

A study on protection of natural capital and assessment of economic and environmental linkages

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Abstract: Natural capital is of concern to all. Natural Capital is the environmental stock or resources of Earth that provide goods, flows and ecological services required to support life. This paper deals with the problems related to the protection of natural capital, the inability of economics to appropriately model and price both market and non-market environmental resources; lack of willingness to pay; lack of knowledge about minimum levels or time spans required for resources to replenish or renew; lack of knowledge regarding the interaction and dependences between resources and their true value, usefulness or necessity; poor management of trans-boundary resources; and inequalities between developed and developing nations. It also bring into focus the case study of Western Ghats .The latter part of the paper deals with the environmental and ecological linkages.

Introduction

Natural capital is the spectrum of physical assets within the natural environment that deliver economic value through ecosystem services. Like a savings account, natural capital can pay interest or be liquidated. If a tree is chopped down for firewood, the capital has been spent. However, if the tree is retained and preserved, it can deliver (perhaps much higher) value through the ecosystem services of shade, air filtration, carbon sequestration and erosion control. Many forms of natural capital provide multiple benefits. Wetlands, for example, provide water treatment and purification services; prevent floods by retaining surface runoff; and provide wildlife habitat.

The concept of natural capital has the potential to reconcile economic and environmental interests by integrating the value of natural capital in decision-making. It makes it possible, for example, to

develop a cost-benefit analysis of a new water treatment plant, versus the restoration or preservation of a wetland for the clean water filtration service it provides.

The Natural Capital Approach (NCA) is a means for identifying and quantifying natural resources and associated ecosystem goods and services that can help integrate ecosystem-oriented management with economic decision-making and development. By integrating economic and environmental imperatives, NCA operationalizes the ecosystem approach and facilitates policy-making for sustainable development.

Born out of theoretical advancements in ecological economics, the NC concept is gaining considerable interest for devising policies that reconcile economic and environmental imperatives. Integrating the concept within economic and environmental management systems is best achieved by treating the natural environment similarly to other forms of valued capital and adopting the ecosystem approach which is compatible with a wide range of contexts.

NC implementation initiatives are being carried out internationally and domestically as the value of preserving and restoring ecosystems it is being increasingly recognized and linked to human well-being. There is a demand and a need in Canada for developing NC assessment and valuation methodologies. NC research and implementation efforts for the preservation and restoration of natural environments will benefit greatly from a comprehensive NC framework.

The Natural Capital concept was popularized in 1990 and was born out of theoretical advances to bridge the gaps between economics and ecology. These advances are succinctly described leading up to current NC state-of-the-art research that is being pursued by the Gund Institute and Stanford University.

The key elements and underpinnings of what constitutes a Natural Capital Approach (NCA) are explored to formulate a Natural Capital Approach working definition. The articulation of the working definition is preceded by NC and Ecosystem Services descriptions. The NCA bridges the disciplines of economics and ecology to facilitate better decision-making for managing, preserving and restoring NC.

The concept is further examined by comparing it to other environmental planning and management approaches. The Economic Growth, Media-based and Ecological Approaches to environmental planning and management are used to compare and contrast the NCA and identify its innovative and challenging aspects. The NCA is established as a means to operationalize the ecosystem approach for sustainable development practice.

Integrating and implementing the NCA within economic and environmental systems is explored. Treating NC similarly to other types of capital will ensure its integration within economic systems and the NCA's compatibility with a plurality of contexts is required for it to be an effective environmental management tool. Efforts to move the concept from theory to practice are discussed.

An ecosystem is defined by the 1992 Convention on Biological Diversity as: "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Markandya et al., 2002, p.69)." Ecosystem services are in simplistic terms nature's entities and functions which enable existence (Millennium Ecosystem Assessment, 2003). Although ecosystems function as a whole their services can be characterized. The Millennium Ecosystem Assessment (2003) organizes ecosystem services by grouping them into four categories: Provisioning services include the basic necessities we consume and require for our survival and well-being; Regulating services provide us with a habitable environment; Cultural ecosystem services benefit people in a nonmaterial manner; Supporting ecosystem services are necessary for the continuation of the other three types of ecosystem services (see Figure 1).

