 6. Total cropped area (gross cropped area) | 185.74 | 190.76 |
| 7. Area sown more than once | 42.74 | 48.74 |

(P) - (Provisional) Source: [61]

Table 3: List of Medicinal Plants recommended by various workers for cultivation at degraded land for reclamation

| Scientific name | Local name | Life form | Family | Parts used | References |
|---|---|---|---|---|---|
| *Acacia nilotica* | Babul | Tree | Mimosaceae | Bark,tender shoots, gum | [62,63] |
| *Aegle marmelos* | Bail | Tree | Rutaceae | Fruit and leaves | [56,62,64,65] |
| *Aloe vera* | Gwar patha | Herbs | Mimosaceae | Bark,flowers and seeds | [64,65] |
| *Withania somnifera* | Ashwagandha | Tree | Solanaceae | Roots and leaves | [64,65] |
| *Asparagus officinalis* | Satavar | climber | Liliaceae | Roots | [64,65] |
| *Azadirachta indica* | Neem | Tree | Meliaceae | All parts | [53,57,63-65] |
| *Bauhinia varigata* | Kachnar | Tree | Caesalpiniaceae | Leaves, bark and pods | [57,59] |
| *Butea monosperma* | Palas | Tree | Papilionaceae | Seeds, bark | [62] |
| *Catharanthus roseus* | Sadabahar | Shrubs | Apocynaceae | Roots and leaves | [66] |
| *Chlorophytum borivillianum* | Safed musli | Herbs | Liliaceae | Roots | [64,65] |
| *Cymbopogon flexuosus* | Lemon grass | Herbs | Poaceae | Leaves | [52,58] |
| *Cymbopogon martinii* | Palmarosa grass | Herbs | Poaceae | Leaves | [52] |
| *Datura metal* | Dhatura | Herbs | Solanaceae | Leaves and fruits | [67] |
| *Emblica officinalis* | Amla | Tree | Euphorbiaceae | Fruits | [57,58,64,65,68] |
| *Evolvulus alsinoides* | Shankpushpi | Herbs | Convolvulaceae | Whole plant | [54,64,65] |
| *Jatropha curcas* | Ratanjot | Shrubs | Euphorbiaceae | Seeds, oil and latex | [64,65,69] |
| *Madhuca longifilia* | Mahua | Tree | Sapotaceae | Leaves, flower and seeds | [53] |
| *Mentha arvensis* | Japanese mint | Herbs | Labiatae | Whole herb and oil | [70] |
| *Rauvolfia serpentine* | Sarpagandha | Shrubs | Apocynaceae | Roots | [64,65] |
| *Solanum nigrum* | Makoy | Herbs | Solanaceae | Fruits, leaves and seeds | [64,65] |
| *Cassia fistula* | Amaltas | Tree | Caesalpiniaceae | Fruits and seeds | [59] |
| *Asparagus racemosus* | Satavari | climber | Liliaceae | Dried roots | [64,65] |
| *Bambusa bambos* | Bans | Tree | Gramineae | Leaves | [68] |
| *Pongamia pinnta* | Karanj | Tree | Leguminosae | Seeds oil and leaves flowers root bark | [57,62,71] |
| *Ficus carica* | Anjeer | Tree | Moraceae | Bark, fruits, flowers and seeds | [72] |
| *Lantana camara* | Laltern | Herbs Shrubs | Verbenaceae | Leaves and roots | [59] |
| *Sida cordifolia* | Atibala and Kungyi | Shrubs | Malvaceae | Whole herb | [73] |

