Mitigation of Desertification Process in India

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Introduction :Technology packages for dry-land areas have been developed by several agencies. For example, ICAR has developed many technology packages and likewise the Indian Council of Forestry Research and Education (ICFRE) for combating desertification and for mitigating the effects of drought. In addition, the traditional practices, which are still relevant, need to be revived, improved and incorporated in the programme. A few of the technology packages and traditional practices merit discussion here.

A number of technologies to combat the process of land degradation have been evolved by ICAR Research Centres and State Agricultural Universities which constitute the National Agricultural Research System (NARS). In Addition, the traditional technologies are also in use.

Technology packages can be broadly categorised as follows:

a) Technologies for conservation of soil, water and vegetation.

b) Technologies specifically to control land degradation in different bio-climatic regions: Arid, Semi-arid and Sub-humid.

c) Technologies for management and reclamation of degraded lands: Alkaline or Saline soils and water logging.

d) Traditional technologies for combating desertification.

e) Technologies for mitigating the effects of drought.

Technologies for Conservation of Soil, Water and Vegetation

Integrated soil fertility management

Soils in arid areas are generally of poor quality. Soil organic matter status regulates the available nutrient status of the soil not as source but also by buffering the soil reaction. Nearly 95 percent of nitrogen and sulphur are contained in soil organic matter. Bulk of the zinc and copper are also in organic form. Therefore, decline in soil organic matter level due to soil erosion by runoff or poor vegetal cover also multiplies the nutrient deficiencies. Management of soil organic matter at its equilibrium level therefore is one of the foremost frontal challenges of resource management in arid areas.

Integrated Nutrient Management

Since no immediate improvement in the use of chemical fertilizers is likely to take place in rain-fed areas, integrated nutrient management is the key to maintain the productivity of soils on a sustainable basis. Globalization may eventually result in steep rise in fertilizer prices in the near future making them beyond the reach of small farmers of arid zone. Large number of experiments at research and farmer fields has demonstrated the importance of organics, farm yard manure, compost and bio-fertilizers in supplementing the nutrient requirements of crops and providing stability to yields. Fifty percent of the fertilizer nitrogen could be replaced with the use of farm yard manure or compost in a variety of soils. Use of organic manures not only reduces the use of chemical fertilizer N requirement substantially in addition to supplementing important primary and secondary nutrients. The use of compost and farm yard manure also improves the soil physical condition and crop yield on a long term basis. In addition, it also improves the moisture holding capacity of spoils.

Availability of farm yard manure in quantities adequate to obtain good response in field crops is a major limitation for wide adoption of this technology in arid areas of India. Consequently, alternate sources like green leaf measures and crop residues have been evaluated at a number of locations in arid areas. Studies in alfisols and vertisols have

indicated that up to 20 Kg N ha-1 can be supplemented by following green leaf cover cum manuring technique through the addition of loopings of *Leucaena* or *Glyricidia*.

Double cropping could be possible in higher rainfall areas where a legume crop can be rotated to contribute in the maintenance of the soil fertility. In lower rainfall areas of arid areas, there are little opportunities for producing green manure without competing with the main crop. Therefore, strategies for non competitive production of green leaf manures and their incorporation in the soil need to be evolved.

Bund farming where nitrogen fixing trees and bushes can be raised on either side of the farms boundary bunds and the lopping incorporated in the soil. Yet another approach for arid areas could be to raise a post rainy season cover crop like horse-gram or cowpea utilising the off season rainfall and ploughing it back into the soil before flowering. A third method that may be tried is to raise leguminous trees and bushes on marginal lands and incorporate the loppings in the nearby fields. Some studies done by the agriculture department revealed that within two years *Leucaena leucocephala* grown on 0.25 ha of land could meet the nitrogen requirements of about 0.67 ha of sorghum crop. A minimum of two cuttings can be obtained in one season for incorporation in the crop field. This could be an excellent example of self sustaining agriculture system in such semi-arid areas.

The other method to enhance the use of organics could be the compost. This way animal manure , which is in short supply for use in rain-fed regions can be converted into compost, increasing the yield several fold yet the benefits remain the same or a shade better than farm yard manure. Moreover, decomposed manure would make the nutrients more readily available to the existing crop. Considering the local market price of farm yard manure, the cost of composting organic wastes along with farm yard manure may be on par with that of pure farm yard manure as the quantity of farm yard manure gets reduced substantially. It has also been reported that termite infestation is much less when compost is used, compared to farm yard manure.

Soil Quality Monitoring:

Maintenance of soil health is critical for sustained agricultural productivity more so in arid areas. In view of the problem of land degradation and nutrient deficiencies, linking of soil quality with crop productivity is necessary on a continuous basis. Rainfall variability among years further compounds this relationship. Nevertheless, soil quality monitoring on a regular basis under different cropping systems/land uses is necessary in order to capture significant enhancements or deterioration in physical, chemical and biological properties over time. While changes in physio-chemical properties affecting soil quality have been reported adequately through land use experiments, little information is available on biological properties. One can easily ascertain the significant effects of cropping systems and manuring practices on reversible and irreversible changes in soil micro-flora and its diversity. A number of parameters have been identified for monitoring of soil quality. The soil health index developed in US can be used as a starting point for work in this direction.

Permanent Vegetative Cover through Alternate Land-use Systems

Annual crops cultivated on land capability Class IV and above are prone to lower yields and risks, and lack of response to inputs. Soils in these capability classes can be best utilised for alternative land uses where self generating grasses, legumes and perennial woody trees constitute the major components. Agro-forestry approach that includes systems like agri-silviculture, agri-horticlture, hortipasture and silvipasture can be successful as an alternate land use.

Conclusion: Management of lands of lower capability through such interventions is the best way of integrating livestock production in semi-arid areas, thus contributing to the sustainability of the production system. Alternate land uses not only provide fodder, fuel wood and timber and fruits but also enhance the quality of resource base through greater biomass production and providing a land cover for most part of the year which constitutes the basic step for control of soil erosion by wind and runoff. Off season rainfall which otherwise

goes unutilised in single kharif cropping areas can thus be best utilised with such production systems. Trees also make the micro climate more favourable to crop growth.

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