

COCONUT AND ECOSYSTEM SERVICE

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1. INTRODUCTION

Horticultural crops in general and plantation crops in particular provide several ecosystem services to the mankind. Ecosystem services are those services provided by the natural environment to benefit both people and other organisms. They are the biological foundations that are linked to economic prosperity and other aspects of human well being. Some of the important ecosystem services include socio-cultural, crop biodiversity preservation, diversity of soil organisms, nutrient recycling, C sequestration, microclimate regulation, and water and air purification.

Coconut (*Cocos nucifera* L.) is one the most important crops grown in the humid tropics. Coconut palm is aptly called as 'Kalpavriksha', 'Tree of Life' 'Tree of Heaven' 'Nature's Super Market' because each and every part of the palm finds one or other use in everyday life. The versatile palm provides essential needs in every walks of human life viz. food and beverage, medicine, cosmetics, industrial raw material, construction material, cultural and religious functions etc. It also supports the livelihood of millions of people in the world, directly or indirectly.

India is one of the leading coconut producing countries in the world and it is cultivated in an area of 2.09 million ha with a production of 22167.45 million nuts during 2015-16. The average productivity is 10,614 nuts/ha. The role of coconut in India's economy is to be well appreciated in terms of total value, export earnings, as well as employment generation. However, looking at coconut from its product value alone underestimates its ecological significance. Coconut plays an important role in the ecological landscape of the country particularly in the hilly to mountainous areas planted to coconut.

SOME OF THE IMPORTANT ECOSYSTEM SERVICES PROVIDED BY COCONUT ARE LISTED BELOW.

2. Socio-Cultural Services: From time immemorial, cultivation of coconut palm has deep rooted cultural and spiritual connections in India. The palm plays an important role in

the life of the farmer and growing coconut palm was considered as important as bringing up a child, to this extent it is involved in the locals' existence. In earlier days, education of children as well as household expenditure was met by selling coconuts.

The de-husked coconut is an important offering to the deities in Hindu temples across the country and many family and social festivities are incomplete without its offering. The small sized coconuts are very popular among the Ayyappa devotees to offer ghee at Sabarimala temple. During temple festivals in Northern Kerala, where local folk dances are performed (e.g Theyyam), tender coconut leaves are used for dressing the performers. The coconut inflorescence and the leaves are used for decorative purpose for many social and cultural celebrations in different parts of Southern India. The plaited coconut leaves find use as roofing and fencing material of many rural homes. There are ample opportunities for recreational activities through Eco-tourism/farm

tourism with coconut grooves.

Among all the states of our country, our state 'Keralam' is the only one that can be proud to have the name after this important plantation crop.

3. Crop Species Diversity Preservation: In a systematically planted coconut garden (7.5 m x 7.5 m spacing), only about 25% of the soil area is actually utilized by the coconut palms. The remaining portion could be effectively utilized for growing other combatable plants as inter/mixed crops. An array of crops belonging to vegetables, tubers, spices, fruits, medicinal and aromatic plants, ornamental plants, cereals, pulses, fodder, beverage crop etc. could be accommodated as companion crop along with coconut depending on the growth stage of the main crop. The coconut based multi storied, multi species cropping systems have its own effect on the micro climatic parameters in the

and productive soils. Soil organisms are responsible for a large number of ecological functions and ecosystem services including: nutrient cycling and N₂-fixation, P-solubilization, decomposition of organic matter as well as carbon sequestration, maintenance of a good soil structure for plant growth and rainwater infiltration, detoxification of contaminants, control of pest and diseases (as bio control agents), etc.

Coconut rhizosphere harbours a wide range of beneficial microorganisms which take part in improving the nutrient and fertility status of coconut gardens. The belowground microbial diversity (general as well as function specific) is found to be higher in multiple cropped coconut gardens, than monocropped ones, and is greatly influenced by the type of above ground vegetation such as annuals biennials and perennials. Hence,

garden and thus, could be regulating the climate of that area.

Cultivating crops with different time of planting and maturity period provides opportunities to the farmer to plant and harvest crops at multiple points in the season to guard against total crop loss to environmental risks, price fluctuations as well as earn year-round income. Cultivation of coconut along the coastal belts has known to save the hinterland from cyclonic storms by absorbing the destructive forces of the wind and water and acting as a bio-shield. The non-uprooting of coconut palms along the seacoast during the tsunami is a testimony to the service of coconut to the mankind.

