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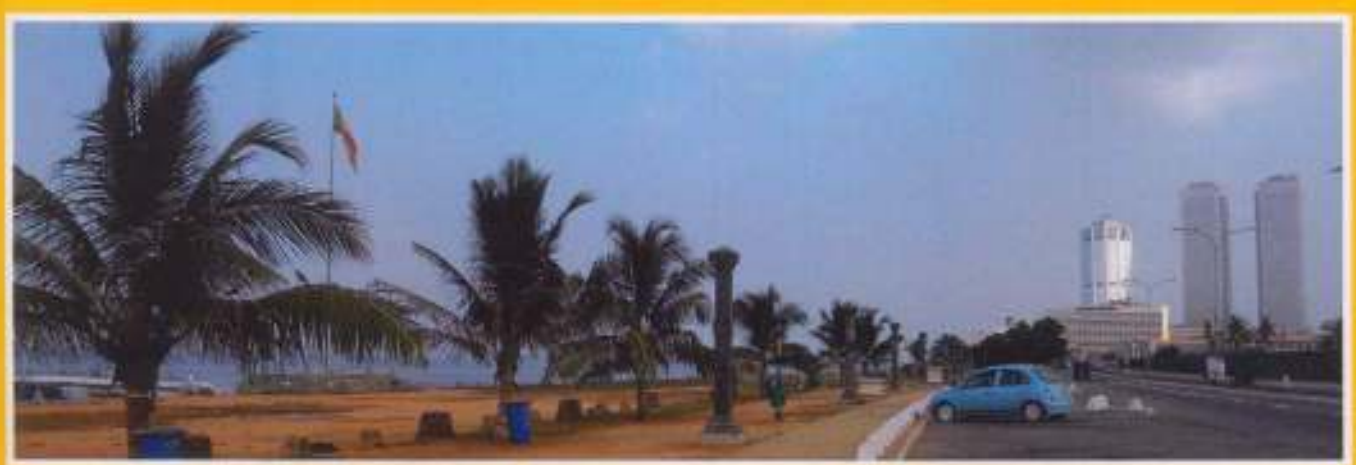

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About the Journal

- The Journal of Ecological Society is published annually.
- The opinions expressed in the papers here are not necessarily those of the Ecological Society.
- The Journal is available free of charge upon request.

About the Cover

The cover illustrates four landscapes, each different from the other. The biotic and abiotic features within the landscape bestow a uniqueness to each one and determine the productivity within its confines. Our planet comprises of millions of such unique landscapes interacting with each other through energy and mass flows and locomotion of species.

Construction of roads, buildings and structures interferes with natural processes interrupting food chains and mass flows and reducing its productivity. Unbridled human intervention has dramatically reduced the ecological productivity of landscapes and has challenged the life sustaining capacity of the planet.

Cover Design

Gurudas Nulkar

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Prakash Gole

11th January 1938 - 27 November 2013

The Late Prakash Gole founded the Ecological Society and was the editor of this Journal of Ecological Society for the last 24 years. Author of several books, papers and articles, Prakash Gole propagated the ecological approach to landscape management. His approach towards sustainable management of natural resources has been validated through several experiments which the Ecological Society has, under his guidance, conducted over the last 30 years.

An ornithologist of international repute, an admired ecological thinker and a respected author, Prakash Gole encouraged his students, peers and policy-makers to have a holistic approach towards ecology and economics. His views on technology and resource consumption have been widely appreciated.

A teacher, mentor and friend to many, Prakash Gole will be greatly missed. This issue of the Journal of Ecological Society is dedicated to this great man.

Contents

Foreword

At the pronouncement of the term 'nature conservation' the first image that appears in the mind's eye is that of a national park or a wildlife sanctuary that now represent small specks of what were extensive and diverse natural ecosystems at the end of the last ice age 12000 years ago – on such millions of years old evolutionary platform the human civilization has raised its edifice of development. The appearance of images of protected areas is spontaneous because those wondrous wilderness areas are now all but rare in the rapidly human-caused transformation of extensive geographic tracts to their new identities of land uses unrelated to the originals. Even the last vestiges of natural ecosystems are considered as hurdles to development by those who cherish power and pelf. Although they constitute a small percentage of citizenry anywhere, their influence arbiters the fate of the world's most ancient, productive and wise entities. However, rather than dwelling upon the negatives and despondency it is necessary to find ways for integration of the security of natural ecosystems in the plans for our future wellbeing.

