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Role of Trees in Land Restoration

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Abstract: Land restoration refers to the process of halting degradation or rehabilitating degraded land, typically through activities like reforestation, soil conservation, and the protection of natural processes. It aims to enhance biodiversity, restore ecosystem services, and mitigate climate change impacts. There are a number of interrelated land degradation components, all of which may contribute to a decline in agricultural production. The land is degraded by many types like as soil degradation, vegetation degradation, water degradation, Climate deterioration, Losses to urban/industrial development. Restoring land can have numerous benefits, such as improving soil fertility, increasing water retention and preventing land degradation. It also helps in conserving biodiversity by providing habitat for plants, animals, and microorganisms, thus supporting overall ecosystem health.A tree is any plant that has a woody stem of at least 8 to 10 feet in height, with crown of branches and leaves at the top. Trees have a different impact on soil properties than annual crops, because of their longer residence time, larger biomass accumulation, and longer-lasting, more extensive root systems.Trees are the silent protectors of the overall health of our planet. Environmental protection, they reduce soil erosion, act as sink for atmospheric carbon dioxide and release large amount of oxygen. Therefore, the trees can play a major role in the land restoration.

Keywords: *Land restoration, agroforestry, trees*

I. INTRODUCTION

Land degradation means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns such as: soil erosion caused by wind and/or water; deterioration of the physical, chemical and biological or economic properties of soil; and long-term loss of natural vegetation (UNCCD, 1993).

According to FAO (1999), land degradation is the reduction in the capability of the land to produce benefits from a particular land use under a specified form of land management).

Land degradation is a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic, climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity or value to humans. [Note: This definition applies to forest and non-forest land. Changes in land condition resulting solely from natural processes (such as volcanic eruptions) are not considered to be land degradation. Olsson et al., 2019 suggested as reduction of biological productivity or ecological integrity or value to humans can constitute degradation.

Land restoration refers to the process of halting degradation or rehabilitating degraded land, typically through activities like reforestation, soil conservation, and the protection of natural processes. It aims to enhance biodiversity, restore ecosystem services, and mitigate climate change impacts.

In the soil conservation arena, the terms soil degradation and land degradation are sometimes incorrectly used interchangeably, with soil erosion regarded as synonymous to both. However, there is more to soil degradation than just soil erosion, and land represents a broader concept than simply soil. As with its use in the context of land evaluation (FAO, 1976), the term land refers to all-natural resources which contribute to agricultural production, including livestock production and forestry. Land thus covers climate, landforms, water resources, soils and vegetation (including both grassland and forests) (FAO, 1999).

There are a number of interrelated land degradation components, all of which may contribute to a decline in agricultural production. The most important according to Douglas (1994) cited by FAO (1999):

- *Soil degradation*: decline in the productive capacity of the soil as a result of soil erosion and changes in the hydrological, biological, chemical and physical properties of the soil.
- *Vegetation degradation*: decline in the quantity and/or quality of the natural biomass and decrease in the vegetative ground cover.
- *Water degradation*: decline in the quantity and/or quality of both surface and ground water resources.
- *Climate deterioration*: changes in the micro- and macro-climatic conditions that increase the risk of crop failure.
- *Losses to urban/industrial development*: decline in the total area of land used, or with potential, for agricultural production as a result of arable land being converted to urban, industrial and infrastructure uses (FAO, 1999).

Land degradation has both on-site and off-site effects. On-site effects are the lowering of the productive capacity of the land, causing either reduced outputs (crop yields, livestock yields) or the need for increased inputs. Off-site effects of water erosion occur through changes in the water regime, including decline in river water quality and sedimentation of river beds and reservoirs. The main off-site effect of wind erosion is overblowing or sand deposition (FAO, 1994).

Examples of causes of different types of land degradation include water erosion, wind erosion, soil fertility decline, waterlogging, salinization, lowering of the water table, deforestation, forest degradation and rangeland degradation (FAO, 1994).

Studies indicate that land degradation directly affects 1.5 billion people worldwide, with a disproportionate impact on women, children and the poor, and it reduced the productivity of the world's terrestrial surface by about 25.00 per cent between 1981 and 2003 (FAO, 2020).

Restoring land can have numerous benefits, such as improving soil fertility, increasing water retention, and preventing land degradation. It also helps in conserving biodiversity by providing habitat for plants, animals, and microorganisms, thus supporting overall ecosystem health.

Restoring land requires diverse approaches

Restoration techniques vary depending on the type and extent of land degradation and the needs of local communities. They can involve measures like planting native vegetation, implementing sustainable land management practices, establishing protected areas and adopting agroforestry systems to restore soil health and productivity

1. Native vegetation
2. Implementing sustainable land management practices
3. Establishing protected areas
4. Adopting agroforestry systems to restore soil health and productivity

1. Native vegetation

In an area without anthropogenic influences, vegetation consisting of completely native causes called native vegetation. The factors influence the native vegetation like as humansand animalsby cut plants, fires, grazing, irrigation and drying of areas of life.A lot of people from the intensification of economic activities in the world, after the last 50years, especially with the increasing environmental pollution, anthropogenic influences largely been talk of a distant vegetation. The world's most secluded and found not the people living in the bodies of living things, even if the environmental pollution caused by the accumulation of many chemicals were transported. For these reasons, today, even the anthropogenic impact in less developed regions is still far from human influence. Description of the plant natively grows only in certain areas of native vegetation, but also to be expressed in those areas should be moved by the people.

