CHAPTER: I

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1.1. BACKGROUND

The relationship between human beings and their environment is constantly evolving and changing, and thus, provides numerous avenues for a fascinating study into this dynamic relationship. Prehistoric man was completely dependent on forests for their survival. Every component of their livelihood was natural product. However, apart from food, shelter and building materials, only a few other articles were essential to meet up their needs like making of hunting instruments, dresses, satisfying evil forces which (they believed) were causing distress and diseases to man and their pets, etc (Tucker, 2008). Requirement of firewood was less and dead timbers were abundant in the forest for this.

Over time, humans learned to use a wide array of forest products for their sustenance, comfort and happiness. Over centuries humans continued to increase their dependence on forests and other natural products, and this unabated process of natural resource extraction and usage by humans, has contributed to widespread environmental degradation and damage (Das, 2012). In this aspect Moore (1995) and Salem *et al* (http://www.unep.org) argued that, "Economic growth by its very nature creates negative spill over effects for the environment". Today humans continue to extract resources from the environment and dump the waste back into the environment, in the past two hundred years, the rate of forest extraction continued to increase with the improvement of health care techniques, as the population structure also continued to increase in parallel.

Today humans have learned to exploit forests in innumerable ways and the forest areas on this planet are dwindling steadily at every moment. Every year we are losing 5.2 million hectares (0.13%) of forest cover around the world (FAO, 2010) and in every hour we are loosing three species (Dattagupta, 1999). During 1990 – 2000 the planet has lost 16 million hectares of forest cover every year and this trend is continued (FAO, 2010). In general, the ratio between the rates of deforestation and reforestation is 10:1 around the world and 5:1 in Asia (Bagchi, 2001). In 1980 the rate of global energy consumption was 10 TW (Terra Watt); by 2025 the same global population would require 55 TW (Brundtland, 1987) and these requirements will be fulfilled by the exploitation of the existing renewable and the non-renewable resources.

People living in forest villages are known to take care of forests for their own survival. The close interaction of local communities with the forests and their dependence on various forest products is one of the most important factors identified as contributing to the continued survival of forests (Gokhale *et al*, 2004). However, this precarious balance is threatened due to high discount rates and short-term decision-making, rural households are reported to be participating in increased unsustainable practices to ensure survivability (Shone and Caviglia-Harris, 2006).

Human dependence on nature for fulfilling various need continues to increase every day, and this dependence is not only restricted to the forest products, but extends beyond excavation of minerals, acquiring land for urbanisation and the construction of factories, exploitation of oceanic biodiversity etc. Everything is increasing at an exponential rate. This increasing over dependence is causing irreparable damage to the nature and modifying the habitat availability and quality in such a way that numerous species are being ousted on a daily basis (Sarkar *et al*, 2009) as human influence continues to impact the environment. The most sever impacts are being felt by forests that have been cut, degraded and modified to suit human needs and if this trend continues unmitigated (FAO, 2010). There is an ever increasing threat of forest cover declining to critical threshold levels. Given this, it is important to recognize factors that influence forest growth.

1.2. ROLE OF FORESTS FOR THE SOCIETY

"Achievement of all the Millennium Development Goals will depend on maintaining the environmental goods and services that are crucial to human productivity" (Cottray *et al*, 2006). We exploit tangible benefits from the environment like water, stones, minerals, timber, NTFPs etc – and are considered as environmental goods. From the ecological or amenity perspective, forests absorb carbon, regulate soil, water levels and nutrients, protect biodiverity, improve resilience and adaptation capacity – and are considered as its services (Prakash *et al*, 2010; Bishop, 1998). Like sea and other hydro-ecosystem, forest ecosystem plays a prominent role in controlling environmental well being. Broadly forest services are ecological, socio-cultural and economical. Richards *et al*. (2003) classifies forest services in the following way:

"1. *Direct use values*:

- extractive uses-marketed or subsistence forest products
- non-extractive uses- ecotourism, recreation and scientific studies, cultural or spiritual values to forest users.

2. *Indirect use values*: Forest users and people outside the forest receive forest benefits as environmental or ecological services.

3. *Option values*: Various stakeholders keeping open the option of receiving future direct and indirect use values through undiscovered environmental, pharmaceutical or scientific values of forests.