Table 3: Continued

| | | | | | |
|---|---|---|---|---|---|
| *Zizyphus jujube* | Ber | Shrubs | Rhamnaceae | Fruit, root and bark | [56,62] |
| *Zingiber officinale* | Adrak | Shrubs | Zingiberaceae | Rhizome | [74] |
| *Achyranthes aspera* | Latjira | Herbs | Amaranthaceae | Roots, leaves and seeds | [59] |
| *Euphorbia hirta* | Dudhi | Herbs | Euphorbiaceae | Whole plant | [54] |
| *Gloriosa superba* | Karihari | Herbs | Liliaceae | Tuber and seeds | [64,65] |
| *Clitoria ternatea* | Aparajita | Shrubs | Papilionaceae | Roots, flowers and seeds | [71] |
| *Cymbopogon martini* | Palmarosa grass | Herbs | Poaceae | Leaves, inflorescence | [52,58] |
| *Diospyros melanoxylon* | Tendu | Tree | Ebenaceae | Barks, fruit | [62] |
| *Hedychium spicatum* | Kapoorkachri | shrubs | Zingiberaceae | Rhizome | [64,65] |
| *Phyllanthus amarus* | Bhumiamlaki | shrubs | Euphorbiaceae | Whole plant | [64,65] |
| *Plantago ovata* | Isabgol | Shrubs | Plantaginaceae | Seeds and husk | [75] |
| *Syzygium cumini* | Jamun | Tree | Myrtaceae | Fruits and leaves | [59,62] |

An appropriate technology for sodic - wasteland management was a rich experience gained through experimentation of plantation in sodic soil by Narendra deva University of Agriculture and technology, Kumarganj, Faizabad was effectively implemented by KVK. Plantation of selective fruits plants suited to sodic soil, such as Aonla, Guava, Ber, Beal and Karounda was popularized by the KVK on farmers field and as well as at the KVK farm. The farmers are very much convinced with the performance of these fruits plants in sodic soil [56].

Performance of different multipurpose tree species in degraded land of Satpura region of Madhya Pradesh was evaluated.12 tree species were tried on the degraded land of Satpura region of Madhya Pradesh, the survival percentage at the end of the fourth year was found to be maximum in *Gmelina arborea* (94%), followed by *Azadirachta indica* (92%). Higher height growth was noted for *Gmelina arborea* (610.0cm) and *Dalbergia sissoo* (602.8cm), while coller dimeter (6.9cm) and canopy spread (2.9cm) was noted higher in *Bauhinia variegate*. The results of the study reveals that *Dalbergia sissoo* and *Gmelina arborea* were among the faster growing species and appears to be promising tree species for rehabilitation of degraded land; *Pongamia pinnata, Azadirachta indica and Emblica officinalis* showed moderate performance [57].

Medicinal and aromatic plants for utilization of sodic lands and reported some medicinal and aromatic crops like *(Artinni) Palmorosa cymbopogonm, Lemon grass (Cymbopogan flexuosus), Vetiver (Vertiveria zizinoides), Garman chamomile (Matricaria chamomile*) etc. can be successfully grown on sodic soils [58].

The role of revegetation for rehabilitation of sodic soils in semiarid subtropical forest India was reported and about 28 species were found naturally regenerating in our rehabilitated forest, which was about 64% of the total species listed in the forest and these may be considered adapted to sodic soils. Some of the important ones may be cited here for further trials on sodic lands, viz *Aegle marmelos, Alangium salvifolium, Albizia lebbeck, Azadirachta indica , Buhinia variegataa, Cassia siamea, Cassia fistula , Corddia dichotoma, Dalbergia sissoo, Ficus glomerata, Holopteleinterifolia, Pithecellobium dulce, Derris indica, Putranjiva roxburghii, Sterculia alata, Terminalia arjuna etc* [59].

## CONCLUSION

From the ongoing review it may be concluded that a large land area of the world especially India and other developing countries is occupied by degraded land. In developing countries due to high population rate the cultivated land is under high pressure for more and more food production. India has very good wealth of medicinal plants since past but due to increasing population some important medicinal plant species have lost their diversity and shifting towards extinction. There is great demand of Indian medicinal plant in world market. Therefore to save the important medicinal plants they may be cultivated at degraded land of the country, as different medicinal plants also reclaim the degraded soil clear from the review. Thus plantation of herbal plants at degraded land will help to save the diversity of these herbal plants and simultaneously will help to minimize the pressure on crop lands and reclaim the degraded land of the country.

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