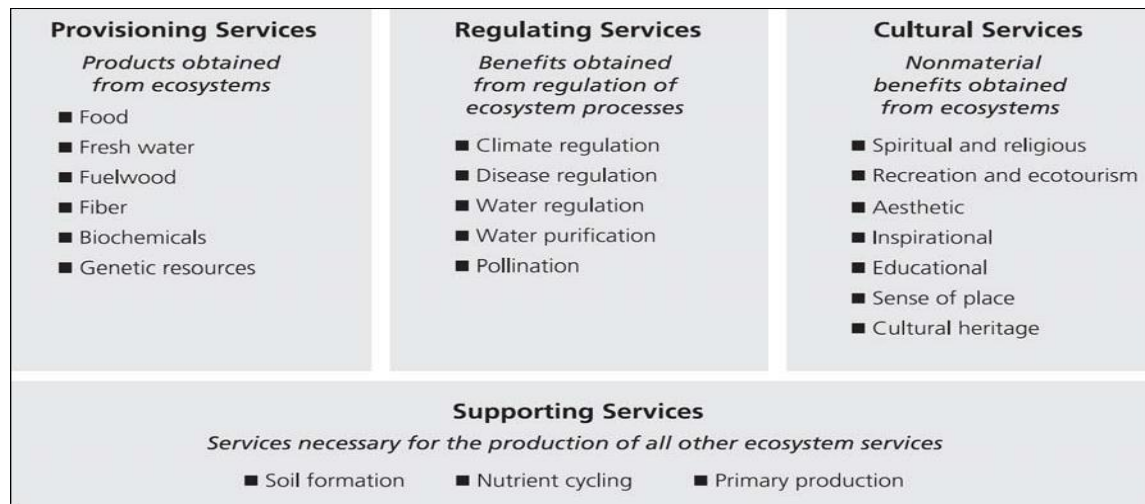


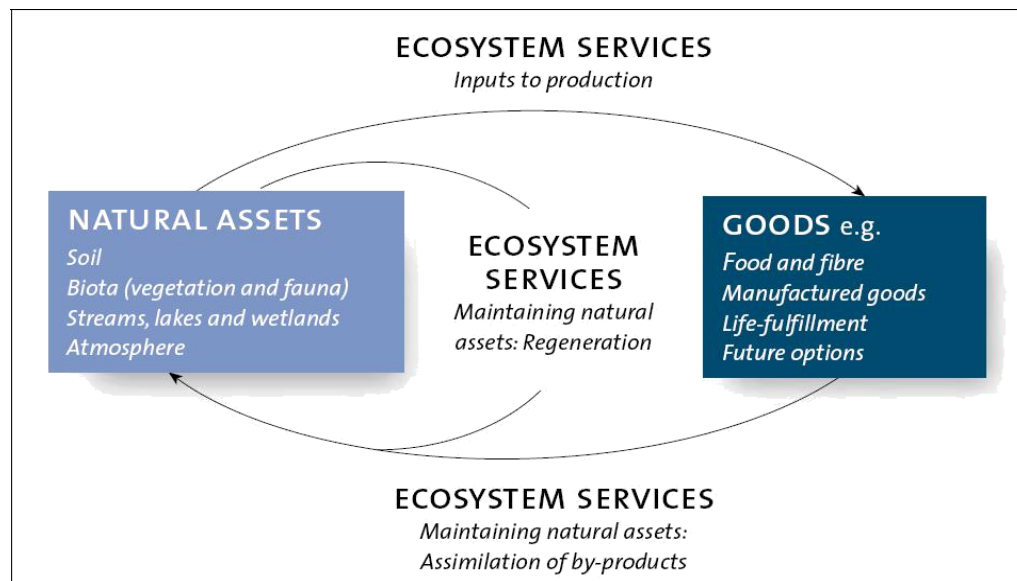
Figure 1: Ecosystem services are the benefits people obtain from ecosystems (Millennium Ecosystem Assessment, 2003, p.57).

Ecosystem services flow from NC. For instance, NC in the form of flowers, pollen and pollinators are required to perform the ecosystem service of pollination (Binning, Cork, Parry, & Shelton, 2001). NC becomes an ecosystem provisional service when it is harvested for a particular use. For example, bee pollen, natural capital when embedded in the natural environment, becomes an ecosystem provisional service when extracted for human consumption. NC must be interconnected, healthy and whole to provide ecosystem services. Its ability to provide services is compromised when degraded, exploited, disturbed or fragmented and is improved when preserved, enhanced or reconnected. NC is the basis for human capital, social capital and built or manufactured capital.

