沙漠研究 **22**-1, 127 -129 (2012)
Journal of Arid Land Studies

"ICAL 1 / DT X"
－Refereed Paper－

Sustainable Land Management to Combat Desertification in Pakistan

Zahid HUSSAIN[1] and Muhammad IRFAN[*2]

Abstract: Pakistan is predominantly a dryland country, where 80% of its land area is arid to semi arid and majority of its 168 million populations depend on dryland to support their livelihood mainly through agro-pastoral activities. Out of 79.6 million hectares of land area of Pakistan, 62.4 million hectares are susceptible to desertification, as only 4.2% of the total land is under forests. In view of the aridity, 60% of the country is classed as rangelands, 48% of these rangelands are degraded. However, like many other dryland developing countries, the majority of land is severely affected by land degradation. The desertification is mainly due to unsustainable land management practices. The situation is further aggravated by scarcity of water, frequent drought, flash flood climatic change impacts, which results in contributing to expansion of deserts, reduce land productivity and consequently increase in desertification and increase in rural poverty. There are policies, institutional, financial and socio-economic issues which affect adversely to sustainable overall land management in the country.

Key words: Desertification, Land management, Sustainable drought, Water management

1. Introduction

Desertification is basically an outcome of soil degradation. Decrease in land productivity is the direct effect of the desertification; the desertification is the cause of agricultural productivity losses and increases poverty, also reason of major reductions in carbon storage in soils, loss of biodiversity and increasing global warming. Decrease in vegetation, extra pumping of water and overgrazing are the major cause of desertification which increases the soil erosion, soil salinity, saline water and also cause of siltation in reservoirs. Rapid growth in population and inefficient agricultural practices are the manmade cause of increase in desertification.

Over 250 million peoples are affected by desertification, 3.6 billion hectares land area threatened by desertification and one billion people are under threat and 135 million peoples are homeless all over the world. In Pakistan where 80% area is semi arid and arid and 168 million populations depend on dryland to support their livelihood through agriculture. Out of 79.6 million hectares of land area of Pakistan, 62.4 million hectares are susceptible to desertification, as only 4.2% of the total land is under forests. In view of the aridity, 60% of the country is classed as rangelands, 48% of these rangelands are degraded.

Pakistan is running the national (Federal/Provincial organizations and NGOs) and international (UNCCD, UNEP, UNDP, GEF, FAO and WFP) projects to combat the desertification in different areas of country, and have successful achievements and lessons for future work.

2. Issues Related to Desertification

2.1. Water erosion

The soils in the Indus basin are undeveloped and surrounding mountains have world's largest and steepest slopes which convey snow melting and rainfalls to contribute the soil erosion, about 11 million hectares are affected by the water erosion and about 40 million tons of soil brought into the Indus basin each year. The upstream riverside of the dam is losing its top soil and downstream, sediments reducing the efficiency of the irrigation system.

2.2. Wind erosion

The force behind the land degradation in deserts of Thal, Cholistan, Ther, and Makran coastal areas is due to wind erosion, 0.5 m to 4 m moving sand dunes are present in these areas which create problems to cultivate the land, 28% of soil is removed by the wind of the total loss.

2.3. Deforestations

4.2% of the total land is under forests which are shrinking by 3.1% and wood biomass 5% annually due to deforestation. Pakistan is losing forest badly due to indiscriminate cutting, overgrazing, poor management and manmade changes which are desertification increasing factors.

2.4. Overgrazing

Overgrazing is also very serious matter to increase the desertification because it is the cause of reducing forests; it is

* Corresponding Author: u03337363314@yahoo.com
H.No. 185, St.No: 53, Sector G-10/3, Islamabad, Pakistan
1) Ministry of Food and Agriculture, Government of Pakistan 2) Ministry of Food and Agriculture, Government of Pakistan

increased day by day due to increase in livestock population. Overgrazing reduces the productivity of land due to soil compaction and vegetation.

2.5. Biodiversity

Increase in population, livestock and reduction in vegetation, illegal hunting, water logging and salinity of soil are the factors contributing the loss of biodiversity in the country. 31 species of mammals, 20 species of the birds and 5 species of the reptiles are listed endangered in the country.

2.6. Water logging and Salinity

The major reason of the water logging is excessive percolation from water channels system which higher the ground water level. The obstructions of the drains also increase the problem of the water logging. 11 million hectares area is affected by water logging and 2.8 million hectares area is affected by the salinity/sodicity in the country.

3. Techniques for Decrease Desertification

1. Irrigation improvements, which can reduce water loss from evaporation and prevent salt accumulation. Laser land leveling is the most important part of the land preparation, after leveling of land water conveyance in the field will be improved automatically because leveling provides an ideal slop for the movement of water from head of the field to tail of the field. Conveyance losses are reduced by the lining of the watercourses up to 30% after lining of watercourses 6 MAF water is saved which is now available for 17% more area for crop production, irrigation time saving is up to 28%, increase in cropping intensity 23% and labor saving is 50%. Permanent raised bed (Furrow Irrigation) is also good practice to replace basin irrigation system, the results reviled that water was saved 30 to 50% and yield increase in wheat crop from 8 to 15%, maize 15 to 30%, cotton 10 to 18% and fertilizer saving was up to 10 to 15%. The sprinkler/drip irrigation is the best method for reducing the water loss and improving the water use efficiency.
2. Re-vegetation, which prevent soil erosion from wind and water. Trees can reduce the local effects of drought and help to maintain normal rainfall patterns.
3. Crop rotation, different crops rotation on the same field for several different growing seasons. This will help to maintain the productivity of the soil by replenishing critical nutrients removed during harvesting.
4. Rotational grazing, the grazing should be rotational, any area of grazing leave before that will cause permanent damage to the plants and soil of any one area.
5. Terracing, which are leveled flat ground on the hills. This will slows the pace of runoff, which reduces soil erosion.
6. Windbreaks, which involve the establishment of lines of fast-growing trees planted at right angles to the prevailing surface winds. They are primarily used to slow wind-driven soil erosion.

