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Biodiversity Benefits of Agroforestry

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Abstract: Biodiversity has become one of the major environmental issues of our time especially with the on-setting climate change. The basic problem is the increased rate of extinction as a result of expanding human population, over exploitation of natural resources, land clearing and land use development for mono agriculture without vast integration of trees into crop production. Biodiversity refers to the life forms on earth and include the millions of plants, animals, birds and micro-organisms, the gene they contain and the intricate ecosystems they help to built into living environment. If the biological wealth of the world is to be maintained, the benefits of biodiversity in agroforestry need an international recognition. It forms the major part of our life-support systems. It constitutes the source of all our food and much of our raw materials. In order to create the necessary consciousness that would lead to wise use of land and conservation of biodiversity, the knowledge of the benefits of biodiversity in agroforestry should be wide spread. This paper highlights some of these benefits.
Keywords: Biodiversity, agroforestry, environment, ecosystem, fauna and flora, Biological wealth, livelihood.

INTRODUCTION

Agroforestry is the purposeful integration of forestry production and conservation practices with those of agriculture [1]. Reported that agroforestry could provide short term economic benefits while waiting for the long-term traditional forestry products, its benefits goes beyond economic but include biodiversity benefits.

By the close of the 1990's the international community became worrisome about scientists' reports on the environment which included loss of biodiversity as a result of nation's development activities. Consequently, treaties such as the Kyoto protocol were ratified with greater emphasis on the environmental service functions of alternative land uses. Agroforestry was identified as having numerous important environmental services [2] which include biological diversity; wood and non-timber products; healthy ecosystems; soil and water resources; maintaining carbon cycle; multiple socio-economic benefits and legal and institutional framework [3].

Agroforestry could be adapted in that it has various forms of practices and a general classification by [4] partitioned these practices into three major components which are: Agrisilvicultural which integrates crops and woody plants; Silvopastoral which integrates pasture and /or animals and woody plants; and Agrosilvopastoral which integrates crops, pasture and/or animals and woody plants. Despite these classifications the systems are further classed into two according to their functionalities. These are simultaneous agroforestry where the tree and crop components grow at the same time and sufficiently close to each other to allow competition for light, water and nutrients. Examples of this type are alley cropping, contour hedges, parklands, boundary plantings, home gardens and other silvopastoral systems. Sequential agroforestry systems are those where the maximum growth rates of crop and tree components occur at different times, even though both components may have been planted at the same time, and are in close proximity. Examples of this type are shifting cultivation, improved fallows, taungya and some multistate systems.

BIODIVERSITY BENEFITS

Biodiversity describes the total interaction of the genetic species and ecosystem levels of biological complexity of a particular region, and the influence of human cultural diversity on them. Biological complexity of the world changes as a result of evolution of new species, uncontrolled exploitation of non-renewable natural resources [5] especially forests and its numerous products beginning from trees to micro-organisms in forest soils, habitat destruction for agriculture, urbanization and industrialization, which results to loss of biodiversity [6]. Agroforestry could play an important role in biodiversity conservation within deforested fragmented landscapes through the

provision of habitats and resources for plants and animal species, maintaining landscape connectivity (and thereby facilitating movement of animals, seeds and pollen), making the landscape less harsh for forest-dwelling species by reducing the frequency and intensity of fires, potentially decreasing edge effects on remaining forest fragments and providing buffer zones to protected areas [7]. Greater diversity in the agroforestry systems would result to greater ability to conserve native plants and animal species. Some agroforestry which closely mimic the natural ecosystem e.g. home gardens, agroforests as well as rustic coffee and cacao agroforestry systems shows a variety of niches and resources that support a high density of plant and animals, though usually less than that of intact forest [8].

