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DIVERSITY EVALUATION: A CRITICAL FOREST CONSERVATION STRATEGY

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ABSTRACT

Forests remain one of the most diverse terrestrial ecosystems with a variety of natural resources including trees species. Over the years, there has been drastic decline in forest composition especially valuable trees species, mainly as a result of anthropogenic activities, indiscriminate exploitation and ultimately, poor conservation strategies. This problem is a global concern, and has necessitated the adoption of sustainable forest management techniques in the recent time. Several efforts had been invested to salvage forest resources from being lost, however, a great number of forest trees is continuously threatened by extinction. Diversity study is an highly essential technique which helps in providing background information for species conservation, management and improvement. Despite its immense significance as an important forest conservation strategy, it has not been giving much attention needed to explore its potentials considerably. This paper review takes a critical look into the significance of forest diversity assessment with a view to sensitizing forest conservationists and research scientists in the field on the need to give the technique more consideration.

KEYWORDS: Forests, Ecosystems, Diversity, Habitat and Conservation

INTRODUCTION

Biological diversity is described as variations among set of entities; within the living world, including all living organisms both individuals and their relationship with one another where each species plays a fundamental role (Emma-Okafor*et al.*, 2009; Jones and Lawton, 2012). The presence of different species ensures ecosystem resilience and the ability to keep life conditions within tolerance levels around an oscillating equilibrium (Lenton and Lovelock, 2000). Biological diversity is an essential factor in ecosystem management and is critical for assessment of population dynamics and other population parameters. The twenty first century is experiencing a dramatic decline in biological diversity especially in the tropical regions as a result of increasing anthropogenic pressure (Battipaglia *et al.*, 2015; Cazzolla, 2016).

Forests constitute an integral part of the world's ecosystems, and approximately 80,000–100,000 different tree species are estimated to cover 31% of land area globally (Food and Agricultural Organization FAO, United Nations). Tropical forests are species-diverse terrestrial ecosystems with a variety of life-sustaining natural resources which vary greatly from one place to another mainly due to bio-geographical variations, differences in habitats and disturbance species (Whitmore, 1998; Kumar *et al.*, 2006). For example, the dominant family in the Neo-tropical lowland is the Leguminosae and it has the most abundant species in most lowland forests of Africa, whereas in the Southeastern Asia, the dominant species are the Dipterocarps (Richards, 1952; Gentry, 1988; Whitmore, 1998). The prominent structural features of the African lowland tropical forests are a greater abundance and diversity of lianas than in either Neotropical of Asian forests, or a higher total basal area (Gentry, 1998). The diversity of the tropical forests is majorly determined by the diversity of its trees species considering the fact that trees provide resources and habitats for almost all other forest species (Huston, 1994; Whitmore, 1998). There is rare assessment of biodiversity in some tropical areas due to hinderance posed by species abundance, remoteness and ecosystems complexity (Danielsen *et al.* 2000; Bonn and Gaston, 2005; Cazzolla, 2016). Despite the high number of known species, approximately 450 different forest tree species are actively part of a deliberate domestication process through tree improvement programs. The majority of the world-wide forests represent natural forests (93%), with 12% dedicated as conservation forests. A major challenge regarding forests status is the diminishing forest genetic diversity as documented as early as 1967 (FAO, 2014). Among the tropical areas, Africa is one of the least studied regions, especially in terms of rainforest diversity (Mayaux *et al.*, 2013). Whereas, assessment of forest diversity is very a important step in forest management, being a crucial aspect for increasing tolerance to stress, climate change and reducing pest and pathogen attack to ensure better productivity. Despite its immense significance as an important forest conservation strategy, it has not been giving much attention needed to explore its potentials considerably. Therefore, this review aimed at highlighting the significance of forest diversity evaluation in order sensitize people on its need as a conservation strategy.

Significance of Forest Diversity Study

Forest trees diversity assessment render numerous functions such as:

(i)**Unraveling evolution of forest tree species**

Forest trees diversity studies provides the fundamental basis for evolution of forest tree species. It has enabled valuable assessments of forests and trees species with respect to adaptation to changing and adverse conditions for thousands of years, and has resulted in a unique and irreplaceable area of forest management technique. Despite its popularity, the vast majority of forest genetic diversity remains unknown, especially in tropical forests. It has been estimates that, the number of tree species vary from 80 000 to 100 000, yet fewer than 500 have been studied in any depth for their present and future potential. Until recently, studies of forest tree genetic resources have concentrated on domesticating those few deemed most applicable for wood, fibre and fuel production from plantations and agroforestry systems.