4. *Non-use values*: It accrues mainly to people who do not use the forest, but who value the fact that it exists – its biodiversity.

5. *Bequest value*: The value (to current users) being able to pass on the forest in its present condition as an inheritance to future generations."

1.3. DIFFERENT FACTORS INFLUENCING FOREST GROWTH

Forest growth depends on the combination of environmental factors such as climate, soils, slope and aspect, and elevation, all of which affect not only to determine the vegetation type, but how fast they grow and their form at maturity, as well as determine the micro-climate of a site (McCoy, 1995). Extreme temperature has large impact on the survival and distribution of plants (Blennow, 1997). Such effects vary with distance from the forest edge, canopy structure, topography (which influences aspect and drainage), and soil type (Grimmond *et al*, 2000). .Linking environmental variation to population dynamics is necessary to understand and predict how the environment influences species abundance, distributions and other ecological factors in a forest system (Dahlgren, 2008) or in a vegetation.

1.4. NON-TIMBER FOREST PRODUCES (NTFP)

Socio-cultural environment grew within the human society for its own survival and a separate knowledge base developed in the form of ethno-botany or ethno-medicine (Vandebroek *et al*, 2011). 'Scientific research is revealing an ever increasing number of links between biodiversity and human health, not only in terms of food resources or food security, but also with regard to materials to treat and cure diseases' (Pandey *et al*, 2010; Chakravorty *et al*, 2011). Medicinal plants – which are very important NTFPs - constitute the principal source of ingredients for traditional medicine (Almeida *et al*, 2006; Kumar *et al*, 2011; Machkour-M'Rabet *et al*, 2011). 4,22, 000 flowering plants are reported from the world (Govaerts , 2001), of which more than 50,000 are used for medicinal purposes (Schippmann *et al*, 2002). In India medicinal properties have been assigned to several thousands – 43% of the total flowering plants (Pushpangadan, 1995). The use of different plant substances for medicine is a bridge, linking conservative users of all groups and religions. Forest dwellers inherit a rich traditional knowledge and are very much concerned about their degradation in wild (Uniyal *et al*, 2006). Ethnobotany, ethnobiology, ethnoecology (including ethnopedology and ethnoclimatology), traditional

environmental knowledge, ethnoveterinary, folk medical, and pharmaceutical knowledge are now recognized as being inextricable components of culture, and therefore worthy of being protected and sustained (Pieroni *et al.*, 2005). In addition to their medicinal value some plants have dye yielding properties and plays important economic role in the local communities. Dye substances of plant origin are present in many wild and cultivated species (Guarrera, 2006), and thus, dye is another very important NTFP to be considered. Approximately 450 taxa are known to yield dyes in India alone, of which 50 are considered to be the most important (Chandramouli *et al*, 1995). It is interesting to note that over "2000 pigments are synthesized by various parts of plants, of which only about 150 have been commercially exploited" (Siva, 2007). Dye yields from plants are environment friendly compared to recent day's synthetic dyes (Siva, 2007; Gokhale *et al*, 2004). However, dyes are one of the most important uses of the plants, as it relates with cultural practices, rituals, arts and crafts, fabrics and to satisfy personal embodiment (Gaur, 2008). Excluding the above mentioned uses of NTFPs, some other uses are noticed viz. rope making, plate from leaves, collecting and selling wild mushroom and honey (Moerman, 1998). People also harvest and use different fruits and nuts, vegetables, mushrooms for their subsistence (FAO, 2010). Around 75,000 flowering plants are edible of which about 3000 are regarded as source of food (Krishnamurthy, 2003). In addition to use of different floral species forests provide us some other benefits – carbon sequestration, supply of clean water and soil formation – which may count as NTFPs.

1.4.1. RATIONALE TO CONSERVE NTFPS

The conventional view of villagers using forests solely to provide fuel-wood and fodder must be challenged in the light of the multiplicity of products those are provided by forests. However, the forests managed by Governments were simply to sustain the forests' productive role for the timber industry (Khanal, 2006). With the promulgation of Wildlife protection Act, access to collection of NTFP and fishing has been prohibited in some states causing deteriorating relationship between forest department and forest user groups (Das, 2005). A full understanding of the complexity of forest usage by local people leads also to a need to change management strategies for these areas (Malhotra *et al*, 1993). Indigenous management systems tend to be responsive to external factors such as demographic, economic, political and ecological change, which may lead to an increase of tenure insecurity and to destructive harvesting practices (Berg *et al*, 2000).