In areas where most of the landscape is occupied by croplands, linear riparian buffers and field shelterbelts could be useful for maintaining plant and animal biodiversity mostly in a changing climate as ours. Agroforestry could add plant and animal biodiversity to landscapes that might otherwise contain only monocultures of agricultural crops [9, 10]. Agroforestry provides opportunities for birds to nest on forage that were not available in the mono-cropping cornfield. A study conducted by [10] reported that only one species of bird nested in the cornfield while seven species nested in the agroforestry system. Ten species and two species foraged in the agroforestry system and cornfield respectively. Homestead forest has moderately high biodiversity and species richness.

Healthy forest Ecosystem

Agroforestry plantings could help in the restoration and addition of structural and functional diversity to landscapes. They could restore many ecological functions if strategically located [11]. Agroforestry systems could provide ecological resilience and contribute to the maintenance of beneficial ecological functions such as soil improvement and water quality.

Soil Improvements

In Agroforestry soil improvement is associated with the growth of nitrogen fixing trees or deep-rooted trees and shrubs that increase nitrogen availability through biological fixation, recycled plant nutrients from depth and build up soil organic matter [12]. Accumulation of organic material and nutrient storage in biomass, increased root density as well as greater vertical extension of tree roots help in maintaining nutrient stocks by reducing leaching losses or by taking up nutrients from deep layers. With proper designed and management, agroforestry techniques could contribute to ecosystem protection and forest restoration functions.

Water quality

Trees in agroforestry system could influence water cycling by increasing rain and cloud interception, transpiration and retention of water in the soil, reducing run off and increasing infiltration. Riparian forest buffers is efficient in reducing water pollution from agricultural activities when they are well designed and properly located while infiltration in areas cultivated with maize or soya or under pastures was five times less than under riparian strips cultivated with a variety of plant and tree species, meaning that the latter had much more higher potentials to prevent surface runoff from reaching water courses. Agroforestry system could reduce ground water contamination by nitrate and other substances that could be harmful to wildlife population, microorganisms as well as human health.

Maintenance of soil organic matter

There are three major ecological zones in the tropics namely humid, sub-humid and semi-humid. Biomass from multipurpose agroforestry species is adequate to maintain soil organic matter at about 60% or more, than that under natural vegetation. That level is generally accepted to be adequate for soil fertility.

Maintenance of soil physical properties

Soil physical properties could be as important as nutrient levels in terms of fertility and crop production. With a satisfactory level of organic matter, the added benefits from tree root systems will ensure conservation of physical properties. One of the direct evidences of biodiversity benefit in agroforestry is that soil physical properties are maintained under hedgerow intercropping [13].

Reduction in soil acidity or acidification

Acid soils with acidity level of less than 5.0 are predominant in the humid tropics and have been a serious problem in some part of the sub-humid zone. Acidity in this respect would lead to phosphorus deficiency and aluminum toxicity. The mass of calcium and magnesium derived from tree litter though very small could exert a buffering effect, helping to check acidification thus providing suitable medium for microbial populations in the soil as well as encourage increase diversity in the population of non-tolerant plant species.

Water availability to crops

Water availability to crops is many a time more important for crop production than nutrient supplies. When crops are stressed of water there are possibility of wilting and progression to a lethal state. Cultivation of many non-drought tolerant crops would be difficult and could lead to extinction. However, agroforestry systems could bring about reduction in evaporation by 20 to 30% as recorded for wind breaks.

Reclamation of degraded soils

Trees have been successfully used in the reclamation of saline soils, notably in India [14] and the

more the land area brought into use the more the flora and fauna populations. There is a positive relationship between productive soil and healthy forest stands either in agroforestry systems or in the natural, which in turn houses the largest biodiversity of the world.

Erosion control

The more the proportion of fine sands the drier the soil and the greater the susceptibility to wind erosion because these particle are small enough to be carried and are not cohesive. Soils with least ground cover are obviously the most prone to erosion, while the more elevated parts of the landscape tend to receive the highest wind speeds and so are also very susceptible. Trees could provide shelter against prevailing winds and thus decrease wind speed. Trees are effective at decreasing soil erosion when planted at 90 degrees to the prevailing wind. Areas prone to wind erosion are coastal sand dunes and inland rainfed farming areas where soils are sandy and mean annual rainfall is less than 400mm per year. Alley farming, which involves planting rows of trees to form alleys between rows of crops or pastures, may be suitable in these conditions. Trees are often planted at 90 degrees to the prevailing wind to form a permeable barrier. The spacing and height of the rows of tree help determine the amount of shelter which they provide for the crop or pasture in between [15].

