THEME:
NATURAL FOREST MANAGEMENT / BIODIVERSITY

Title of the technology

Rehabilitation of degraded land through seed sowing to increase land productivity and combat desertification**.**

A: Nature of technology

Rehabilitation through seed sowing

B: Process in brief

In order to minimize the adverse effects of the environment and to increase the supply of fodder and fuel wood from the marginal/degraded lands, introduction of woody perennials is a common practice in dry areas. Many schemes like desert development wasteland development and externally added programmes are in way in order to combat desertification and to mitigate the adverse effect of this calamity. Millions of seedlings raised in nursery are planted under afforestation activities every year to improve fodder and fuel wood availability. The common species under plantations are *Acacia tortilis, A. senegal, A. nilotica, Zizyphus nummularia* and *Azadirachta indica* under rainfed conditions. *Dalbergia sissoo* and *Eucalyptus camaldulensis* are raised under irrigation in Indira Gandhi canal command area. Sowing of seeds of tree species particularly; *A. senegal, A. catechu, Jatropha, Z. mauritiana* etc along the raiiwater harvesting structures or field bunds is common in dry areas, where the performances of regenerated seedlings are found equally good as the planted seedlings. This practice may be adopted in rehabilitation of degraded lands including sandy areas giving major emphasis on site preparation and selection of suitable drought hardy species. To prove this, an experiment was carried out at AFRI experimental farm during drought period of 2002 and found encouraging and implementable.

To study the effect of site preparation and seed sowing of *Azadirachta indica* and *Colophospermum mopane* tree species, a field experiments was laid during 2001-2003 (**Fig. 1**). The climate of the site is arid. The mean annual rainfall is 420 mm and the mean annual pan evaporation is 2025 mm indicating high water deficit in the area. The soil is loamy sand with low soil organic matter and nutrients. The soil is slightly alkaline in reaction. Topography of the land under experimentation is almost flat. The experimental site is located in the city of Jodhpur in western part of the state Rajasthan. In this, fruits of *A. indica* and *C. mopane* were collected from the experimental area. Site was deep ploughed to remove the existing vegetation and to enhance water conservation. Half kg of dry fruits was weighed and number of fruits counted in triplicate

for both the species. Weighed fruits were broadcasted in July, 2001. The broadcast seeds were mixed through further ploughing to ensure seed burial in the soil. Average number of seeds in each plot were 1530 and 955 for *A. indica* and *C. mopane*, respectively. Measurements of germinated seedlings were taken at different time interval. Some plants were also excavated to monitor root growth and its penetrability of the hard layer of calcium carbonate for better survival under harsh environment.

Germination percent for *A. indica* and *C. mopane* was 54 and 94 with respective population 27500 and 30100 seedlings ha^{-1}. The survival reduced to 1.2% and 9.7%, respectively after one year, but still provided more than 300 plants per ha. Root of *C. mopane* seedlings was more than two fold lager as compared to *A. indica* plants. Shoot and root dry biomass of *C. mopane* were greater than 5-fold than the biomass of *A. indica* seedlings. Biomass allocation was high in root in both the species. Best field survival of *C. mopane* seedlings was due to their deep rooting behavior, which penetrated even hard layer of calcium carbonate to extract water/nutrient from the deeper soil layers and shoot during harsh conditions.

Fig. 1**.** Regeneration of *C. mopane* under the canopy of same tree (left) and performance of 8 years old *C. mopane* plants grown through seed sowing (right).

C. Beneficiaries of the technology

1. Prominent beneficiaries/user groups: Farmers, State Forest departments and non-government organization working in the area and industries.

2. No. of clients to whom technology has been transferred

State forest departments are the main clients and have general practice of seed sowing particularly along the bund of rainwater harvesting structures and ditch fencing. Farmers of the region are also main beneficiaries to whom this technology was demonstrated through field visits of the area. This technology has been discussed at many forums such as workshop/conferences, meeting/ stakeholder meetings, public forum, etc.

