Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 10 [3] February 2021 : 237-241

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

REVIEW ARTICLE **OPEN ACCESS**

Rehabilitation of Degraded Lands for Sustainable Crop Production

T. Pandiaraj[1]*, Prakash Yadav[1] and Kichenaradjou[2]
[1]College of Agriculture, Acharya Narendra Deva University of Agriculture and Technology, Azamgarh, UP
[2]RVS Agricultural College, Thanjavur, Tamilnadu
*Corresponding author: pandianeagro@gmail.com

ABSTRACT
Soil degradation in India is projected to be going on 147 million hectares (Mha) of land. Although has only 2.4% of the world's land area, this is very serious as India supports 18% of the world's human population and 15% of the world's livestock population. Agriculture, forestry and fisheries report for 17% of the gross domestic product and employs about 50% of the total workforce of the country. Causes of soil degradation are both natural and human-induced. Natural causes include earthquakes, tsunamis, droughts, avalanches, landslides, volcanic eruptions, floods, tornadoes, and wildfires. Human-induced soil degradation consequences from inappropriate agricultural practices, over-grazing, land clearing and deforestation, improper management of industrial effluents and wastes, mining, and industrial growth. Injudicious agricultural practices include excessive and unbalanced use of inorganic fertilizers, pesticide overuse, excessive tillage and use of heavy machinery, poor irrigation and water management techniques, and meager crop cycle planning. Reclamation of land degradation can be done effectively through innovative agricultural practices like micro irrigation, crop residue management, afforestation programme. Conservation agriculture is a promising technique to combat further land degradation problems. Proper land use planning policy should be given by government to alleviate the problems of further land degradation and suitable strategies should be developed for existing land degradation.
Keywords: *Afforestation, Agroforestry, deforestation, Erosion, Reclamation*

Received 05.11.2020 Revised 02.01.2021 Accepted 19.01.2021

INTRODUCTION

Land degradation will remain an important global issue for the 21st century because of its adverse impact on agronomic productivity, the environment and its effect on food security and the quality of life. Land degradation is not being satisfactorily addressed, but is of crucial importance to increase awareness so that future land management decisions make possible to more resilient and sustainable agricultural systems. Productivity impacts of land degradation are due to a decline in land quality on site where degradation occurs. Degraded lands are lands that have lost part or all of its productive capacity as a result of inappropriate human intervention. Various forms and degrees of degradation, both reversible and irreversible form of degradation requires investment. Land degradation refers to a decline in the overall quality of soil, water or vegetation condition commonly caused by human activities. Agricultural production has witnessed dramatic rise in the last 3 decades. In India, Green Revolution brought about technological breakthrough, which led to the use of short duration high yielding varieties helping intensive use of land in a year, increasing area brought under irrigation and prolific use of chemicals such as fertilizers and pesticides. India, being vastly agriculture oriented, historically had policies in various phases for the development of agriculture with the expectation that development of agriculture would lead to overall development of the nation and help eradication of poverty. It has been of late recognized that the increasing efforts to raise agricultural growth has cost us dearly in the form of land and water degradation. Large scale ecological losses were reported in crop land, grass land and forest land, such as soil erosion, soil alkalinity and salinity, micronutrient deficiency, water logging and fast depletion and contamination of ground water. These factors limit future gains from the land and water resources. The specific crops grown and the cropping practices employed also determine the residuals generated by the erosion and run-off. Irrigation is considered as the principle means of water loss from the natural system and it leads to arid condition downstream and ground water depletion [1, 2]. Apart from on site costs reflected in the loss of productivity of soil, the offsite costs due to agriculture is reported to be quite significant. The offsite costs are caused by soil sediments transported in the surface water from eroded agricultural land. These include river and dam siltation, damage to roadways and sewers, siltation of harbours and channels, loss of reservoir storage, disruption of stream ecology and damage to public health. In addition, by raising stream beds and burying streamside wetlands, sediment can increase the frequency of flooding.

SOURCE OF LAND DEGRADATION

Of India's total geographical area (328.7 Mha), 304.9 Mha comprise the reporting area with 264.5 Mha being used for agriculture, forestry, pasture and other biomass production. The severity and extent of soil degradation in the country has been previously assessed by many agencies (Table 1). According to the National Bureau of Soil Survey and Land Use Planning [2] ~146.82 M ha is degraded (Table 1). Water erosion is the most serious degradation problem in India, resulting in loss of topsoil and terrain deformation. Based on first approximation analysis of existing soil loss data, the average soil erosion rate was ~16.4 ton $ha^{-1}year^{-1}$, resulting in an annual total soil loss of 5.3 billion tons throughout the country [3]. Nearly 29% of total eroded soil is permanently lost to the sea, while 61% is simply transferred from one place to another and the remaining 10% is deposited in reservoirs.

