Optimising forage production on degraded lands in the dry tropics through silvopastoral systems

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Introduction In India, 187 M ha out of a total area of 328 M ha face the problem of land degradation, mostly due to water and wind erosion. The problems are aggravated by poor land cover and increasing pressure of human and livestock populations. There is over-exploitation of the scarce resources of forage and firewood. Several techniques, including watershed based silvopastoral land use have been proposed (Patil & Pathak, 1977). Tree, grass and legume based systems have been tried after land treatment to reduce runoff and soil loss while meeting the forage needs of the livestock and firewood for cooking in many studies (Debroy & Pathak, 1983). Results of an operational research project on silvopastoral systems are reported in this paper.

Materials and methods Watershed-based land treatments such as staggered contour trenches, bunds, diversion drains, gabion structures were coupled with an appropriate silvopastoral model to rehabilitate four different types of degraded lands: degraded revenue lands and forests, salt-affected ravines and undulating terrains around Jhansi (central India). The experiment involved the tree species *Acacia tortilis, Albizia amara, A. lebbeck, Hardwickia binata* and *Leucaena leucocephala* planted at three spacings in associations with *Cenchrus ciliaris, Chrysopogon fulvus, C. setigerus, Dichanthium annulatum* and *Stylosanthes hamata, Macroptilium atropurpureum* on the degraded lands. Control plots were not given any soil conservation treatments, except protection from grazing. Initial application of fertiliser was 40 kg N, 40 kg P and 20 kg K/ha followed by 20 kg N/ha every year. Use of leguminous nurse crops seeded on the mounds on the side of trenches to assist better tree growth and edaphic enrichments, controlled grazing by livestock for testing the value of biomass produced and bio-economic modelling were attempted to evaluate the fitness of different interventions (Pathak *et al*., 1995).

Results The treatment with 600 contour trenches (3x0.4x0.5 m) per ha followed by seeding of grasses and legumes and tree planting (4x4 m) reduced soil loss from 17.8 to 1.26 t/ha/yr in 4 years. It also increased species richness and biodiversity of the natural vegetation. There were also improvements in the physical, chemical and biological properties of the soil. The production of herbaceous and woody biomass of less than 1 t/ha/yr was increased to 10 t/ha/yr with a 10-year rotation. There was a 7-fold improvement in crude protein. The system was evaluated by a mixed herd of cattle, sheep and goats grazing year-round in a deferred rotational system at the equivalent of 1 adult cattle unit per ha stocking rate after 7 years of establishment of the system. During the monsoon period the heifers grew 500 g/head/day without any supplemental feeding. During the remaining part of the year the animals gained 250-350 g/head/day after supplementation of concentrates and tree leaves. The models were able to predict the harvest cycle along with the yield to assist land managers. The benefit/cost ratio and the internal rate of return (IRR) from this project was 1.42 and 18 % respectively, ensuring the possibility of getting support from banks for the rehabilitation of dry degraded lands. Based on these studies, the species have been identified for scaling up forage and firewood production from different types of degraded lands in India (Pathak *et al*., 1995). Currently the Government is allocating >20 M ha degraded forest to the landless under Joint Forest Management, where this technology has a great scope to assure environmental conservation together with forage and firewood supply. It is assumed that if 50 % of the degraded lands are allocated to this technology, it will be possible to meet the deficits of fodder in the country (Pathak & Roy, 1994).

Conclusions Silvopastoral systems of degraded land management assured conservation of natural resources along with supply of fodder, grazing and firewood in addition to the environmental amelioration. Grazing livestock within the carrying capacity produced high levels of individual livestock production. Such projects have been found economically viable and environmentally sound. It has a great applicability as a technology.

References

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