Native plants in geological times in a region that region-specific climate, soil, rainfall, drought and frost, depending on the physical and biotic characteristics evolve and interact with other species in that region are found in the local plant communities. In this way, the conditions under which native plants will have certain features that makes them perfectly adapted to the characteristics and landscaping, conservation and restoration of soil is extremely important to provide alternatives. Plant sociologists, often talking about the native vegetation of different "Potential Native Vegetation". The material is of great importance for landscaping with native plants and plant communities that make us the main ones are as follows: Forests, savannah, maquis,savannahs, deserts, meadows, tundras, alpine plants, swamps. These are usually the mostimportant plant communities that make up the earth, ecological bakance, have come togetherand established a partnership between the livings, rather than growing the plant compliedevaluated in terms of their formation and utilization conditions. Development of vegetation in an area and constantly remain in the area of environmentalconditions that have an impact on the router. Environmental conditions, climatic conditionsgenerally (temperature, humidity, rainfall, light, wind, etc.)., edaphic conditions (soil,water), orographic conditions (pressure area, slope, elevation, etc.)., biotic conditions (theeffect of the surrounding creatures) is understood. Environment, living environment,"Biyosenoz" and the non-living environment "Ecotope" ecosystem, which together arecalled. Ecotypes a harmonious balance between native surroundings and has biyosenoz. Atthe end of the evolution of ecosystems composed of many years in this environment andvegetation is appropriate that this "Klimax" is called. There is one or more of the conditionsthat make the environment as a result of changes in the plant community, especially, areseen in the changing ecosystem. For these reasons, making any assessment of the vegetationin an area that should be examined thoroughly the effects of local environmental conditionsand their vegetation.

Plants form the key elements stored in the primary energy production. All living thingsdepend on other living plants. Native plants natively occur in the region in which theyevolved. While, non-native plants might provide some of the above benefits, native plantshave many additional advantages. Because native plants are adapted to local soils andclimate conditions, they generally require less watering and fertilizing than non-natives.Natives are often more resistant to insects and disease as well, and so are less likely to needpesticides. Wildlife evolved with plants; therefore, they use native plant communities forfood, cover and rearing young. Using native plants helps preserve the balance and beauty ofnative ecosystems

Native vegetation provides many benefits principally through the protection of the landsurface, amelioration or modification of local climate, maintenance of critical ecosystemprocesses, conservation of biodiversity, enhancement and protection of cultural andaesthetic values, and the provision of economically important products such as timber andgrazing forage. However, significant degradation and loss of native vegetation has takenplace since European settlement, principally as a result of human activity (Smith, et. al.,2000).

The native vegetation is directly related to land use and environmental change and is themost easily visible and perceived part of the landscape. It is important in relation to visualeffects. However, without detailed studies cannot be understood fully the relationshipbetween other landscape elements. According to Peter et al. (2000), as well as providingessential habitat, native vegetation, including small isolated remnants and scattered trees,has an important role in providing connectivity across the landscape

2. Sustainable land management system

Sustainable land management is crucial to minimizing land degradation, rehabilitating degraded areas and ensuring the optimal use of land resources for the benefit of present and future generations.

One out of every three people on earth is in some way affected by land degradation. Latest estimates indicate that

nearly 2 billion ha of land worldwide – an area twice the size of China – are already seriously degraded, some irreversibly. This includes large areas of cropland, grassland, woodland and forest areas whose degradation reduces productivity, disrupts vital ecosystem functions, negatively affects biodiversity and water resources, and increases vulnerability to climate change.

Sustainable land management is work based on four common principles:

- Land-user-driven and participatory approaches.
- Integrated use of natural resources at ecosystem an farming systems levels
- Multilevel and multi-stakeholder involvement.
- Targeted policy and institutional support, including development of incentive mechanisms for SLM adoption and income generation at the local level.

Its application requires collaboration and partnership at all levels– land users, technical experts and policy-makers– to ensure that the causes of the degradation and corrective measures are properly identified, and that the policy and regulatory environment enables the adoption of the most appropriate management measures.

3. Establishment of protected area

The major soil degraded areas can be restored byclassify such area and protect from the other activities. A protected area is "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values". Protected areas can be found in different environments ranging from mountains to the sea, deserts, forests and freshwater lakes and even traverse national boundaries. They are known by a multitude of names in different countries: national parks, nature reserves, natural monuments, wilderness areas, wildlife management areas, tourism management areas, ecological stations and sacred groves. Many of these nationally designated protected areas also form part of international systems of protected areas established under global conventions (e.g. World Heritage Sites, Ramsar sites). These mechanisms and the degree of protection vary considerably depending on the type of protected area.