4. Diversity of Soil Organisms: Soil organisms are an inseparable part of agricultural ecosystems. The presence of diverse community of soil organisms is very much needed for the maintenance of healthy

the functioning of the below ground microbial communities greatly influences the stand of the above ground vegetation and both are highly interrelated. This, apart from crop diversity, also forms an important ecosystem service provided by the coconut based cropping systems.

5. Nutrient Cycling: The coconut palm is a unique perennial plantation crop and once it starts flowering, the productive phase lasts not only throughout the year but all through its economic life, which may average seventy years. Traditionally the nut is harvested and used either as whole nut (culinary purpose) or as copra (oil preparation), thereby removing all the nutrients contained in the nut taken up from the garden.

Some plant parts like coconut water, husk, bunch waste, coconut frond are left in the farm, though some of them are used as





fuel and transformed into ashes. Nevertheless, some plant parts of coconut (coconut fronds, bunch waste etc.) left in the garden itself undergoes decomposing and in turn supply back some of the nutrients removed from the soil. The understory vegetation could also provide significant biomass for nutrient recycling. Deep rooted companion crops could mine deeper soil layers and bring up nutrients.

The coconut palm generates large quantity of biomass which can be utilized for many useful purposes. One hectare coconut garden with bearing palms is found to generate around 8-11 tonnes of biomass which can serve as source of kitchen fuel and can also be recycled to make vermicompost, an ideal organic manure.

6. Carbon Sequestration: Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation and geologic formations. When more photosynthesis takes place, more CO₂ gets converted into biomass, thereby reducing carbon in the atmosphere and sequestering it in plant tissue as above and below ground biomass. Soil carbon plays a very important role in improving plant health, ability to make available nutrients to plants through microbial intervention, increasing water-holding capacity, maintaining biodiversity etc.

For the carbon sequestration, the measurement of the net annual CO₂ fixed in the coconut trunks and roots will reflect the capability of the plant to transform atmospheric carbon into biomass in the tissues of coconut. In the case of coconut, the annual carbon sequestration in the above ground biomass is reported to vary

from 15 to 35 Mg CO₂/ha/year depending on cultivar, agroclimatic zone, soil type and management. Assuming that the fronds, husk, shell and peduncle are used as fuel, the net CO₂ fixed by coconut in the roots and trunk is estimated by coconut researchers to be 12.81 Mg CO₂/ha/year. Different coconut types have different growth rate, and hence, they differ in the amount of carbon sequestered.

7. Soil Conservation: The role played by coconut palms on hydrologic characteristics including soil conservation of the coconut watershed also needs to be emphasized. Coconut as well as its companion crops provides sufficient ground cover thereby

intercepting raindrops and reducing terminal velocity of raindrops to prevent loss of soil by runoff, or other removal processes. Such a system also enables storage of transported silt and clay by ground cover. The fibrous mat of roots of coconut palms also helps in reducing soil loss through runoff.

8. Relationships of Coconut Ecosystem Services: Quite often, the multiple ecosystem services of coconut explained above pose possibilities for complementary or conflicting relationships. Complementarity of ecosystem services occurs when one ecosystem service could enhance the other, while conflicting relationship occurs when one ecosystem

service would deprive or worsen the use of other ecosystem service (Garcia et al.,2009).

Among the coconut ecosystem services, the opportunity for community diversity has the highest complementation with other ecosystem service. The score for food function is 0 depending on whether the vegetations under coconut canopy are food crops or not. The ecosystem service with the most negative relationship is fuel. It has a direct conflict with erosion control, community diversity, and nutrient cycling, because the use of coconut parts as fuel would give nothing for the other ecosystem service.

9. Conclusion

The highly versatile coconut palm offers considerable ecosystem services to mankind in

tune with “Nurturing Ecology and Nourishing Society”. Coconut ecosystem services like nutrient cycling, community crop and microbial diversity and soil conservation will have complementary relationships with all other ecosystem services. This clearly supports the rationale for taking up projects and programmes that will lead to coconut diversification, soil conservation and recycling of farms by products as organic manure to sustain the economic values of coconut agro-ecosystems.

Reference

Garcia, M.N.J et al. (2009). Valuation of Ecosystem Services of Coconut Types: Framework and Methodology Development. *J. Environmental Science and Management* 12(1): 68-78.