Drawing from the above information a “Natural Capital Approach” is defined as follows:

A means for identifying and quantifying the natural environment and associated ecosystem services leading to better decision-making for managing, preserving and restoring natural environments.

Identifying and quantifying NC and its ecosystem services provides additional rationale for effective environmental management. Consequently, an appropriately designed NCA is a bridging concept between effective environmental management and sustainable development (Fenech et al., 2003). Costanza and Daly affirm that “maintaining natural capital stocks is a prudent and achievable policy for insuring sustainable development (Costanza& Daly, 1992, p. 37).”



NATURAL CAPITAL IMPLEMENTATION INITIATIVES

International Initiatives

1. *China's Green GDP Index*
2. *Australia's Environmental Assets Accounting*
3. *Ecosystem Services Project – Goulburn Broken Catchment, Australia*

Natural capital underpins the economy, society and human well-being

The term 'capital' is generally used by economists to describe a stock of anything that has the capacity to generate a flow (normally of goods and services) that benefits — and is valued by — people. The emergence of the concept of natural capital in recent decades reflects the recognition that environmental systems play a fundamental role in determining economic output and human well-being — providing resources and services, and absorbing emissions and wastes.

Natural capital is the most fundamental of the core forms of capital (i.e. manufactured, human, social and natural) since it provides the basic conditions for human existence. These conditions include fertile soil, multifunctional forests, productive land and seas, good quality freshwater and clean air. They also include services such as pollination, climate regulation and protection from natural disasters (EU, 2013). Natural capital sets the ecological limits for our socio-economic systems; it is both limited and vulnerable.

A CASE STUDY OF WESTERN GHATS

The Western Ghats are second only to the Eastern Himalaya as a treasure trove of biological diversity in India. Originally recognized as among the several global 'hotspots of biodiversity,' the Western Ghats along with its geographical extension in the wet zone of Sri Lanka are now also considered one of the eight 'hottest hot spots' of biodiversity (Myers et al. 2000).

At the same time, the high human population density and major transformation of the landscape since the mid-18th century also emphasize the urgency of conservation of the Ghats and sustainable use of its resources. A study in the southern region, comprising the states of Karnataka, Kerala and Tamil Nadu, showed that between 1920–1990 about 40% of the original vegetation cover was lost or converted to another form of land use (Menon and Bawa 1997). It is estimated that not more than about 7% of the area of the Western Ghats is presently under primary vegetation cover, though a much larger area is under secondary forest or some form of tree cover. Nearly 15% of the Ghats is also under the Protected Area system.

The great topographic heterogeneity (from sea level to 2695 m at its highest point, the Anaimudi peak) and a strong rainfall gradient (annual precipitation of <50 cm in sheltered valleys in the east to >700 cm along west-facing slopes) combine to give rise to a tremendous diversity of life forms and vegetation types, including tropical wet evergreen forest, montane stunted evergreen forest (shola) and grassland, lateritic plateaus, moist deciduous and dry deciduous forest, dry thorn forests, and grassland.

Many of these are critical habitats for plants and animals: for instance, the lateritic plateaus of Maharashtra harbour unique floral elements as well as provide seasonal foraging grounds for large mammals such as gaur; the shola forests and grasslands of the southern Western Ghats are unique as well as highly vulnerable to future climate change; the riparian vegetation along the numerous east and west-flowing rivers and streams of the Ghats shelter high levels of plant and animal diversity in addition to acting as corridors, while the relict lowland dipterocarp forests and Mysristica swamps to the west are highly threatened.

The importance of the Western Ghats in terms of its biodiversity can be seen from the known inventory of its plant and animal groups, and the levels of endemism in these taxa (Gunawardene et al. 2007). Nearly 4000 species of flowering plants or about 27% of the country's total species are known from the Ghats. Of 645 species of evergreen trees (>10 cm dbh or diameter at breast height, a standard method of expressing the diameter of the trunk or bole of a standing tree), about 56% is endemic to the Ghats. Among the lower plant groups, the diversity of bryophytes is impressive with 850-1000 species; of these 682 species are mosses with 28% endemics and 280 species are liverworts with 43% endemics.

Among the invertebrate groups, about 350 (20% endemic) species of ants, 330 (11% endemic) species of butterflies, 174 (40% endemic) species of odonates (dragonflies and damselflies), and 269 (76% endemic) species of mollusks (land snails) have been described from this region. The known fish fauna of the Ghats is 288 species with 41% of these being endemic to the region. The Western Ghats are particularly notable for its amphibian fauna with about 220 species of which 78% are endemic; the recent discovery of a new genus of frog, *Nasikabatrachus sahyadrensis*, with Indo-Madagscan affinity, in the southern Western Ghats affirms the importance of the region in harbouring these ancient Gondwanan lineages.