Table 1 The extent of various land degradation in India as assessed by NBSS&LUP

S.No.	Category	Extent(m.ha)
1.	Water erosion	93.68
2.	Wind erosion	9.48
3.	Water logging	14.30
4.	Salinity/alkalinity	16.03
5.	Soil acidity	10.03
6.	Complex problem	7.38
	Total	**146.82**

According to another estimate out of the geographical area of 328 million ha, the rural and urban habitats cover 64 million ha (Bhattacharyya *et al*., 2015). The distribution of the remaining 264.5 million ha land is being used for agriculture, forestry, pasture and other biomass production (Table 2).

Table 2 The distribution of various land degradation in india

Types of land	Total area million ha.	Area degraded million ha.
Cultivated area	142	90
Forest	67	31
Permanent fallow	24	24
Pasture	12	12
Culturable wastelands	16	16
Culturable wastelands	3	-
Total	**264**	**173**

Types of land degradation

i. Soil erosion by water
ii. Soil erosion by wind
iii. Soil fertility decline
    a. Reduction of soil organic matter
    b. Degradation of soil physical properties
    c. Build up of toxic substances
iv. Water logging
v. Lowering of water table
vi. Loss of vegetation cover
vii. Increase of stoniness and rock cover of the land

Cause of land degradation:

i. Overgrazing of range land
ii. Over cultivation of crop land
iii. Water logging and salinization of irrigated land
iv. Deforestation
v. Pollution due to industrial causes.

The Government of India has launched various programmes for sustainable production and increasing the productivity of degraded lands. The main features are

i. All India Soil and Land use survey

a. The following tasks have been assigned under this scheme
b. Rapid reconnaissance Survey (RRS) of wastelands or river valley projects and flood prone rivers.
c. Detailed Soil Survey (DSS) of very high and high priority sub watersheds to provide a sound database for the execution of soil conservation measures as well as for scientific land use planning.
d. District based Land Degradation Mapping (LDM)
e. Soil Resource Mapping (SRM)
f. Development of GIS based Web server
g. Organizing short training courses on soil surveys and data uses for planning of watershed management for user departments
h. Consultancy projects in soil mapping

ii. Soil conservation Training Centre, Damoder Valley Corporation Hazaribagh, Jharkhaland
iii. Soil conservation for enhancing productivity of degraded watershed in the catchments of River alley Projects/Flood prone Rivers
iv. Eco- restoration Project of Degraded Land in the Catchment of Jhelum, Cheab and Shivalik (Jammu and Kashmir)
v. Reclamation of alkali soil
vi. Watershed Development project for shifting cultivation areas:
vii. Uttar Pradesh Sodic Land Reclamation Project with world Bank Assistance
viii. Impact Evaluation of watersheds
ix. Programmes for North – Eastern States

SUSTAINING SOIL PRODUCTIVITY IN DEGRADED LANDS

An important factor responsible for low yields is the neglect, misuse, and mismanagement of soil resources and the resulting widespread degradation of soil and environment. The amount, frequency, and type of off-farm inputs depend on land resources and the yields desired. Considerable amounts of nutrients harvested annually must be replaced. The already imbalanced consumption ratio of 6.2:4:1 (N:P:K) in 1990–1991 has widened to 7:2.7:1 in 2000–2001 and 5:2:1 in 2009–2010 compared with a target ratio of 4:2:1. Some highly weathered and excessively leached soils of the tropics and sub-tropics are virtually devoid of essential plant nutrients (e.g., N and P). For these soils, the addition of organic amendments may enhance soil structure, but they may not eliminate the need for balanced fertilizer because large amounts of nutrients are required in easily available forms to produce economic returns. In addition to the supply of major nutrients (N. P. K), some soils are deficient in certain micro-nutrients (Zn, Cu), while others may have toxic levels of other elements (Al, Mn, and other salts). Every year, ~20 Mt of the three major nutrients are removed by growing crops, but the corresponding addition through inorganic fertilizers and organic manures falls short of this harvest [6]. Low or high pH may require ameliorative measures for high yields. In the human time frame, soil is a non-renewable and finite resource. A national, regional, and world soil policy is needed to advocate the judicious use of soil resources.

