



### Carbon Sequestration in Arid Ecosystems: Untold Benefit of Agroforestry

Archana Verma\*, Ram Partap, P. Rathakrishnan and J. C. Tewari

Central Arid Zone Research Institute, Jodhpur (Raj.)-342003

\*Email of corresponding author: [vermaarchana29@gmail.com](mailto:vermaarchana29@gmail.com)

Climate change is threatening the human existence. Dryland areas are said to be more susceptible to global warming because of already prevailing harsh and inhospitable climatic conditions. As agroforestry is practised traditionally in these areas it can be subsequently utilised for climate mitigation and adaptation along with other utilised benefits by intensification of woody components. Carbon storage has to be enhanced in the biomass as well as in soil to minimise the negative impact of emission of greenhouse gases.

#### Introduction

Global climate change has become a greatest global threat, humanity is facing today. Climate change is manifested by the reoccurrence of drought, floods, and famine that have threatened millions of people and livestock in recent decades. There has been substantial increase in the emission of greenhouse gases of which CO<sub>2</sub> has shown 31 per cent increase since 1750 (IPCC, 2001; Albrech and Kandji 2003). Climate change has now become a reality and arid ecosystems have to face the consequences in the form of erratic rainfall, rising temperature and increased incidences of other extreme events. Various international environment agencies, agreements like Clean Development Mechanism of the Kyoto Protocol and some voluntary carbon markets have emphasized on the tree planting projects to combat the increasing emission of the greenhouse gases.

Agroforestry, like many other land use systems, offers great potential for sequestering carbon. There are lot of evidences that agroforestry plantations supply abundant benefits to rural communities, national economy and our ecosystems. Mitigating the climate change and greenhouse gases through carbon sequestration because of greater efficiency of integrated systems in resource (nutrients, light, and water) capture and utilization than single-species systems is well identified (Nair *et al.* 2009). Therefore there is increased need of agroforestry not only because agroforestry has high carbon sequestration potential in long term (Fig. 1) but also many wastelands can be converted to agroforests of various kinds.

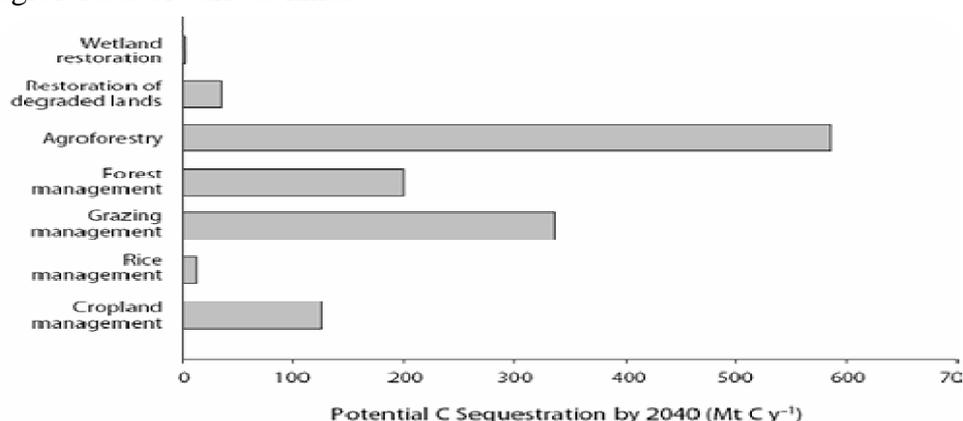


Fig. 1: Carbon sequestration potential of different land management options (adopted from IPCC, 2000)

### Agroforestry in Drylands

Agroforestry practices are major features of the land-use systems in the dry lands. Drylands covers 6.15 billion hectares *i.e.* 47.2 % of the world's land area. The 3.5 to 4.0 billion hectares are deserted or is prone to desertification (Lal, 2003). The drylands of India occupy an area of more than 3 million hectares. Like other drylands, they suffer from inherently low productivity due to low rainfall, high evapotranspiration and excessive wind-speeds (Harsh *et al.*, 2003). The major distinguishing feature for defining and for planning the arid zone is the low rainfall (below 500mm or Aridity Index <0.20) with CV around 50% variability. Therefore, the ecosystem and the socio-economic-cultural factors are very challenging in such areas. High wind and solar regimes further increase the effect of rainfall variability and whole complex makes ecosystem fragile in which small disturbance may cause great loss to the sustainability and sometimes such perturbations are irreversible. Due to so many constraints, drylands are vulnerable to many kinds of perturbations in agro-ecosystems however, but sustainability is required for food security, and as well as to mitigate and adapt to climate change. Agroforestry can provide a better production with structural diversity which provides ecological and environmental benefits.

It is a system that blends food and income security with ecosystem services (Nair *et al.*, 2008; Jose and Bardhan, 2012). The main focus of agroforestry systems in drylands should be attainment of diversity by minimizing the climatic disturbances and degrading environmental factors. The available natural resources should be judiciously used to provide monetary and ecological prosperities. The integration of woody perennials with fodder and food crops helps in making arid and semi-arid areas sustainable by providing multitudes of products for human and livestock needs. In addition to this various practices like conservation tillage, integrated nutrient management, rotation of crops and water conservation should be put into practice to enhance the environmental sustainability through diversified integrated farming systems.

### Factors Suitable for More CO<sub>2</sub> Sequestration in Arid Regions through Agroforestry

Agroforestry, mixed cropping and silvi-pastoral systems are traditional systems of farming practices in Rajasthan. Agroforestry systems with *Prosopis cineraria* and *Zizyphus nummularia* are practiced on fields and helps in increasing the yield of crop like pearl millet, mungbean, cluster bean etc. These systems further help farmers to sustain their livelihood, income profitability and mitigation of harsh climate which consecutively helps in their socio-economic-cultural upliftment. The arid zone trees provide multipurpose benefits like food, fodder, fibre and timber and their supply chain is already known as practice. One of the notable contributions of woody components for better livestock maintenance is nutritious leaf fodder provided by them. Top feed from trees provide proteinaceous fodder to animal diet during dry seasons. Therefore agroforestry plays a major complementary role in the arid regions and its practice should be promoted among farmers for its multiple utility.

### Scope of Carbon Sequestration for Farmers in Arid Regions of India

Arid regions are characterized by high temperatures, high PET, low and erratic rainfall. Desertification, high wind erosion and land degradation add the problems to the already prevailing critical climatic conditions. Agroforestry is the traditional land use practised by the farmers in these areas. Carbon sequestration activities are supported by clean development mechanism of Kyoto protocol through afforestation and planting of more trees to trap the carbon in the form of biomass. Farmers will get compensation of carbon they sequester on the basis of market price of carbon in

terms of carbon credits and gains in crop productivity as a result of carbon sequestration practices to be adopted on their fields. Each carbon credit is equal to one tonne of carbon dioxide sequestered issued by UNFCCC under CDM projects. Therefore, there is great scope of agroforestry in arid regions particularly north-western parts of India, for utilisation of its multiple uses as well as mitigating and adapting potential ever changing climate scenario.

### Conclusion

Agroforestry provides multiple benefits along with ecosystem services and has a great role in sequestering carbon in its multiple components. Agroforestry is a traditional practise in arid regions of India for the sustenance of livelihood. However the carbon sequestration studies are lacking in these regions. Farmers will get the carbon credit for each tonne of carbon dioxide they sequester. Therefore, agroforestry will play a major role in arid regions of India for its economic as well as ecological benefits to farmers.

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