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Disturb and perish, conserve and flourish – regenerating forests: a review

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ABSTRACT

Forests are valuable natural resource system and have tremendous influence on the environmental conditions and human welfare. A dense forest cover reduces soil erosion, regulates stream flow and heat budget of the area, maintains atmospheric humidity and soil moisture, and provides shelter to a diverse variety of flora and fauna. The most important cause of forest depletion and biodiversity loss in tropical and subtropical regions is shifting cultivation and logging for timber-based industries. Substantial reduction in forest cover is also caused by fuel wood extraction. Mizoram has an extensive forest cover of about 19,563 sq km, which accounts for about 92.8% of the total geographical area during early 1990's, but has been significantly reduced in the past decade. The rich forest flora and the vegetation diversity of the state, at present, have been under critical conditions of alteration and depletion. The need and suggestions for conserving and regenerating the forests are discussed in this paper.

Key words: Flora; forest; natural resource; regeneration; seed; species; trees.

INTRODUCTION

Forests are complex and self-perpetuating system, which cover about 26.6% of the world's land area.[1] They are valuable natural resource system and have tremendous influence on the environmental conditions and human welfare. A dense forest cover reduces soil erosion, regulates stream flow and heat budget of the area, maintains atmospheric humidity and soil moisture, and provides shelter to a diverse variety of flora and fauna. Besides influencing the environmental conditions, forests have profound link with the human welfare which is very important in developing places like Mizoram, where more inhabitants are still directly depending upon the natural resources of the forests as food, fuel, fodder, medicine, shelter, etc. Forests, therefore needs to be conserved and protected or managed scientifically to support the economic activities of human on a sustainable basis. On the other hand, destructive exploitation of forests caused serious economic, social and environmental losses.

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TROPICAL FORESTS (SUSTAIN OUR DEMAND FOREVER?)

The tropical region of the world, where about 2.5 billion people depend on the natural

resources for economic and environmental goods and services, has faced the most serious depletion of forest.[2] It's rain forests are disappearing at alarming rates world-wide, exceeding 1-4% annually of their current area,[3] and we know next to nothing of the majority of the species' interactions within tropical rain forests and therefore how vulnerable they will be to anthropogenic disturbance, how quickly they will be lost and what can be attempted to slow down this extinction.[4] In modifying wild areas beyond recognition, people are creating new types of habitats.[5] The most important cause of depletion and biodiversity loss in this region is shifting cultivation and logging for timber based industries.[6]

Population densities of many of the tree species are often very low and selective logging can easily cause local extinction. Timber species having higher wood quality are the first choice to be selectively logged from rich tropical forests, often illegally by 'tree poachers' and ignorant and unlicensed local people. Thus, only trees in the most remote and inaccessible parts are likely to flourish. Substantial reduction in forest cover is also caused by fuel wood extraction, since nearly 3 billion people worldwide depend on wood, primarily on natural forests and trees outside forests areas, as their main or only source of household energy.[2]

Many processes contribute to the maintenance of tree diversity in tropical forests. Recently studied processes include density and frequency-dependent recruitment success,[7] dispersal limitation,[8] and niche differentiation or resource partitioning during early recruitment.[9] Forest biodiversity is also affected by numerous scale dependent factors like climate, substrate, and site history, with successional development and direct management, including coppicing and grazing by wild ungulates or livestock.[10]

In order to know the co-existence of tree species in the tropical forests, attempts have been focused on biotic interactions and specialized regeneration requirements of the tree species.[11] Disturbances such as gap formation, herbivory, landslides and logging affect the abundance and composition of the seedlings in the forest understorey,[12] and therefore, play an important role in tree regeneration processes. The importance of disturbance for maintaining community composition, and for determining population dynamics has been studied in a variety of ecosystems. In many of these systems, either increasing or decreasing disturbance changes overall community structure.[13]

WHAT ABOUT US?

Mizoram having a geographical area 21,081 sq km, and lying within one of the biodiversity hot spots of India, has an extensive forest cover of about 19,563 sq km, which accounts for about 92.8% of the total geographical area during early 1990's, but is heavily dominated by jhum fallows. There is only about 19.92% of the total areas which seems to consists of forest trees (with canopy cover > 40%) free of shifting cultivation.[14] Shifting cultivation is the main cause of deforestation, as has also been practiced almost everywhere in the tropics and subtropics.[6] The state is a 'paradise' for diverse of flora and fauna owing to its moderate winter and summer temperature, tropical location and abundant rainfall. Thus, the state has been harbouring ca 1360 flowering species of which 892 are reported dicotyledons.[15] This figure justify that the state contributes a good proportion of the North-eastern flora which combinedly records about 8000 species, about half of the total Indian flowering plant.[16] Though the state occupies only 0.64% of the total area of India, it harbours about 8% of the total country's flowering species. However, the forest flora and the vegetation cover of the state, at present, has been under critical conditions of alteration and depletion brought about by human activities to great extent and by natural factors to a lesser extent.

In the early 1990's the total forest cover in the state of Mizoram was as high as 19,563 sq km (92.8% of the total geographical area), which alarmingly decreased to about 17,494 sq km (82.9% of the total geographical area) in 2001.[14,17] Thus, in a decade (i.e., 1990-2001) the

state loses about 2,069 sq km (10.58%) of the forest cover, which is too large to be neglected for geographically small state like Mizoram. As stated earlier, the main causes of loss in forest cover are logging for timber trade and fuelwood, and continued practice of shifting cultivation. At present only ca 16,717 sq km (79.30% of the total geographical area) has been covered by forests, and the rest (20.70%) remain open (Statistical Hand Book of Mizoram 2006). The mature forest in the state are found only in protected areas like national parks and wildlife sanctuaries, and few patches here and there in the remote and inaccessible areas or otherwise protected by village communities.