Recently, management of NTFP has caught the attention of conservation scientists as a means of ensuring forest conservation and as an alternative to conversion (Srivastava, 2007; Hiremath, 2004). Non-timber forest products (NTFPs) are wild plant and animal products harvested from forests, such as wild fruits, vegetables, nuts, edible roots, honey, palm leaves, medicinal plants, poisons and bush meat (Andel, 2006; Forest Practices Board, 2004). It is different from timber and important as a conservation strategy as the assumption is that the forest will remain standing and more or less biologically intact under sustained NTFP harvesting (Neumann and Hirsch, 2000). NTFP plays an important role for ecological conservation, building socio-ecological relationship and economic development of a region (Forest Practices Board, 2004). Some studies have found critical links between plants and other plant and animal species (O'Hara, 1999). This link creates ecological and socio-cultural environment in an area. Looking several aspects of NTFP's importance we have to frame suitable management strategy for its sustenance.

So far, we have experienced several management practices to manage forest resources. Government, private, community, government and forest people and present model public-private partnership approaches in management are operative. Several significant flaws are noted in several management practices and observed community manage forest resources comparatively well than other systems. In terms of harvest of forest products, a heterogeneous interest considerably plays positive role for the management and sustenance of a forest. Joint Forest Management (JFM) in Indian context may be fruitful if the power of management is solved and government provides local users de-jure right on the property they manage. A leasehold forest for the poor is an approach to

address the problems of both poverty and land degradation (Kunwar and Adhikar, 2007). Social research can help in developing strategies for the management and sustainable use of forest resources (Monteiro *et al*, 2006). The present generation should pass on to the children of future generations an adequate supply of natural capital which they will need to live adequately (Cowles, 1995). The Environment (Protection) Act, 1986 empowers the Government of India to take all measures required to protect and improve the quality of environment (Datta *et al*, 2006). So, preparation of National NTFP policy to institutionalize the harvest and sale of Non-Timber Forest Produces (NTFP) may be the answer of this question.

1.4.2. NTFP IN POVERTY ALLEVIATION

Excluding the timber, all other plant parts are also useful to the people. "NTFP is not only an important food source for people and their livestock but also contributes substantially to household cash income" (http://www.cifor.org/publications/ corporate/cd-roms/bonn-proc/ pdfs/ posters/ T2_FINAL_PujaSawhney .pdf). Despite the small cash incomes from trade, they provide an important contribution that complement the diverse livelihood strategies within a household, especially for the poorer sectors of rural society (Shackleton and Shackleton, 2004). Therefore, the harvesting of NTFPs contributes to poverty reduction, securing both food and income for local communities (Das, 2005). According to the United Nations Food and Agriculture Organization (FAO, 2010), it has been estimated that , millions of household depends heavily on NTFP products for income generation worldwide and NTFP marketing is approximately US$16839 million worldwide.

Even though the major bottlenecks affecting productivity of NTFPs is the poor market access and the absence of proper infrastructure (Feto, 2009). In Sri Lanka, communities living in the Peak Wilderness Sanctuary derive up to 53 % of their income from NTFP's or up to 58 %, if subsistence products are taken into account (Wickremasinghe, 1993). However, the vicious circle of increased poverty, with reduced bargaining capacity by collectors, can lead to an increase in unsustainable harvesting intensities as collectors require harvesting more to obtain the same income (Ruiz-Perez, 2005). A combination of conflicting plant parts harvesting and use regimes result in distinct ecological effects of NTFP use (Runk *et al*, 2004). Recently people are recognizing the importance of NTFPs from their long standing view over forests as the only source of timber (Pandit *et al*, 2004). People have started realizing its substantial subsistence, environmental, economic and cultural impacts. Around 10 % of the 7,000 estimated plant species of Nepal have been officially cited everywhere as NTFPs (Khanal, 2006). NTFP is potentially obtainable from about 3000 species found in the forests of India (Das, 2005).