Similarly, the Ghats are unique in its caecilian diversity harbouring 16 of the country's 20 known species, with all 16 species being endemic. Of the 225 described species of reptiles, 62% are endemic; special mention must be made of the primitively burrowing snakes of the family Uropeltidae that are mostly restricted to the southern hills of the Western Ghats.

Over 500 species of birds and 120 species of mammals are also known from this region. The Western Ghats region harbours the largest global populations of the Asian elephant, and possibly of other mammals such as tiger, dhole, and gaur. The Western Ghats also harbour a number of wild relatives of cultivated plants, including pepper, cardamom, mango, jackfruit and plantain. This biological wealth has paid rich dividends over the years. In fact, the tract was famous for its wild produce of pepper, cardamom, sandal and ivory.

This diversity has been in continual decline over the last century and more especially in recent decades, with many biological communities and types being almost totally eliminated. It is, however, notable that some of the age-old conservation practices, such as maintenance of sacred groves, sacred ponds and river stretches, as well as protection of sacred species such as many primates and peafowl, continue to effectively protect many elements of biodiversity to this day. In addition, recent decades have seen other significant measures being initiated to conserve some of this fast vanishing biological diversity with the constitution of Wildlife Sanctuaries, National Parks and Tiger Reserves. These measures have led to a welcome increase in populations of many wild animals. Regrettably this has also exacerbated man-wildlife conflict.

Exploitation of Western Ghats

The traditional land use in the Ghats has been paddy cultivation in the valleys, supplemented by cultivation of millets and legumes on the hill slopes. Hill slope agriculture used to be largely of the shifting slash-and-burn type, but this has gradually been changed to cultivation of terraces. The traditional horticultural crops were arecanut on the hills and coconut on the coast, along with mango and jackfruit. Cattle and buffalo were maintained in great numbers wherever the natural vegetation was deciduous forest, but these were largely absent in tracts of evergreen vegetation.

A number of horticultural and tuber crops were introduced to this region through European influence. Prominent amongst these are tea, coffee, rubber, cashew, tapioca and potato. Pepper and cardamom, which are native to the evergreen forests of the Western Ghats were also taken up as plantation crops on a more extensive scale in modern times. Many of the newer plantations were taken up by clear felling natural evergreen forests tracts which till then had predominantly tribal populations.

The most important forest produce of the Ghats in earlier times were cardamom, pepper and ivory although teak wood had been exported from the west coast ports even in medieval times. The earliest forest plantations recorded were the teakwood plantations raised by the Angres, Maratha naval chiefs of Shivaji in the 17th Century. Exploitation of timber on a large scale, however, started only with the British.

The evergreen forests were extracted for railway sleepers and deciduous forests were progressively replaced by teak plantations. As this demand picked up, forests which were till then largely managed by Village Communities were bifurcated into forests on village common lands and state-owned Reserved Forests. The community held grazing lands and forests cover extensive areas in many parts of the

Western Ghats, as do privately held forest lands to a lesser extent. These lands have been considerably overexploited and degraded in recent decades.

The demands on reserved forests peaked between 1950–1980 with an explosion of forest-based industries such as paper, plywood, polyfibres and matchwood. Although these demands were expected to be met through sustainable harvests, this did not materialize and the forests were overexploited. The response was a switch to ‘aggressive’ from ‘conservation’ forestry with large-scale clear felling of natural forests and plantation of exotic species such as eucalyptus and *Acacia auriculiformis*. Many of the eucalyptus plantations failed because of various diseases.

Consequently, harvests from Reserved Forests have slowly tapered off after the 1980’s with the industry turning to import of pulp, pulpwood and timber from abroad. There have been other competing demands on reserved forest lands as well, especially for cultivation and river valley projects. Collection of forest produce such as pepper, cardamom, ivory, honey, wax, myrobalan has gone on for a long time in the Western Ghats. The bamboos and reeds of the Ghat forests have also supported extensive basket weaving.

There have been shipyards on the west coast using the timber of the hills for a very long time, as also artisans making wooden toys. There has been substantial decline in many of these activities with depletion of resources like honey and bamboo, and complete ban on use of ivory.