An Improved system must alleviate the soil-related and other biophysical constraints to intensive land use for high and sustained production. The conceptual bases of new and innovative systems are known and have been described by Okigbo [5] with special reference to Africa, and by Beets [1] with special reference to small land holders of the tropics. There are two approaches: one is to bring new land under cultivation and the other is to restore the productivity of degraded land.

MANAGING EXISTING LANDS AND RESTORING THE PRODUCTIVITY OF DEGRADED LANDS

Because of a shortage of prime agricultural land, an increase in production in several countries will have to be achieved by more intensive cultivation of land already developed Furthermore, vast areas of land previously developed from TRF have been degraded because of land misuse, adoption of productivity-mining cultural practices, and use of resource based rather than science-based production systems. It is important to restore the productive capacity of these lands so that the need for deforestation and bringing new land under cultivation can be minimized. Restoring these lands requires:

- Controlling soil erosion through runoff management and ground cover establishment;
- Improving soil structure through appropriate measures of soil surface management;
- Establishing vegetative cover through growing an appropriate combination of aggressively growing cover crops and quick-growing perennials;

- Replenishing plant nutrients lost out of the ecosystem; and preventing additional losses of water and nutrients from the ecosystem.

Once restored, the land should be managed judiciously to maintain its productive capacity, life-support systems, and environmental regulatory mechanisms.

TECHNOLOGIES FOR REHABILITATION OF DEGRADED LANDS

Agroforestry for erosion control

Under red soil conditions agri + silvi+hort+ pastoral system can be taken with components Viz., field crops, teak, papaya, grasses. In cultivated hilly zone silvicultural crops such as eucalyptus, casuarinas, *Albizia lebbeck*, *Dalbergia sisoo* etc., can be grown along with horticultural crops as Sapota, Mango, Guava on bunds and terraces.

Use of implements to control water and wind erosion

Tractor drawn channel former, Coir pith applicator, Power tiller drawn basin lister, Basin lister/broad bed former cum seeder attachment to cultivator etc., can be used to control erosion.

Reclamation of saline soils

Leaching/removal of salts and growing green manures, formation of proper drainage system and afforestation saline soils are some of the methods to improve the productivity. The tree species *Acacia catechu, Pongammia pinnata, Azadirachta indica, Prosopis juliflora, Acacia nilotica, Casuarina equisetifolia, Tamarix articulata, Leptochloa fusca* etc., are some of the tree species that can be grown in salt affected soils.

Reclamation of saline alkali soils:

Leaching of excess salt and addition of green manures and amendments like gypsum are some of the measures. Afforestation techniques with saline and alkaline tolerant plants. The tress *species Prosopis juliflora, E. robusta, Acharas sapota, Xizypus, Medicago sativa, Trifolium alexandrum, Avena sativa, Medicago denticulata* can be grown.

Reclamation of alkali soils

Removal of sodium from exchange complex, substitution of Ca in the place of Na to improve the soil physical and chemical properties, addition of judicious organic manures/organic matter to build up the organic carbon content of the soil and to improve the physical properties and growing the salt tolerant varieties like rice, ragi, cotton, forage grasses, trees, wheat, barley are some of the methods.

Reclamation of acid / Laterite soils

Growing acid tolerant species *Alnus gultinosa, Crotalaria anagyriods, Casuraina eqisetifolia, Fagus sylvatica, Pinus sp* and *Populus sp* can be grown.

Rehabilitation of gullied/ravenous lands

Afforestation with tress species like *Acacia nilotica, Azadirachta indica, Dalberia sissoo* etc.

Rehabilitation and reclamation of water logged lands

Drainage either surface or sub surface or both to remove surplus water, Lining canals to prevent seepage and rise of water table and sinking tube well and utilization of water for irrigation to lower the water table. The tree species found suitable for waterlogged soils are *Acacia auriculiformis, Acacia nilotica, Dalbergia sissoo, Eucalyptus teresticornis, E. robusta and Pongamia pinnata*.

Rehabilitation of shifting cultivation lands

The tree species that can be grown are *Acacia catechu, Dalbergia sissoo, Anacardium occidentale, Bombax ceiba, Santalum album, Acacia nilotica, Schima wallichii, Pterocarpus dalbergioides, Albizia lebbek.*

Rehabilitation of sand dunes and mine spoils

The trees recommended are *Prosopis juliflora, P.cineraria, Acacia senegal, Albizia lebbek, Tamarix articulata, Cenchrus ciliaris, Saccharum munja.* In mine spoils planting of *Acacia cenegal, Prosopis juliflora, Tamarix aphylla* and *Cercidum floridum* will rehabilitate the mine spoils.