1.4.3. VALUATION OF NON-TIMBER FOREST RESOURCES

In many developing countries, rural populations exploit non-timber forest products such as vines and edible fruit for both subsistence and sale, but this activity is rarely recorded and is thus easily ignored by forest authorities (Bishop, 1998). "Under-valuation of material goods alone from the forests of India is reflected in their estimated (real) value of about US$ 43.8 billion compared to forestry's share of GNP of US$ 2.9 billion. The difference will increase further if an imputed value is assigned to the environmental contributions of forests" (Verma and Kumar, 2006). Collection and processing of NTFP is a significant economic activity (Das, 2005.). Pandit *et al* (2004) recorded 132 species of plants or their parts are used as NTFP in Jaldapara Wildlife Sanctuary. People of Jainti harvests around 35 commercial plant species for selling and their average monthly income is around Rs.2716/- (Sarkar and Das, 2012).

1.4.4 INDIA'S PERSPECTIVE

Incidentally 347.217 million hectare — approximately 14 percent of global forest has been designated as protected area (PA) around the world, to conserve biodiversity in their natural habitats (FAO, 2007). However, such reserves are cornerstone of biodiversity conservation within a confined area (Folke *et al*, 2002).

India is rich in biodiversity, harboring about 8 % of the total world biodiversity. Around 45,000 plant species are present in India (MoEF, 2005a, www.ifs.nic.in/rt). The extent of annual depletion of forest cover prior to 1990 was 0.03 % (MoEF, 2005b). Thanks to recent policy initiatives, the decline in forest cover has been arrested. Forest cover increased at an annual rate of 0.57 percent (0.36 million ha) between 1990 – 2000 (FAO, 2005; FAO, 2007). However, the tempo could not be maintained and the annual rate of increase fell to 0.04 % (0.03 million ha) between 2000 – 2005 (FAO, 2005). Further, it will be wrong to assume that such a positive national trend is visible uniformly across the country. For example, the trend of deforestation has been continuing unabated in East Himalayan region (Das *et al*, 2010).It should be noted that around 15.6 million hectare (23.04 %) of recorded forest area is under Protected Area (PA) network in India (FAO, 2005), being the last available habitat for different endangered species.

Buxa Tiger Reserve (BTR) is an extension of Sub-Himalayan West Bengal with an area of 760.87 sq km and the 15th Tiger Reserve in India. This is the house of 597 floral species (Pestonjee and Dutta, 1999). A considerable proportion of these species are used as NTFPs. Core area of BTR is inhabited by at least112 species of NTFPs (Sarkar and Das, 2012). This is an important place to understand the socio-ecological dimension (Das, 2005).

1.5. CARBON SEQUESTRATION

Carbon (C) pool of a forest can actively be influenced by adapted forms of forest management that increase forest productivity and, thereby, increase the C input to the soil (Jandl *et al*, 2006; FAO, 2010). This can have tremendous effect on the growth and availability of NTFPs, which can be crucial in sustaining communities that are dependent on these products for their livelihood and sustenance. In addition to that, it may help people to enter to the upcoming carbon market.

1.6. SOIL AND WATER – ROLE OF FOREST

Forests affect the rates of soil formation or erosion (www.forestfacts.org/l_3/forests_5. htm). "The dynamic interaction between vegetation and soil is so strong that it's unclear which is dominant" (www. forestinfo.org/Products/eco-links/05-4ForestSoil.PDF). Accumulation of organic substances in soil may depend on the plant roots (Plyusnin, 2003). Chemical composition of soil regulates the growth of vegetation type and their health. It's retaining water and in catchments forests generally result in cleaner water to downstream (IUCN, 2008).

1.7. UNDERSTANDING THE BTR VEGETATION

Forests of BTR are very old, quite stable and probably are in its climax. At the same time, these forests are also facing anthropogenic interaction for over the last 100 years mainly by the out siders and/or migratory human settlements. The problems created through such interaction were visible and it was also essential to evaluate the situation scientifically. On the other hand the rate and intensity of the interaction was increasing quite fast with the increasing numbers of settlers, and of different added kinds of exploitations.