Men-induced threat includes factors like destruction of forests for agriculture, urbanization, heavy exploitation of various gene pools due to collection of woods for timber and domestic fuel that leads to rapid and often irrevocable transformation in the landscape. Developmental works carried out here and there, though not as much as other states of India, like construction of roads, establishment of small-scale industries, etc without much awareness to its impact on the ecosystem, are also important factors, which leads to degradation of forests. A rapid increase in human population since five decades ago (for example, in 1991 census there were 6,89,756 persons, whereas in 2001 census there were 8,88,573 persons) leads to increase in demand on natural forests areas for cultivation, fuelwood, timber, etc., which in turn brought about destruction of natural forests at a greater pace year after year.

In comparison to other states of the country, Mizoram ranks one of the least populated states, with a density of 42 individuals per sq km (Statistical Handbook of Mizoram 2006), yet their impact on ecosystems through various activities is too conspicuous due to the fragile nature of the hill ecosystems. Nevertheless, the major destructing factor of the forest existence is the age-old slash-and-burn agriculture (shifting cultivation). Disturbances, whether natural or man-made have much influence on community composition, tree population structure and regeneration ability of the forest ecosystems.

NATURAL REGENERATION

Regeneration of trees refers to the recruitment, survival and growth of tree seedlings and sprouts in a given area. When the source of this process occurring in nature is from seeds or other vegetative propagules, the regeneration is known as natural regeneration. Harmer[18] defined 'Natural Regeneration' as the establishment of trees from seeds that fall and germinate *in situ*. Whether the regeneration occurs by natural or artificial means, it is important not only in revegetating an area but also in the survival and continuity of a species.

FACTORS AFFECTING NATURAL REGENERATION

The success of tree regeneration in a forest is determined by successful completion of several events in the tree life cycle such as seed production, dispersal to safe sites, germination and seedling emergence, establishment and onward growth.[19] The successful regeneration is also determined by the presence of sufficient number of seedlings, saplings and young trees in a given population. Tree regeneration is influenced by the interaction of biotic and abiotic factors of the environment to a greater extend.

Seed production is affected by several factors like resources availability, pollination failure, predation on flowers, fruits and leaves, climatic conditions, age and size of the plant and its genetic constitution.[20] For the successful regeneration of a species, it is necessary that the seeds are dispersed to a 'safe site' where they will germinate and establish seedlings. Since each species has its own characteristic requirement, a site, which may be safe for one species, may not be safe for another. The heterogeneity in edaphic, biotic and abiotic factors in an ecosystem can therefore play a vital role in both species as well as genetic diversity.[17] Due to this heterogeneity the same site may not be a safe or favourable one for other species or indi-

vidual of the same species.

During seedfall as well as post-seedfall period, seeds are exposed to various threats, apart from abiotic factors like above-mentioned habitat heterogeneity, as predation by animals, birds and even human. Thus, seeds are required to be dispersed to sites where these stresses are low. The interplay between seed predation and dispersal is an important determinant of seedling establishment.[21] It has been argued that seed predation decreases with distance from the parent tree and the 'escape hypothesis' seems to hold good in many plant communities.[22] Differences in the magnitude of spatiotemporal variation near and far from adult plants can influence the pattern of survivorship and recruitment as predicted by the escape hypothesis.[23]

A FRAGILE PROCESS (DO NOT DISTURB)

Once a species arrives in the community (through seeds, etc.), the main barriers to the successful establishment and expansions of a species are abiotic stress, competition from established species, herbivory and parasitism, and the lack of mutualists. A combination of abiotic factors and biotic interactions which works as a filter to determine which species will successfully colonize is the most influential factor in the germination and early establishment phases.[24]

For certain species disturbances, creating gaps, are a primary requirement to regenerate. However, when disturbance (especially of man-made) continues for a long periods, the forest ecosystems are degraded and eventually transformed into other land-uses. Therefore, the presence or absence of disturbances (Natural as well as due to human activities) alters local immigration and extinction processes.[25] Once the seedlings established themselves to a particular site they need to grow to adult plants to colonize the area. The frequency, duration and degree of disturbances are, therefore, crucial factors for natural regeneration. There is a general agreement among plant ecologists that seedling recruitment is the most critically important stage for understanding the dynamic assembly of ecosystems.[26]

This is because the final configuration of the community is controlled by safe sites and barriers to survival that are species-specific and variable over space and time.[10,27] Multiple requirements need to be met for a microsite to be considered a safe site, including the existence of suitable conditions for germination, favourable conditions for early growth and an absence of consumers or competitors that would prevent a seedling from reaching adulthood. Eminent as well as young scientists are, therefore, alarmed to join hands in putting their effort to study the regeneration pattern of various species of our forests, so that these species are allowed to continue their traits and in turn, our forests be conserved. [26]

It is, therefore, clear that forests needs to be conserved as they are the only source of energy for domestic purposes as well as the only source for construction of shelter and making of furniture and household goods for majority of inhabitants of the state. Let us conserve and give our forests a chance to regenerate and flourish, rather than continue to disturb them, for our next generations.

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