(ii) Climate change and pests control

The impact of forest diversity study can be much appreciated with the illustration by Commission on Genetic Resources for Food and Agriculture presented below:

Changing weather patterns are altering the growing conditions for forest trees as well as the population dynamic of the pests and diseases that attack them. In Canada, cold winters used to prevent or reduce the spread of a bore beetle plague. The insect is now, with warmer winters, expanding into new areas and attacking pine trees that have no resistance, and therefore threatening the genetic diversity of forest populations.

Improving knowledge of forest genetic diversity, including on pest resistance, will be increasingly important in forest management.

(iii) Estimating genetic loss

Each year, 13 million ha of forests are being lost, mainly through conversion to other land uses. While this loss is somewhat offset by 5.7 million ha of new forest restoration and afforestation annually, the earth is still losing some 200 km^2 of forests each day. It is impossible to accurately estimate genetic loss that is resulting from deforestation and forest degradation given our general lack of knowledge of forest genetic resources (www.fao.org).

(iv) Detecting appropriate sustainable management approach

The sustainable management of forests requires a better understanding of the specific features of forest trees and their genetic diversity. Forest trees are generally managed with long rotation periods (the time between regeneration and harvesting), from 5-10 years and up to 150-200 years. With climate change, it can no longer be assumed that today's growing conditions will be the same in 100 years and adaptability to change over lengthy rotation periods will increasingly be an important management consideration.In recent years, motivated in large part by wide-spread loss of species and natural habitats, ecological research has focused increasingly on the consequences of exploitive and long-term management activities for species diversity.

Consideration of biological diversity has also guided the design, implementation, and critique of existing policy on natural resource management (Harris, 1984; Salwasser, 1990; Westman, 1990; Lubchenco *et al.*, 1991). With the exception of the humid tropics, nowhere has the relationship between natural resource use and conservation of biodiversity been more controversial than in the Pacific Northwest region of the United States (Swanson and Franklin, 1992; Lippke and Oliver, 1993).

Information on species diversity and distribution patterns are essential for helping managers evaluate the complexity and resources of these forests (Kumar, 2006). Trees form the major structural and functional basis of tropical forest ecosystems and can serve as robust indicators of changes and stressors at the landscape scale.

(v) Other Significance of Forest Diversity Study

Knowledge of the genetic diversity within and among forest tree species could provide an important basis for maintaining food security and enabling sustainable development (FAO, 2014). Furthermore, according to Ilga and Yousry (2014), genetic diversity assessments also serves several important purposes: (a) as a resource for tree breeding and improvement programs to develop well-adapted tree species varieties and to enhance the genetic gain for a multitude of useful traits; (b) to ensure the vitality of forests as a whole by their capacity to withstand diverse biotic and abiotic stressors under changing and unpredictable environmental conditions; and (c) the livelihoods of indigenous and local communities that use traditional knowledge.

Conclusion

Forest loss and degradation remain major global concerns as a result of pressures on forest lands and the effects of unsustainable use of forest resources despite the enormous efforts invested to achieve a sustainable forest management system. The great potential of forest genetic resources is thus at risk of being lost forever if necessary intervention is not put in place. For this reason, there is increasing awareness of the critical values of forest genetic diversity in the area of conservation of forests and trees.

The sustainable management of forests requires a better understanding of the specific features of forest trees and their genetic diversities. Forest tree species are generally long lived and extremely diverse. A certain species can occur or survive in a broad range of ecological conditions, climatic conditions or threats.

Molecular markers and marker mapping are essential part of the intrusive new genetic that is pushing its way in to all areas of modern biology, from genomics to breeding, from transgenic to developmental biology, from systematics to ecology, and even, perhaps especially in to tree and crop physiology. These are helpful in selection for hybridity, disease resistance and wood quality, pest resistance, adaptability to survive drought or wetter site. Some traits and markers are conserved across related species and so comparative genomics of traits and markers between trees also help in breeding process.

Markers will probably continue to enjoy increased application to forest genetic studies (such as diversity and conservation, phytogeography, mating systems) and tree improvement (fingerprinting, paternity analysis, breeding and testing, QTL mapping, Marker Assisted Selection) though most effort is likely to be concentrated on few highly valued species.

Therefore, the genetic diversity study of forest trees species can help in discovering novel genotypes that can adapt to various conditions and this will help in breeding and improvement.

Recommendations

Forest trees diversity assessment is quintessential in tree breeding and conservation programmes. It helps in understanding of the dynamics of plant resources, sustainable management, utilization and conservation. Monitoring the diversity of tree populations through diversity tracking in primary forests can improve knowledge on how ecosystem services and goods are being delivered.

Moreover, more attention should be drawn to molecular diversity studies of forest species, as this will save time in the evaluation process and it is more efficient and reliable than the traditional approach.

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