Industry and irrigation

Several industries were started in the early decades before independence, primarily to utilize the forest resources of the Western Ghats. These have included saw mills, brick and tile, paper, polyfibre, matchwood, plywood, and tanning. A few other industries have sprung up based on the mineral resources of the hills such as the steel works at Bhadravati.

By and large, these industries have grown beyond the capacity of the Western Ghats forest resource base to sustain them, and are now depending on imports or wood resources produced on farmland. The bulk of the rains of Peninsular India fall on the Western Ghats from which originate Krishna, Godavari and Kaveri, the three major rivers of the Southern Peninsula, as well as many shorter west flowing rivers of the west coast.

Traditionally these water resources were used to irrigate the valleys under paddy and arecanut on the hills with construction of small ponds and channels. Beginning with the British times, however, many major river valley projects have been executed, either to irrigate the drier tracts to the east or to generate power by taking advantage of the steep slopes to the west. These have rapidly proliferated

since independence and today cover almost every river valley in certain regions such as that stretching from Mumbai to Kolhapur in Maharashtra.

In recent years these reservoirs have also become the locus of development of resorts and hill stations like Amby Valley and Lavasa. In another more recent development, wind mills are being set up in large numbers on the crestline of the Ghats with steep roads up the hill slopes leading to substantial negative impacts on ecology and water resources.

The Western Ghats are rich in iron, manganese and bauxite ores in parts of their ranges. These are being extracted on a large scale and exported in ore form, especially from Goa. With a steep increase in iron ore prices and demand for lower grade ores, mining activities have grown rapidly and often in violation of all laws, resulting in serious environmental damage and social disruption.

Several centres of pilgrimage have traditionally attracted many visitors to the Western Ghats, prominent amongst these being Sabarimalai in Kerala, Madeveshwaramalai in Karnataka and Mahabaleshwar in Maharashtra. A number of other tourist centres have sprung up in modern times. The best known are Ooty in the Nilgiris and the Thekkady Wildlife Sanctuary in Kerala. Recent decades have seen a boom in building of second holiday homes, tourist resorts housed in plantations and new hill stations.

Transport and urbanisation

Transport and communication has been difficult in the Western Ghats because of the hilly terrain, heavy rains, washing off of roads and thick forests. In fact, the strength of the Maratha empire founded by Shivaji rested on the strategic advantages of an inaccessible terrain. Transport and communications really began to reach deeper into the Western Ghats only in British times.

A spurt was given to the development of these facilities after independence when major river valley and mining projects brought development of extensive transport and communication facilities in their wake. Recent decades have seen a rapid spurt in growth of roads as well as railway lines across the Ghats with resultant disruption of connectivity between natural habitats.

The Western Ghats have always been sparsely populated compared to the adjoining plains, because of the difficult terrain and widely prevalent incidence of malaria. The coastal plains under paddy and coconut have supported far denser populations while the Deccan plateau to the east had intermediate levels of population density.

The settlements on the Ghats have been of small sizes and scattered; the bigger towns all falling on the eastern side on the banks of major rivers, or on the west coast at river mouths, where they served as

ports. With rapid increase in means of communication and transport, emergence of a large wealthy middle class and availability of powerful earth-moving machinery, the Western Ghats are beginning to be urbanized with a proliferation of holiday homes and resorts. These tend to be accompanied by a total decimation of natural biological communities and displacement of local people.

The people of the Western Ghats traditionally depended heavily on natural vegetation for meeting their requirement of shelter, fodder and fuel. They also derived much nutrition from hunted meat; consequently their quality of life has rapidly eroded in recent decades with the depletion of natural vegetation and extermination of wild animals. The major gain for the people from the view point of a better life has been the eradication of diseases, especially malaria, and the development of better means of transport and communication.

Modern health and educational facilities have percolated little to the hills except in the State of Kerala where there has been remarkable progress, accompanied by a substantial fall in the rate of population growth.

The Western Ghats has a large tribal population only in a few pockets such as the Dangs and Thane districts north of Mumbai and Wynaad and Nilgiris tracts. The Nilgirisharbour the only truly stone age hunting gathering tribe of Peninsular India, the Cholanaikas. The tribals have borne the brunt of the degradation of the Western Ghats environment and have received little of the benefits of development. Vested interests have also blocked the implementation of acts such as PESA and FRA that were meant to give them a better deal.