4. Role of agroforestry systems to restore soil health and productivity

Agroforestry is a collective for land-use systems in which woody perennials are grown in association with herbaceous plants or livestock in a spatial arrangement, a rotation or both". It has both productive and services function. Among the productive function 3Fs (fuelwood, fodder and fruit) are the most important besides construction wood, gums, resins, medicines, fibers and a host of other economic base and greater food security (Kumar et al. 2020).

Anefficient and integrated land use management system by raising of certain agricultural crops, forest tree species and or animals simultaneously or sequentially on the same unit of land with appropriate management practices which result in overall increase in the production, under a particular set of climatic and edaphic conditions and socio-economic status of local people.

The agroforestry system for different purposes can be designed like as follows,

- Agroforestry for erosion control
- Agroforestry for improving soil fertility
- Nitrogen fixation and nutrient cycling
- Agroforestry Systems as carbon Sink for soil fertility
- Agroforestry system in improving soil water quality

Advantages of trees under agroforestry systems

- The roots of trees reduce in loss of soil as well as nutrients through reduction of run-off.
- The trees added carbon and its transformation through leaf, twig and bark fall etc.
- The Nitrogen level of soil improved by fixation of nitrogen fixing trees, shrubs etc.
- Enhancement of physical conditions of soil such as permeability, water holding capacity, and drainage etc.
- Release and reutilizing nutrients by moving biochemical nutrient cycling
- More microbial associations and addition of more root biomass
- Moderately effect on extreme conditions of alkalinity & soil acidity
- Lowering effect of the water table in areas where the water table is high

Table –1 List of nitrogen fixing tree species used in agroforestry systems

Sr. No.	Botanical name	English name/common name	Family
1	Faidherbiaalbida	Faidherbia	Fabaceae
2	Acacia auriculiformis	Auri	Fabaceae
3	Acacia catechu	Kher	Fabaceae
4	Acacia aneura	Mulga	Fabaceae
5	Acacia dealbata	Silver wattle, blue wattle	Fabaceae
6	Acacia decurrens	Black wattle or early green wattle	Fabaceae
7	Acacia farnesiana	Needle bush	Fabaceae
8	Acacia implexa	Lightwoodor hickory wattle	Fabaceae
9	Acacia leucophloea	Reonja	Fabaceae
10	Acacia mearnsii	Black wattle, Late Black Wattle or Green wattle	Fabaceae
11	Acacia melanoxylon	Australian blackwood	Fabaceae
12	Acacia mollissima	Black wattle	Fabaceae
13	Vachellianilotica	babul	Fabaceae
14	Acacia planifrons	Umbrella thorn	Fabaceae
15	Acacia Senegal	Kher	Fabaceae
16	Albiziachinensis	Albizzia	Fabaceae
17	Albizialebbek	Siris, woman's tongue tree	Fabaceae
18	Albiziaprocera	white siris	Fabaceae
19	Alnusnepalensis	Nepalese alder	Betulaceae

20	Alnusnitida	Kosh	Betulaceae
21	Samaneasaman	Rain tree	Fabaceae
22	Saracaindica	Asoka tree	Fabaceae
23	Sesbaniaaegyptica	Sanai	Fabaceae
24	Bauhinia variegate	Kachnagar	Fabaceae
25	Butea monosperma	flame-of-the-forest, palash	Fabaceae
26	Cassia fistula	Golden shower	Fabaceae
27	Cassia siamea	kassod tree, cassod tree	Fabaceae
28	Casuarina equisetifolia	Australian pine tree	Casuarinaceae
29	Dalbergialatifolia	Indian rosewood	Fabaceae
30	Dalbergiasissoo	North Indian rosewood,	Fabaceae
31	Delonixregia	Flame tree	Fabaceae
32	Gliricidiasepium	Quickstick	Fabaceae
33	Hardwickiabinate	Hardwickia	Fabaceae
34	Leucaenaleucocephala	white leadtree	Fabaceae
35	Moringaoleifera	Drumstick tree	Moringaceae
36	Oogeiniaoojeinensis	Sandan	Fabaceae
37	Parkinsoniaaculeata	Jelly bean tree	Fabaceae
38	Peltophorumferrugineum	Yellow flame tree	Fabaceae
39	Pithecellobiumdulce	Manila tamarind	Fabaceae
40	Prosopis alba	white carob tree	Fabaceae
41	Prosopischilensis	Chilean mesquite	Fabaceae
42	Prosopis cineraria	Ghaf	Fabaceae
43	Robiniapseudoacacia	Black locust	Fabaceae
44	Sesbania grandiflora	vegetable hummingbird	Fabaceae
45	Tamarindusindica	Tamarind	Fabaceae

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