Food, medicines and non-timber forest products

Biodiversity is vital in supporting human life on Earth. It provides many benefits, including all our food, medicines, and industrial products. It supplies clean air, water, and fertile soil as already mentioned. Indigenous peoples' food (fruits, herbs, nuts, resins, wax, oils) form part of rich knowledge of the systems. Traditional food systems typically draws on local biodiversity and are based on local production and management of land through one form of agroforestry systems or the other [16]. From a wide range of ecosystems, some 7,000 of the earth's plant species have been documented as gathered or grown for food [17] and thousands more have medicinal properties [18].

Environmental conservation

Biodiversity conservation is vital to the balance and stability of the environment, which involves ecosystems conservation, water protection, soil protection, erosion control and environmental conservation. The biodiversity benefits which come from agroforestry are both obvious and numerous. Tree integration in cropland prevents or slows down rapid change of the environment in maintaining balance with the immediate environment. The trees prevent heavy rains from turning into floods, while plants and animals are kept well fed and healthy. Reproduction in animals and birds species is known to be higher when food flourishes in their habitats. Trees play important role in absorbing greenhouse gases, act as carbon sink, and maintained balance with the environment. Through photosynthesis, trees absorb and store atmospheric carbon, which helps to combat global warming and purify the air we breathe.

Health-care delivery

From historical time, extracts from plants and animals in the wild have been used by man. In Southeast Asia, about 6,500 and in India 2,500 plant species are used by traditional healers [19]. In China, over 5,000 medicinal plants have been catalogued; of which some 1,700 are in common use [20]. In Nigeria, thousands of plants species are in common use by different ethnic groups in the country as herbal remedies for various ailments, and have subsequently been incorporated in farming systems with food crops. The Food and Agriculture Organization (FAO) of the United Nations, plant-based medicine is said to provide primary health-care to some 75-90% of the world population, mostly in developing countries where world commercial alternatives are unaffordable or unavailable [21].

More importantly, research into traditional medicine has led to the development of many modern medicines. Antibiotics, aspirin, atropine, quinine, digitoxins, and other heart drugs, hormones, morphine, tranquilizers and ulcer treatments for example are among the drugs that are plant or animal derived [22]. In all, more than 74% of plant base drugs are used for the same or similar treatment in both traditional and modern medicine [21]. New medicines are continually being developed from a huge variety of live-forms. For instance, micro-organisms have been the sources of more than 3.000 antibiotics. The ability of sharks and amphibians to avoid infections has led to the discovery of new antimicrobial compounds that are being tested as contraceptives and for treating sexually transmitted disease. In spite of these enormous contributions of biodiversity to medicine through the adoption of agroforestry systems, only a minute proportion of the world's plants and animal (only about 5,000 species of higher plants worldwide for instance) have been investigated for their value as medicines [23].

CONCLUSSION

Having highlighted the benefits of biodiversity in agroforestry, the next line of action should be that of informing and educating people in the world community on how more of the earth's biodiversity could be preserved and protected through adoption of some forms of agroforestry systems especially as it could be adopted in any part of the world. To this end, schools at the primary, secondary and tertiary levels should incorporate agroforestry and environmental education into their curricular.

REFERENCES

1. Ruark, G. A., Schoeneberger, M. M., & Nair, P. K. R. (2003, March). Roles for agroforestry in helping

to achieve sustainable forest management. In *United Nations Forum on Forests (UNFF), Intersessional Experts Meeting on the Role of Planted Forests in Sustainable Forest Management. Wellington, New Zealand*.