FUTURE STRATEGY

Rainwater harvesting, in-situ soil moisture conservation and organic recycling as means to enhanced and sustainable agricultural and pasture production systems, with on-farm and off-farm employment and income generation for better livelihood support, is the strategy and community-led and -owned watershed development is the approach that the LADA project can adopt from successful models on the ground in India. The lessons from the field programmes convince that it is not the 'carrying capacity' of the land by itself that matters. It is the 'caring capacity' of the community that matters more and makes the difference between degradation and restoration, between sustainability and unsustainability. Mixed farming, crop diversification, alternate land use systems, providing dependable scope for crop-animal integration, organic recycling and thus promoting below-ground biodiversity and carbon sequestration in the Drylands watersheds directly contribute to the objectives of UN conventions on Biodiversity and Desertification and Climate change.

A 25-year perspective plan for the development of the dryland areas has been drawn by the Planning Commission. Out of 142 million ha of net cropped area, rainfed agriculture is practiced in about 90 million ha. Nearly 67 million ha of rainfed area falls in the mean annual rainfall range of 500-1500 mm. Because of weather aberrations, crop productivity and yield stability are low. The soils are poor in fertility and are prone to run-off and erosion. Next to soil erosion, soil fertility depletion is the major degrading factor, which is more intrinsically accentuated in acid red soils and laterites.

The Ministry of Agriculture estimates that within next five years, India will be short of 20 million tonnes of rice, wheat and pulses. To feed the growing population it is necessary to conserve the degraded lands and use them more productively. Multidisciplinary approaches in developing location specific strategies in balancing the differential needs of each degraded land will be most appropriate. The approaches adopted in the integrated management of degraded land should have the end result reflected in terms of each degraded land should have the end product of such resource management should have them.

CONCLUSION

Suitable mitigation approaches of the about 147 Mha of existing degraded land in India are of the paramount importance. With changing climate, land degradation is projected to only rise due to extensive dry spells, high intensity storms and loss of forest cover. Fighting additional land degradation and investing in soil conservation is a key mission involving support of sustainable development and nature conservation. An integrated watershed approach should be emphasized maximum attention to reclaim land degradation and environmental issues mainly in fragile areas. Sustainable agricultural production using novel farming practices have remarkable potential of increasing productivity and conserving natural resources, particularly by sequestering SOC (both labile and recalcitrant) and improving soil quality. Conservation agriculture (CA) coupled with other technologies like micro-irrigation, fertigation, and management of problem soils using specific and necessary technologies hold great promise to increase productivity of crops and fruits and reverse soil degradation.

REFERENCES

1. Beets, W.C. (1990) Raising and sustaining productivity of smallholder farming systems in tropics. AgBe Publishing, Alkmaar.
2. Bhattacharyya R , Birendra Nath Ghosh, Prasanta Kumar Mishra, Biswapati Mandal, Cherukumalli Srinivasa Rao, Dibyendu Sarkar, Krishnendu Das, Kokkuvayil Sankaranarayanan Anil, Manickam Lalitha, Kuntal Mouli Hati and Alan Joseph Franzluebbers. 2015. Soil Degradation in India: Challenges and Potential Solutions. Sustainability, 7: 3528-3570.
3. Dhruvanarayan, V.V.N.; Ram, B. Estimation of soil erosion in India. J. Irrig. Drain. Eng. 1983, 109: 419–434.
4. National Bureau of Soil Survey & Land Use Planning (NBSS&LUP). Soil Map (1:1 Million Scale); NBSS&LUP: Nagpur, India, 2004.
5. Okigbo, B.N. (1991), Development of Sustainable Agricultural Production Systems in Africa: Roles of International Agricultural Research Centres and National Agricultural Research Systems, Ibadan: IITA.
6. Tandon, H.L.S. Fertilizers in Indian Agriculture—From 20th to 21st Century; FDCO: New Delhi, India, 2004; p. 240.

CITATION OF THIS ARTICLE

T. Pandiaraj, Prakash Yadav and Kichenaradjou. Rehabilitation of Degraded Lands for Sustainable Crop Production. Bull. Env. Pharmacol. Life Sci., Vol 10[3] February 2021 : 237-241