There are two very important edicts to walk that route. One of Barry Commoner's several laws states 'Everything is connected to everything else and there is nothing as a free lunch' and the other is Isaac Newton's third law of motion 'Action and reaction are equal and opposite'. This can be interpreted as 'the necessity of being able to convert the connectivities between disparate uses of lands to an advantage by reducing the inter se contradictions to the minimum with the tenets of ecology as a common frame of reference'. This implies that in order to maintain the integrity of the ecologically small and scattered nature reserves such as the national parks, sanctuaries and other such categories in this class of land use it is essential to consider these as portions of a large mosaic of interacting land uses referred to as landscapes with people and the impacts of their activities integral to the system. This would underwrite extension of the ecological reach of the protected areas over large landscapes which are all about ecologically sustainable practices.

If the challenge of setting the central priority for ensuring the wellbeing of humans is examined through the prism of intersection of biological and physical sciences, there would be little surprise at biological diversity emerging as its outcome. It is not just about the interest in species of plants and animals alone but as defined it is 'the variety and variability of life forms, the interacting ecological processes and functions'. Thus humans are placed squarely at the center of it. Biological diversity is about security of soil, water and therefore of food, and about amelioration of climate – allowing that self-regulating system of physical, chemical, biological and human components to maintain the atmospheric temperature within the narrow limits that sustains life. The five reports of the IPCC and several similar ones are emphatic on this. The many international treaties on climate change under different titles and forms addressing different ecosystems and many laws are the result of such concern. Thus on the ground every constituent within the interacting mosaic of land uses needs to be aligned with the principle for turning their interfaces to advantage by reducing the inter se contradictions.

The Ecological Society, Pune has espoused such cause since its inception by promoting environmental awareness and nature conservation through its programmes of teaching and training that are designed to create the capability for undertaking studies, to plan and implement projects for ecological restoration and conservation in rural and urban settings. The Society has established demonstration

areas that have integrated the concerns for ecology and economics paving the approach for development.

The northern Western Ghats in Maharashtra represent a tract of one of the world's ecological hot spots. Scenic attractions, salubrious climate in the mountains during the hot summers in the plains below, important watersheds and the diversity of forests and wildlife have constituted a recipe for economic exploitation of the land, in many instances, without responsibility. The Ecological Society for long has focused on some of the niggling issues of ecologically sustainable development in this part of the mountain range and in the related tracts of the plains below.

There are four papers that address different land use issues that respectively deal with forest management, hill station planning and management, ecotourism, and river front management in urban areas. These are among the most sensitive issues. There is a fifth overarching paper that expresses the ecological significance of the northern Western Ghats, describes the land use constituents, the inter se disparities and opportunities, and recounts the ecological principles and practices that need to be considered at different spatial scales from the smallest at the site level to the largest at the landscape.

Forest ecosystems and habitats obviously represent the central concern. Protection, management strategies, techniques for restoration of degraded areas to naturalness, management of watersheds and the system of streams are discussed. Some of the most important rivers in western Maharashtra have their origins in the northern Western Ghats and this logically leads to focusing attention on river front management in urban areas because the greatest impacts on river systems take place in urban areas which are growing continuously and haphazardly.

Rivers and streams constitute the lifeline of the state and the nation. Apart from their critical support to quality of life and development on the ecological front they connect all habitats across and along elevation gradients; they move nutrients, sediments, act as dispersal corridors for plants and animals and are important habitats of aquatic life. Impacts of activities of people release chemical pollutants and solid waste in rivers and river front development all but destroys the natural flood plain by barriers of many kinds to natural flow not to mention the drastic alteration to river ecology.