These are some techniques which will help to reduce the desertification now we will discuss some case studies from country.

4. Case Studies to Combat Desertification

1. The study was conducted at Dingarh on the wind erosion control to stabilize sand dune. The research was on control of wind erosion by fixing and stabilizing the sand dunes by vegetation and some mechanical work at Cholistan desert.

   The study area was fenced for protection of natural and planted vegetation against grazing to present free movement of animals as a requirement for sand dune stabilization. The area was surrounded by micro-windbreaker to reduce wind velocity and stop movement of sand from surroundings. Checkerboard fence was raised by dub, these arrangements were to protect seeding until they were established and withstand for summer winds. Initially four types of trees were planted *Eucalyptus*, *Acacia*, *Tamarix* and *Zizyphus*. Ground water saline with total soluble salts (TSS) 2800ppm, sodium absorption ratio (SAR) 14, pH 8.5 was used finally 75% trees were established and survived successfully.
2. The study was conducted at Pothwar plateau for gully land management through soil conservation and water harvesting. Contoured trenches were constructed with small bunds across the slope of the land on the leveled land; the bunds were act as obstacle to the water flow for controlling run-off. To drain excess water outlets were provided. The tree plantation was made in the eye-brow terraces along the contours. The surface runoff was reduced by 19% with the eyebrow land shaping technique and Leucaena plant with elephant grass. Leucaena's growth rate was best by 23 cm/month, *Eucalyptus*, popular, mulberry, guava, apricot, loquat and ailanthus were also planted productively. Under rainfed conditions we can reclaim the gullied land by adopting this technique.
3. The study was conducted to range improvement through community participation; Pakistan Agricultural Research Council initiated Operational Range Management Program (OPR). In this program farmers were involved for rangeland management interventions on the farmer's field.

Reseeding, planting of trees and shrubs and fodder crops cultivation were done with the contribution of farmers. By adopting these techniques production potential is increased and reducing the soil erosion and providing better environment, 60 to 70 percent of the farmers of the area are growing now Dhaman, cowpeas and sorghum fodders, and now farmers in the area are seeking for help for establishing small scale commercial/livestock farms.

4. Salinity control and reclamation Program SCARP was launched for reclamation of salt affected soil in all over Pakistan by installing underground and surface drainage system in water logged soils by this program cropping intensity was increased up to 121% as whole. In the SCARP area the cropping pattern of rice, sugarcane, maize, and wheat were improved, cattle and buffalos population was increased by 67%, milk production increased up to 56.8% and meet production by 66%. Hence grass production showed 116% increase. In other study Kallar grass is widely distributed in the salt affected areas of the Pakistan. This grass has very good ability to reclaim the salt affected soil and used in the central Punjab and farmers are now aware to use this grass to improve their salt affected soils.
5. In Balochistan Fourwing saltbush can successfully be established in rangelands by using proper soil moisture conservation techniques. It has extreme drought and cold resistance and high quality browse during autumn and winter. Fourwing saltbush has very good ability of resprouting after cutting and also promoted as source of fuel wood and can help reduce uprooting of shrubs from already

References

AFNOR (1997): *Qualité de l'eau, méthodes d'analyses 3*, tome 4, pp 296.

Bahri A. (2002): Water reuse in Tunisia: stakes and prospects; *Actes de l'atelier du PCSI*, 28-29 mai Montpellier, France, 11 p.

Bauder J.W., Hershberger K.R., Bowning L.S. (2008): Soil solution and exchange complex response to repeated wetting–drying with modestly saline–sodic water. *Irrig. Sci*., **26**: 121-130.

Bouri S., Abida H., Khanfir H. (2008): Impacts of wastewater irrigation in arid and semi arid regions: case of Sidi Abid region, Tunisia. *Environ. Geol*., **53**: 1421-1432.

Haruvy N. (1997): Agricultural reuse of wastewater: nation-wide cost-benefit analysis. *Agri. Ecosyst. Environ.*, **66**: 113-119.

Mohammad Rusan M.J., Hinnawi S., Rousan L. (2007): Long term effect of wastewater irrigation of forage crops on soil and plant quality parameters. *Desalination*, **215**: 143-152.

Nakayama F.S., Bucks D.A. (1986): *Trickle Irrigation for Crop Production: Design, Operation and Management*. Elsevier, New York, NY.

Tedeschi A., Dell' Aquila R. (2005): Effects of irrigation with saline waters, at different concentrations, on soil physical and chemical characteristics. *Agric. Water Manage*., **77**: 308-322.

U.S. Salinity Laboratory Staff (1954): *Diagnosis and improvement of saline and alkali soils, USDA Handbook 60*. U.S. Government Printing Office, Washington, DC, USA, 160 p.

Yadav R.K., Goyal B., Sharma R.K., Dubey S.K., Minhas P.S (2002): Post-irrigation impact of domestic sewage effluent on composition of soils, crops and groundwater - A case study. *Environ. Internat.*, **28**: 481-486.