2. Beer, J., Harvey, C. A., Ibrahim, M., Somarriba Chávez, E., Harmand, J. M., & Jiménez Otárola, F. (2003). Service functions of agroforestry systems. In *12. World Forestry Congress. Quebec, Canadá, 2003, páginas 417-424*.
3. Ruark, G. A., Schoeneberger, M. M., & Nair, P. K. R. (2003, March). Roles for agroforestry in helping to achieve sustainable forest management. In *United Nations Forum on Forests (UNFF), Intersessional Experts Meeting on the Role of Planted Forests in Sustainable Forest Management. Wellington, New Zealand*.
4. Nair, P. R. (1985). Classification of agroforestry systems. *Agroforestry systems*, *3*(2), 97-128.
5. Unanaonwi, O. E., & Amonum, J. I. (2014). Changes in tropical forest vegetation composition: The long term impacts. *International Journal of Development and Sustainability*, *3*(3), 456-465.
6. Awodoyin, R. O., Egunjobi, J. K., Ogunyemi, S., Amodeni, A. A., & Adedeji, A. (2001). Homegardens in Biodiversity conservation: A case study with Urban Homes in Ibadan, South Western Nigeria. *Proceedings of Forestry Association of Nigeria*.
7. Perfecto, I., Rice, R. A., Greenberg, R., & Van der Voort, M. E. (1996). Shade coffee: a disappearing refuge for biodiversity. *BioScience*, *46*(8), 598-608.
8. Noble, I. R., & Dirzo, R. (1997). Forests as human-dominated ecosystems. *Science*, *277*(5325), 522-525.
9. Guo, Q. (2000). Climate change and biodiversity conservation in Great Plains agroecosystems. *Global Environmental Change*, *10*(4), 289-298.
10. Olson, R. K., Schoeneberger, M. M., & Aschmann, S. G. (2000). An ecological foundation for temperate agroforestry. *North American agroforestry: an integrated science and practice. American Society of Agronomy, Madison, WI*, 31-61.
11. Nair, P. K. R., Daniel, N. M., Roland, J. B., & Christopher, R. L. (1998). Nutrient cycling in tropical agroforestry systems. *Agroforestry in sustainable agricultural systems. Advances in agroecology. CRC Press, Washington DC*.
12. Hulugalle, N. R., & Kang, B. T. (1990). Effect of hedgerow species in alley cropping systems on surface soil physical properties of an Oxic Paleustalf in south-western Nigeria. *The Journal of Agricultural Science*, *114*(3), 301-307.
13. Rosewell, C. Soil Loss. A programme to assist in the selection and management of practices to reduce erosion. 1993. Department of conservation and land management, Gunnedah. p 127.
14. Singh, G., Gill, HS. Abrol, IP.(1991). Agroforestry for alkaline soil. 1991. *Agroforestry today* 3:10-11
15. Robinson, J. G. (2006). Conservation biology and real-world conservation. Conservation Biology, 20(3), 658-669.
16. Bruner, A. G., Gullison, R. E., Rice, R. E., & Da Fonseca, G. A. (2001). Effectiveness of parks in protecting tropical biodiversity. *Science*, 291(5501), 125-128.
17. Hunter, M. L. (Ed.). (1999). *Maintaining biodiversity in forest ecosystems*. Cambridge university press.
18. Myers, N. The Tropical Forests and Our Future. 1984. Norton and Co. New York.p339.
19. Thorhaug, A. (1979). Utilizing botanical resources in the People's Republic of China. *Resource Recovery and Conservation*, *4*(1), 105-110.
20. FAO. Trees for Life. FAO World Food Day Publications. 1991. FAO Rome. Pp26.
21. Litvinoff, M. (2013). *The Earthscan action handbook for people and planet*. Routledge.
22. Krieger, K. (2010). WWF-World Wide Fund for Nature. In *International Encyclopedia of Civil Society* (pp. 1666-1667). Springer US.