Hill stations in the Western Ghats are centers of tourism for being considered retreats for enjoyment of scenic vistas, salubrious climate during the hot summers and offering relaxation to tired bodies and minds. The great floating population followed by attendant businesses that have sprung up to explore economic opportunities, growing infrastructural needs, needs for water, waste disposal, and degradation of surrounding wilderness are increasingly adding to the already disturbed fragile tract by many development projects. A section of dispossessed and disillusioned local communities has added further disparities. There are strict laws since the two hill stations – Mahableshwar-Panchgani towns as a single axis and Matheran are declared Ecologically Sensitive Areas (ESAs). The problem however revolves around enforcement. A way out is discussed.

Tourism is probably the most rapidly developing industry today. It is needless to state that all kinds of visitor attractions are on the radar of this industry. It is unfortunate that mass tourism with all its serious impacts on the destinations is being popularly referred to and advertised as ecotourism. The Konkan coast of Maharashtra on the windward side of the Western Ghats has many visitor destinations including the attractive features of the coastal and marine ecosystems. A reminder is served about what ecotourism is with emphasis on equity of benefits to the ecosystems and local communities. How participation of local people and empowerment leads to ownership of assets and sustainable management is analyzed. The success story of village Velas as a model for ecotourism is shared with prospects for adaptation of such principles to site specific features of Janjira, a popular visitor destination is discussed.

The northern Western Ghats and its immediate ecological connections to the Konkan coast and the portions of eastern plains is a priceless natural heritage of which every citizen of the state and the country needs to be conscious about and feel and act with responsibility for its ecological integrity.

Vishwas Sawarkar

Landscapes for Conservation of Biological Diversity with Focus on the Northern Western Ghats of Maharashtra (NWGM)

Vishwas Sawarkar

(The author retired as Director, Wildlife Institute of India, Dehradun and is Trustee, The Ecological Society, Pune)

Abstract

National wellbeing is dependent on the productivity of its lands. Productivity is central to the interest of natural ecosystems and the systems of farming. Water is essential for sustaining life, for ensuring food security as well as for effectively driving all development projects. Security of water is ensured by secure natural ecosystems centered on biological diversity. The terms productivity and biological diversity are synonymous therefore it is essential for all processes and projects of development to internalize the security of biological diversity/natural ecosystems. The principle at present however is almost non-existent in all development programmes because had it been so the forest and environmental clearances would not be considered loud and clear as hurdles to development. Western Ghats are one of the ecological hotspots of the world. The northern Western Ghats have diverse forests, protected areas, ecologically sensitive areas declared under law, ecologically sensitive tehsils and villages and sacred groves managed and maintained by local communities. There are significant catchments and watersheds, origins of important rivers, many springs and lateritic plateaus with unique species assemblages that are characteristic only of the northern Western Ghats. These units together constitute the foci of conservation of natural ecosystems. The tract has several dams and the largest hydroelectric facility. It supports diverse economies including the most rapidly growing tourism industry with many visitor destinations and famous hill stations dotted across these mountains. In order to ensure ecological security of these fragile mountain ecosystems it is necessary to address land use at the largest spatial scale recognized as the landscape. Landscape allows using the disparities within its constituents—the mosaic of interacting land uses by creating opportunities for reducing their inter se contradictions. The paper discusses such opportunities and strategies at various spatial scales.

Keywords : *western Ghats, Forests in India, Landscape-based conservation, Protected Areas in India, Ecosystem-based Management*

Introduction

There are two categories of land uses in the class of renewable resources in which productivity of the land is central to the objective of management. These are forests and agriculture lands. The recorded forest area (RFA) of the country – the lands under the control of the forest department – is 771821 km^2 or 23.48% of the country's geographic area[1]. An estimated 50% of the country's geographic extent is under farming of some kind or the other. Forests are natural lands managed for production of goods – ranging from timber of varied qualities to a formidable list of non-timber forest produce (NTFP) that support the livelihoods and economy, cultural security and spiritual needs, and significant support to human and livestock health (ethno medicine and the processed and patented drugs) of many millions of forest dwelling people. While that is so, forests are also critically important for the wellbeing of the millions who live on lands that are far removed from the forested regions, including those urban areas that are completely transformed in character and counted towards the pillars of economic growth and national progress.