By and large the Western Ghats have been subjected to a rapid erosion of natural capital with the building up of man-made capital, regrettably imposing excessive, unnecessary environmental damage in the process, accompanied by a degradation of social capital as well.

Yet, on the positive side, the Western Ghats region has some of the highest levels of literacy in the country, and a high level of environmental awareness. The democratic institutions are well entrenched, and Kerala leads the country in capacity building and empowering of Panchayat Raj Institutions. Goa has recently concluded a very interesting exercise, Regional Plan 2021, of taking inputs from Gram Sabhas in deciding on land use policies.

Evidently, the Western Ghats is an appropriate region of the country to attempt to make the transition towards an inclusive, caring and environment-friendly mode of development.

Develop sustainably – conserve thoughtfully

Many stakeholders have suggested that, apart from the context of provision of Central financial assistance for plan schemes, the Western Ghats Region should have a regulatory content of a go- no go nature; that certain activities would be banned within the limits of the Western Ghats, but fully permitted outside these limits. WGEEP would like to submit that we should move away from such formulae that impart inflexibility to development processes.

To take a very simple example, the norm for the size of agricultural holding in which a farm house may be constructed is 2 acres throughout the state of Maharashtra. But in the hilly terrain of Mahabaleshwar, one of the existing ESAs of Western Ghats, 80% of farmers hold less than 2 acres of land. All of them have therefore been forced to stay in small, overcrowded houses in Gaothans, which have not been permitted to grow over the last 60 years, despite substantial increase in their populations. Farmers of Mahabaleshwar have therefore been requesting that the threshold for permission for a farm house be appropriately changed in their locality, to no avail. They feel particularly frustrated to see considerable construction activity of bungalows for the rich and hotels going on without much difficulty, while they see no signs of relief for themselves.

Indeed, what we see around the Western Ghats and the rest of the country may be termed 'Development by Exclusion' hand in hand with 'Conservation by Exclusion'. Despite the 73rd and 74th Amendments to the Constitution that have devolved powers of making decisions relating to development to Panchayat Raj Institutions and Nagarpalikas, all development decisions are being thrust on the people.

Western Ghats - An Ecologically sensitive area

The Western Ghats ecosystem as a single unit; its ability to cope with environmental stresses – stresses like various human induced developments and their impacts; future impacts due to climate change; essentially the ecological resilience and how it might vary from landscape to landscape;

The most sensitive landscapes are those with the least resilience; Ecological Resilience may be assessed based on our understanding of trends of change in communities of woody plants, amphibians and birds or vertebrate animals in general; it is the lag-time (the time taken by different landscapes and their biological communities to come back to the pre-disturbance state; we may adopt the following working definition

“An ecological sensitive area (ESA) is a bio-climatic unit (as demarcated by entire landscapes) in the Western Ghats wherein human impacts have locally caused irreversible changes in the structure of

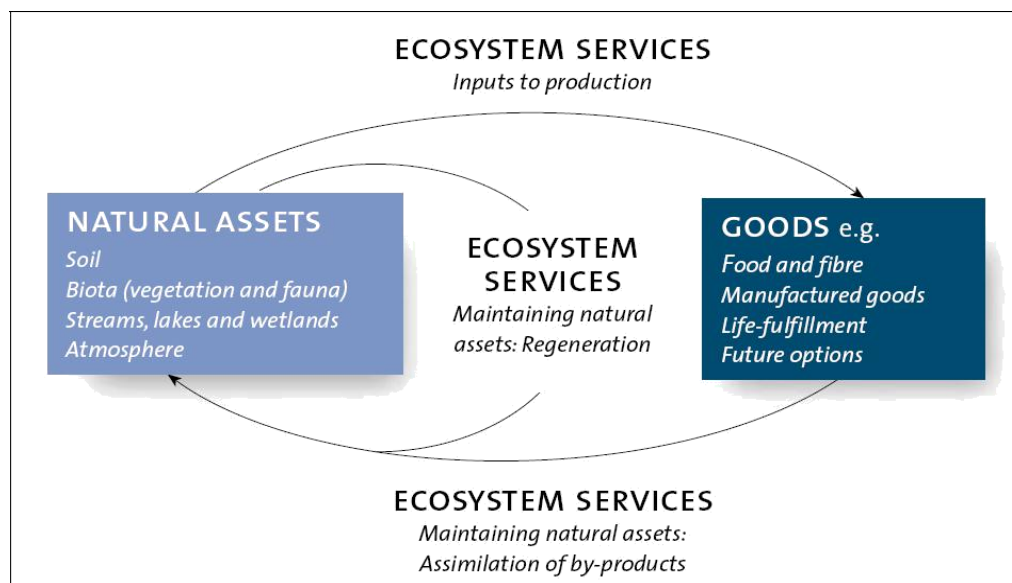
biological communities (as evident in number/ composition of species and their relative abundances) and their natural habitats

Western Ghats region of all six states (Tamil Nadu, Karnataka, Kerala, Goa, Maharashtra, Gujarat).

