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Biodiversity and conservation of Mangrove ecosystem around the World

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INTRODUCTION

Biodiversity, as its name suggests, is a diversified way of encircling variety of life forms on our planet, from a single level of organization till the biosphere. It generally acknowledges the assortment of existing lives on basis of taxonomy, function, phylogeny, tropic or genes (Naeem et al. 2016). Multi-functionality is the term which would appropriately merge with biodiversity, which comprises several ecosystems together. The biological diversity comprises of diversity at the genetic level, diversity at the species level and diversity at species and ecological levels (Plas et al. 2016; Shanmughavel 2007). Biodiversity is a mixture of species and functional oriented things whereas ecosystem encompasses biomass (Mora et al. 2011). Further, the verity of an ecosystem comprising biotic diversity involves forest, grassland, desert, tundra, freshwater and marine ecosystem.

Apart from this ecosystem, there is a unique ecosystem known as mangroves ecosystem which is a marginal ecosystem inhabiting the estuarine and intertidal regions or the interface between land and sea in both tropical and subtropical latitudes confined largely to regions between 30° North and South of the equator (Vannucci 2000; Das et al. 2014). They are also known as coastal rainforest, tidal forest or coastal woodland. There are about 1, 59, 041.5 km2 of mangrove forests which are less than 1% of all tropical forest throughout the world, and less than 0.4% of the total global forest estate (Lavieren et al. 2012). It is distributed in almost 123 countries and territories all over the world comprising

diversified mangrove flora and fauna. Higher percentages of world's mangroves ecosystem can be found in Asian and African countries followed by America (South and Central) (Kathiresan 2010; Saranraj and Sujitha 2015). Their distribution around the globe can be categorized into various territories of West and Central Africa, East and South Africa, Australia and New Zealand, South Asia, North and Central America, South America, South East Asia, Pacific Ocean, Middle East and East Asia (Spalding et al. 2010).

MANGROVE BIODIVERSITY

Mangrove ecosystem is rich in genetic diversity due to the occurrence of both aquatic and terrestrial species and their adaptability to a wide range of rough environmental conditions such as high salinity, high temperature, muddy anaerobic soils, extreme tides and strong winds, which fluctuates violently and frequently (Vannucci 2000). Overall the biodiversity of mangroves ecosystem can be broadly categorized into two groups i.e. exclusive/ major mangrove species (also called strict/ obligate/ true mangrove) and non-exclusive/ minor/ associates mangrove species (Tomlinson 1986). The major species are the strict or true mangroves. The minor mangrove species are less conspicuous elements of the vegetation and rarely form pure stands mostly involves different endophytes. As reported by Das et al. (2014), there are over 74 true mangrove plant species within 27 genera, which belongs to 20 families dispersed through the world (Ward et al. 2016). Only the plant species along with some of their endophytic microorganisms such as bacteria and fungus have been explored up to certain extents. Mangrove-associated microbes include bacteria, fungi and fungus-like protists, macroalgae, seagrasses, saltmarsh (Spartina) and other floras such as different epiphytes (Kathiresan 2010). In the tropical mangrove forests, there are approximately 100 epiphytic species from the families' Orchidaceae, Bromeliaceae, Cactaceae, Araceae, Piperaceae, and Polypodiaceae scattered through the canopy and on trunks of mangrove trees. Mangrove-associated faunal species are zooplankton, sponges, ascidians, epibenthos, infauna, meiofauna, prawns, shrimp, crabs, insects, mollusks, fish, amphibians, reptiles, birds and mammals (Giri et al. 2011).

IMPORTANCE OF MANGROVE DIVERSITY

Mangroves are also an important livelihood source for people's living around mangroves forest. Local communities in mangroves ecosystems collect fuelwood, fodder, and medicine from plant parts, harvest fish, and other natural resources. Again the evolved ability to resist the biotic or abiotic stress and survive is an attributed to their adaptability/ tolerate towards hostile ecological conditions through alteration in physiological processes resulting from several novel bioactive products like hormones, antioxidants, secondary metabolites, resistant proteins and sterols (Basha and Rao 2017). A number of these bioactive