Natural ecosystems provide a host of services that include at least five that are critical for the wellbeing of the nation – soil and water security, amelioration of climate, food and economic security. Besides those forest areas that serve production functions an estimated 20% of the RFA is under the network of

Protected Areas (PAs) – national parks, sanctuaries, conservation reserves and community reserves[2]. The most important fact about the RFAs is that the lands are highly fragmented with variable patch sizes located in a large matrix of incompatible land uses which has resulted in steep challenges for their conservation – unremitting biotic pressures leading to degradation, the increasing demands of the development sector, politics of various kinds and shades and the interplay of the principles of the science of insular biogeography made harsher by the former three.

Agriculture is an artificial or man-made ecosystem whose productivity is measured in terms of the yield of a given farm produce per hectare. Fundamentally agricultural productivity is dependent on the status of soil richness (nutrients, structure and depth) and security that natural vegetation in the region provides. Farmers enhance or replenish soil richness by application of fertilizers and by protecting crops from pests by using insecticides. Along with the quality of soil the other essential in support of productivity and sustainability of produce is water. Apart from the seasonal rainfall and its fluctuations the agriculture system is dependent upon the forests for recharging the enormous reserves of ground water *via* the forested catchments of rivers and streams.

There is a third category of land use that although belongs to the non-renewable resource class it is critical for being considered in the big picture of conservation of natural ecosystems and their sustainable use since its negative influence looms large over the fate of the two renewable land use categories. Most land uses in this category also consider productivity as central to their interest; however its measures would not be considered here since only the natural renewable resources – mainly forests out of the two in the category are under focus. These land uses in the non-renewable resources category are made up by different development programmes and activities. Construction of all kinds and setting up industrial units, power plants, dams and other infrastructure form the bulk of these programmes. Although considerable raw material is mined and processed for the purpose including imports that are all non-renewable, there is heavy dependence on water. Water is considered a renewable resource because of its replenishment by the annual monsoon. The forest and other natural vegetation – all natural ecosystems – are critically important as insurance for charging ground water reservoirs, maintaining the life of dams by keeping siltation at normal rates and ensuring maintenance of intended water levels; keeping alive the flow of water in rivers and streams called water quantity, quality and regime. The development sector most certainly is extremely important but in terms of its attitude and actions – of being considered the last word for national progress – it neglects the security of natural ecosystems that provide many critical services on which development is totally dependent.

All evidence suggests that conservation of natural ecosystems is considered a hindrance to development by a contrived interpretation that conservation is all about locking the 'green' areas and throwing away the key. This is completely at variance with the true meaning of the term conservation including its operational imperatives.

India like many countries in the world faces threats from natural calamities like cyclones, floods and droughts. There is sufficient proof now that effective conservation of natural ecosystems prevents such threats from turning into disasters or if disasters happen in reducing their impacts because of the natural resilience of ecosystems and their capabilities for recovery. The Oxford Dictionary defines the term conservation as – the act of preventing something from being lost, damaged, wasted or destroyed – by all accounts it means 'wise use' or in its differently worded and frequently used form 'sustainable use'. What is the measure of sustainability depends on the nature of the resource, its value and status therefore it must be so defined by the standards of widely established modern ecological principles.

The ecological definition of productivity for the natural lands like the RFA and other natural ecosystems outside the RFA is 'the capability of the soil for producing the full range of native plants at the specified geographical location'[3]. It is a long established fact that evolution of plants is mediated by the inseparable interactions between plants, animals and their abiotic environment. The debate about which came first – plants or animals is similar to the debate about the chicken and egg. Ecologists define plants as primary and animals as secondary productivity, however for the purpose of conservation there is little option but to define productivity as 'the capability of the soil for producing the full range of native plants and animals at the specified geographic location'.

Biological diversity is popularly interpreted as the numbers of species in a given area which is incorrect and such kinds and numbers actually refer to species richness while the widely accepted definition of

biological diversity is 'the variety and variability of life forms, the interacting processes and functions'[4]. The interacting processes involve those between the life forms and between the life forms and the abiotic environment. Thus biological diversity and productivity are synonymous. Any other measures that narrow it down to the needs of a particular produce/product under the term 'productivity' needs to be considered as a subset of true productivity with sustainability as the linchpin of its use. It will thus be observed that conservation of biological diversity is not confined to the attention on species of plants or animals alone – important as these are – but refers to a very complex world of ecological processes, functions and services many of which are unknown or poorly understood.