The **Western Ghats** are a mountain range that runs almost parallel to the western coast of the Indian peninsula, located entirely in India. It is a UNESCO World Heritage Site and is one of the eight "hottest hotspots" of biological diversity in the world. It is sometimes called the Great Escarpment of India. The range runs north to south along the western edge of the Deccan Plateau, and separates the plateau from a narrow coastal plain, called Konkan, along the Arabian Sea. A total of thirty nine properties including national parks, wildlife sanctuaries and reserve forests were designated as world heritage sites - twenty in Kerala, ten in Karnataka, five in Tamil Nadu and four in Maharashtra.

The range starts near the border of Gujarat and Maharashtra, south of the Tapti river, and runs approximately 1,600 km (990 mi) through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu ending at Kanyakumari, at the southern tip of India. These hills cover 160,000 km² (62,000 sq mi) and form the catchment area for complex riverine drainage systems that drain almost 40% of India. The Western Ghats block southwest monsoon winds from reaching the Deccan Plateau. The average elevation is around 1,200 m (3,900 ft).

The area is one of the world's ten "Hottest biodiversity hotspots" and has over 7,400 species of flowering plants, 139 mammal species, 508 bird species, 179 amphibian species and 288 freshwater fish species; it is likely that many undiscovered species live in the Western Ghats. At least 325 globally threatened species occur in the Western Ghats.



Interlink between Economics, Environment and Ecology

Environmental sensitivity calls for an interdisciplinary approach. An efficient management of the biosphere calls for an equal consideration of biology, economics, physics, geology and engineering. An integrated approach to environmental problems alone will help us to identify both curative and preventive aspects. The interaction between Economy and Environment is represented by Material balance approach by Allen Kneese and R.V Ayres. According to them the total economic process as a physically balanced flow between inputs and outputs. The economy is very clearly a part of the environment as much as the environment could be seen as part of the economy. Hence a meaningful solution of environmental problems calls for an interdisciplinary integrated approach.

Bibliography

Agriculture and Agri-Food Canada. (2005, March 7, 2007). The National Land and Water Information Service. Retrieved February 15, 2007, from http://www.agr.gc.ca/nlwis-snite/index_e.cfm?s1=info&page=info#goal

Ayres, R. U. (2007). On the practical limits to substitution. *Ecological Economics*, 61(1), 115- 128.

Barton, A. D. (1999). A Trusteeship Theory of Accounting for Natural Capital Assets. *ABACUS*, 35(2), 207-222.

Conservation International. 2013. <http://www.biodiversityhotspots.org/Pages/default.aspx>. Accessed on 07 January 2013.

Dikshit, K.R. 1981. The Western Ghats: A geomorphic overview. In L.R. Singh's (ed) *New perspectives in Geography 1981*, and in *Memoir Geological Society of India* 47 (1): 159-183. 2001.

Franklin, J., Davis, F.W., Ikegami, M., Syphard, A.D., Flint, L.E., Flint, A.L. and Hannah, L. 2012. Modeling plant species distributions under future climates: How fine scale do climate projections need to be? *Global Change Biology*, doi: 10.1111/gcb.12051.

Gunnell, Y. and Radhakrishnan, B.P. 1967. The Western Ghats of the Indian Peninsula: In *Proceedings of the Seminar on Geomorphological Studies in India*, Sagar, and in *Memoir Geological Society of India* 47 (1):133-144. 2001.

Hamlet, A.F., Mote, P.W., Clark, M.P., Letermaier, D.P. 2007. Twentieth-Century Trends in Runoff, Evapotranspiration, and Soil Moisture in the Western United States. *Journal of Climate* 20: 1468-1486.

IPCC: 2007. *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. [Pachauri, R.K. and Reisinger, A. (Eds).] IPCC, Geneva, Switzerland, 104 pp.