compounds have substantial pharmacological properties and are being used traditionally for medication against several health disorders and ailments (Edreva et al. 2014). The therapeutic extracts of roots, barks, leaves, fruits and cell-free extracts of the microbes have been evaluated for various ethnomedicinal uses for the complete/ partial treatment of malaria, filaria, inflammation, dysentery, diarrhoea, cholera, lung infection, gastrointestinal infection, metabolic disorders etc. (Sosovele et al. 2012; Mendhulkar et al. 2017; Thatoi et al. 2016; Gopal et al. 2016). Despite these conspicuous importances and the resourcefulness of its biotic and the supporting abiotic natural components or mangrove ecosystem as a whole are neglected up to great extents. The extensive and over-exploitation of mangrove biodiversity is slowly taking a shape of an irreversible change which might cast mankind a great deal in in future. Therefore it an urgent needs to conserve this ornamental virtue of the Mother Nature which is a gift to mankind.

CONSERVATION OF MANGROVE BIODIVERSITY

In recent decade, it is visualized that the marginal ecosystem which is considered as an ornament land mass to which it belongs are slowly decorating due the extensive and rapid deforestation, industrial development, fisheries aquaculture, human settlement and climate change; still mangroves survive and perhaps even thrive with the predicted changes in climate in areas occupying high-relief islands and remote areas where humans are unlikely to block landward migration. Moreover, an only new discovery of species and theories will not be much fruitful in conserving biodiversity, it is a necessity to maintain and stabilize the richness and diversity of species within these ecosystems. Conserving the genes will certainly pave new directions for future uses. Now, for conservation, several field surveys are done according to the systematic position of the species, nomenclature, geographical abundance, morphology, anatomy etc. (Shanmughavel, 2007).

For the conservation process, first the list of the species which were obtained through the full fledge data coverage and surveys are collected, and accordingly, the species which are threatened, are made aside, so that more care can be provided to them. Secondly, private sectors measure the amount of risk associated with these endangered species. Thirdly, several investments on the improvement of the species and spreading its conservation strategy are done. Likewise, the conservation plans are spread to millions. Some of the conservation tools used in this processes are the IUCN Red List of Threatened Species, the IUCN Red List of Ecosystems, Protected Planet, World Database of Key Biodiversity Areas and several others (Bignoli et al. 2016). Apart from the above species level conservation, a vast spectrum of structural basis socioeconomic level conservation is also an essential requirement. These include overarching legal and policy

frameworks that define right and ownership, enhancement of the technical, legal and financial capacity of the local inhabitants. Advanced techniques and tools should be available for the improved maintenance at the cheaper price. Better adaptation and disaster risk reduction plans must be designed to withstand the unpredictable natural calamities. And finally for endurable management of the mangrove biodiversity or the ecosystem as a whole will be successful when it is supported by accurate data and precise knowledge, understanding, and awareness for the need of implementation (Lavieren et al. 2012).

FUTURE PROSPECTS

Future is always unpredictable, but by assumptions based on scientific data analysis or observations, leading to results and conclusions that bring the researchers slightly close to definite prediction. So a collection of data and arraigning them into useful information and then their proper interpretation gives us a slight idea of the future condition and prepares us for a prepared tomorrow. Present data shows mangrove biodiversity to possesses versatile bioactive compounds that have heterogeneous application in the field of biomedical, agriculture, industries etc. (Mendhulkar et al. 2017). But still, then there is a vast gap between the practical broad spectrum uses of the serviceability rendered to the mankind from mangrove biotic diversity or biodiversity. This gap is not merely because of the in-capacitance of the service abstracted from mangrove biodiversity but rather the process involved in their abstraction and application. Currently, new or improved amalgamated scientific phenomenon or technologies exploiting this scientific phenomenon are under study to develop the serviceability or the applicability of mangrove biodiversity for the betterment of mankind as a whole.

This might be the better truth or prediction of the future of the mangrove biodiversity which possibly does not need any justification to prove because it is inevitable. If the seven billion populations are unaware of the fact of their greedy exploitation then it is certainly overdue for thinking. Some of the experimented ideas that could possibly be used for conservation of the biodiversity of mangrove ecosystem directly or indirectly involve coastal rehabilitation, alternative mode of livelihood support resilience-building and empowerment. Furthermore, a global partnership which would further support these projects of conservation in terms of revenue (IUCN 2016). Therefore it can be concluded that future of the mangrove ecosystem lies in the hand of mankind. It is now time to either conserve or continue the greedy extraction of the resourcefulness of the mangrove ecosystem.

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