Session 11: Agroforestry for salinity control and land rehabilitation
25th Aug 2009. Drs. Dagar, Khamzina, Lamers

1. Subject of the session

In this session 7 papers were presented dealing with the rehabilitation of degraded saline and waterlogged areas of arid and semi-arid regions. This aspect was investigated in several major agroforestry systems that included degraded cropland converted to tree plantations, windbreaks, silvopastoral system and protective tree belt planting for biodrainage management in Uzbekistan and India. Additionally, the research results on production uses of some of these agroforestry systems and their financial value were presented.

2. Key messages from the session

Agroforestry is bound to produce under even extreme soil saline conditions as occur in the salt-affected, irrigated croplands in Central Asia. Yet, the present perception of farmers for monoculture is a hindrance for the implementation of agroforestry practices to address soil salinity. Research findings showed that the root systems of the crops should be considered when designing agro-silvipastoral models in such saline areas. The transpiration of mineralized groundwater was facilitated by trees thus preventing a further salinity of the soils. The research also showed the importance of halophytes in silvopastural agroforestry systems. Finally, the introduction of native underutilized trees and shrubs are also important for additional income generation for the poor farmers.

Conversion of marginalized cropland, that produces low yields or abandoned from cropping, to tree plantation. This way tree-based systems can be introduced within the agricultural landscape for land rehabilitation without competing with agricultural land uses. Establishing tree plantation with well-adapted species on highly salinized land was feasible with little initial irrigation. The plantations effectively used shallow groundwater table which is common within irrigated cropland. Over 6 years, despite high production and transpiration rate, the 2 ha plantation was not effective in reducing the elevated groundwater table significantly to control soil salinity. The trees contributed to soil fertility by significantly increasing soil N (by 30%) and soil organic carbon stocks (by 20%). Among the ecosystem services studied, the Carbon sequestration is particularly important as it can be potentially monetized under the CDM thus increasing the motivation of land users to incorporate trees on the degraded cropland.

A financial analysis of afforesting marginal lands on experimental plantings was based on empirical data complemented with data on 15-20 year old trees growing naturally on marginal land. The twenty-year established growth functions for these species and their fractions, allowed analysing the benefits for capital investment in small-scale plantations by considering annual fuelwood, fodder and fruit production, plus the stumpage value after 20 years. The benefit-to-cost ratio (BCR) and Net Present Value (NPV) were compared at three discount rates. At a discount rate of 16% (base case), the NPV for *E. angustifolia* was greatest, followed by *P. euphratica*, and *U. pumila* showing a benefit-cost-ratio equal to 7.8, 2.2 and 1.8, respectively. The results demonstrated afforesting of marginal lands is a feasible land use option, which does not compete with food crop production. A change in land use policies of marginal land would thus provide direct economic benefits to rural farmers. But the in-depth financial analyses showed that long-term objectives need to be combined with short term incentives as to render such systems more attractive to land users. This as to respond to the question how can resource-constrained farmers be supported in their quest to adopt practices that in particular provide benefits in the long-run. Future agroforestry research should become more multi-purpose oriented and include collecting information about the different aspects of the AF system examined.

Under the situation of soil salinity and water logging, the use of saline or poor quality water is unavoidable; hence it must be used judiciously as to reduce as much as possible the damage done to soil health. The extended and in-depth studies in India showed that i) the cultivation of fruit trees can be an option for saline/sodic areas where pH is up to 9.5; ii)

Silvipastoral systems are successful agroforestry system for saline soils irrigated using saline water; iii) low water requirement crops like barley can be blended along with fruit trees to maximize production and control salinity; iv) medicinal plant and trees is another useful system that can be raised with a judicious use of saline water; and (v) petro crops such as Jatropha can be an option for such soil but they are frost sensitive.

Long term research showed that the advantages of biodrainage as an eco-friendly technique for combating waterlogging and salinity which is furthermore a less costly alternative compared to the conventional drainage. Benefit cost ratio for agroforestry models was found to be significantly higher than agricultures in saline areas in the research plots established by the Haryana forest department in India. Hence an agroforestry based model of biodrainage has been found most suitable for the combating waterlogging and salinity in canal command areas, located in semi-arid regions of India. This model has been adopted by farmers over an area of more than 5000 ha.

The examination of a windbreak system showed that physical and chemical properties of soil improved because the soil salinity reduced and the soil fertility increased. Moreover, the multiple environmental benefits represent also opportunities for the income generation of farmers.

3. Key new insights and new ideas

The session provided a new insight of the ecosystem services provided by integrating trees in the agricultural landscape. Most of the research results presented at the congress originated from the tropical regions of the world but the extent and knowledge of agroforestry systems functioning in arid agricultural environments is relatively scarce. Irrigated cropland although relatively small within the world's cropland area, are responsible for a substantial share (ca 40%) of the world's food crop production. Thus a better understanding of the functioning of agroforestry systems in irrigated agricultural environments is needed to promote agroforestry as a future of global land use. Particularly limited is the information on the services and goods provided by afforestation of degraded croplands including waterlogged areas, as these are not traditionally used for tree planting, but are primarily targeted within CDM. More research is needed to assess this alternative land use from ecological and socio-economic prospective.

Uzbekistan is an example of a country, where agroforestry systems are re-emerging after a long history of state-regulated agricultural production in which trees were hardly considered. Therefore such countries can benefit from ample research experience in similar agro-ecological environment such as in India, where forestry and agroforestry research have a long lasting experience. This includes in particular the extensive knowledge gained in the field of bio-drainage and salinity control. Hence, this advocates also the support for resource-poor farmers as a priority from governments for reclamation of saline areas

4. Action points for policy, research and extension or education

The research results on ecosystem services such as salinity control, watwerlogging, and land rehabilitation can be further enhanced by showing how they contribute to and diversify rural incomes as land users are rarely interested in environmental benefits per se. Translating these results into monetary terms also will help to communicate them better to policy makers.

Adequate funding must be ensured for rehabilitation of salt-affected, waterlogged, and potential waterlogged areas for increasing farm production and mitigating climate change.

Research attention should be drawn to the use of saline water for bio-saline agroforstry, silvicultural approaches and services and goods provided by tree planting on degraded croplands because these areas are primarily targeted within CDM.