3. Potential for further dissemination

Improper management of land and water resources caused degradation of lands and reduction of precious and finite natural resources resulting in emergence of new environmental hazards. Mounting human population the intensification of agriculture has increased and marginal lands brought under cultivation and has resulted in acceleration of major land degradation processes viz. wind erosion, water erosion and salinization/alkalization. Deterioration in land quality parameters result in decline in its productivity having both economic and ecological consequences. Whereas, major land use changes occurred in the Rajasthan, where net seeded area has increased in the sandy plain and inter-dune plain; and the area under culturable waste land has declined by 18.1%. In addition, vagary of the climate also leads to land degradation and productivity loss, which needs to restored through re-vegetation identifying suitable species. *C. mopane* is able to establish and flourish in habitats characterized by arid or sodic soils. It is a preferred fuel wood and fodder species and therefore could be grown under agroforestry. *Azadirachta indica* is another multipurpose species and is well adapted to the dry areas. These species could be grown under direct seeding to rehabilitate the degraded lands of varying categories. Success of this practice emphasizes the importance of site preparation and conservation of soil and water resources and seed broad casting is an effective solution to improve the vegetation status as low cost technology and could be beneficial for the poor in the dry areas. This experiment demonstrating growth and performance of *C. mopane* is a viable strategy in the direction of rehabilitation of degraded land through broad casting. Based on the experiences elsewhere and this experiment, some more species seems to be useful under broad casting are *Acacia jacquemonttii* and *Clerodendrum phlomides* in bare dune, *Colophospermum mopane* in sandy plain including slight alkaline/saline conditions, *Acacia senegal* in gravelly area, *Acacia catechu, A. leucophloea* and *Acacia ferrugiana* in gravelly/rocky pediments with relatively greater rainfall region.

Publications

1. Singh, G. (2003). Sowing seeds: Seed germination and growth of *Colophospermum mopane* during drought. *Wasteland News*, 19 (1): 48-50.
2. Singh, G. and Rathod, T.R. (2006). Rehabilitation of degraded dry lands of Indian arid Zone through direct seeding. *Indian Forester*, 132(7): 809-817.
3. Singh, G. (2008). Gaining momentum: Growing *Jatropha curcus* with rainwater harvesting in degraded hillocks of Aravalli. *Wasteland News*, 23(1): 17-19.
4. Singh, G. (2009). Performance of seed sown seedlings in rehabilitation of degraded hills of Aravalli under resource management. *Wasteland News*, 24(1): 48-51.

D. Economic significance

1. Potential to address livelihood issues and generate additional income

Though, potential to address the livelihood issues and income are relatively less, but production of fuel wood and fodder may provide livelihood. But increased income by increased land productivity and fuel wood supply and decrease in time of collections of fuel wood and fodder are some of the benefits related to improved livelihood and human resource.

2. Productivity enhancement and economic benefits over replaced technology

Broadcasted seed based seedlings/ regenerated seedlings proved better growth and performance than the planted one under harsh environmental conditions. Some of the best performers are *Acacia senegal, A. catechu, Jatropha curcas, Azadirachta indica* and *Colophospermum mopane*, though they vary in performance among themselves. The reduction in cost for raising nursery plantation, transportation etc are the economic benefits. The seed sown seedlings show better root development and penetrating even hard layer, which enhance survival even during harsh environmental conditions. This species also suited to mild saline/alkaline conditions and can be replicated in similar area. Forest department of Gujarat had procured the seeds of *C. mopane* from AFRI and utilized it in rehabilitating the degraded land of the Gujarat state.

Benefits associated with this practice

Environmental	**Economic**	**Social**
Increase in land productivity under improved soil nutrient status.	Increased landscape value and economic status.	Improvement in social status resulting in diversion towards education.
Reduction in soil and water loss and combat desertification.	Decrease in soil loss involved due to wind erosion.	Improved air quality and human health.
Increased soil carbon stock and biomass.	Increased fuel wood supply.	Reduced time in fuel wood collection by the villagers.
Increased vegetation cover.	Increased landscape value and enhancement in productivity.	Increase in social status.

3. Impact of the Technology

This practice can be replicated at local level and sub subregional level with some adaptation depending upon the requirement for fodder or fuel wood. Forest department of Gujarat has replicated this in many places in Kutchh district of Gujarat. This practice leads to use of *C. mopane* to in rehabilitating the degraded alkaline/saline soils of Gujarat, for which the seeds of *C. mopane* was supplied from AFRI.

E. Technology developed by {Name of Scientist(s)/officers(s)}

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