Conserving biological diversity

Conservation of biological diversity is viewed primarily through protected areas (PAs). The National Forest Policy 1988[5] refers to these as such and the Wildlife (Protection) Act 1972 has provided the teeth to protect and conserve these areas *inter alia* tying together their constituents, a range of species that are listed in its Schedules and laying down provisions for securing their habitats. There currently are four categories of PAs legally recognized in the country – National Park, wildlife sanctuary, conservation reserve and community reserve. There is a fifth category of Biosphere Reserves (BRs) not yet legally recognized as a PA category[6].

The IUCN recognizes six categories of PAs – category (Ia) Strict Nature Reserve set aside to protect biodiversity and also geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring; (Ib) Wilderness Area, usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition –these two categories are absorbed in India's National Parks and sanctuaries with appropriate zones to protect such values. The BRs also serve those objectives.

The IUCN Category (II) includes National Park and by its definition the sanctuaries in India also to a large extent fulfil the purpose of this category. IUCN category (III) represents Natural Monument or Feature set aside to protect a specific natural monument, which can be a landform, sea mount, and submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value. India does not have this category of PA. Category (IV) represents Habitat/ Species Management Area to protect particular species or habitats and management reflects this priority. This category fits into specific areas of national parks and sanctuaries in India where such objectives have been set. The GIB sanctuary in Solapur district is an example.

Category (V) is for Protected Landscapes and Sea Scapes where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values. This category is mostly in the domain of a priority management concept. The countrywide assessment of the status of the tiger, co-predators, prey and their habitats undertaken every four years by the National Tiger Conservation Authority (NTCA) and the Wildlife Institute of India (WII), Dehradun recognizes five landscapes and their sub-units. The information generated is used for conservation action and to an extent for preparation of the Tiger Conservation Plans (TCP). Conservation of the coastal and marine ecosystems requires the use of such big picture that connects with terrestrial landscapes.

Category (VI) bears the title 'PA with sustainable use of natural resources'. The BRs are based on such philosophy with a difference that these within their large extent include some PAs such as national parks and sanctuaries. The conservation and community reserves that are the other legally recognized PAs besides the national parks and sanctuaries fit into this IUCN category. Portions of many PAs in future might fit into this category in context of the settlement of rights under the Schedule Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 (FRA). Considering the large numbers of villages in many PAs, and with the paucity of funds to relocate those that have volunteered for relocation outside PAs many villages are likely to remain within PAs with such people's rights to lands and resources settled in favour of individuals and communities.

On practical considerations Category (V) and (VI) share several purposes that include the Reserve Forests, Protected Forests, and other categories of

forests – the Recorded Forest Lands (RFA) as defined by the Forest Survey of India – under the stewardship of the forest department. These tracts represent various ecosystems, habitats, wild species, communities, populations and ecological services[7,8].

The World Heritage Convention proclaimed by UNESCO has added World Heritage Sites and World Heritage Sub-clusters as a category of PA. PAs that meet the criteria can qualify for such status plus those that are not PAs can also feature in these[9].

Assessing, measuring and conserving biological diversity

Biological diversity is assessed and measured at five scales – genes, species, communities, populations, ecosystems and landscapes. These in a sense constitute a design of nested scales with genes as the smallest of these at the micro scale to be assessed and measured by scientists in a laboratory to determine among the vast numbers of outcomes the environmental fitness of a species by the measure of genetic variability of its population which in turn predicts the future of the species[10, 11]. This provides options for undertaking the appropriate conservation interventions. For the manager in the field the visible manifestation of biological diversity is by species, communities and populations of wild plants and animals by the size and distribution. There is a wide range of techniques for their assessment and measurements. The ecosystem as a concept is not difficult to comprehend but ecosystems are not easy to assess and measure because of their fluid and merging boundaries and of their different components some of which might qualify to be identified as independent systems. Landscapes being clearer spatial units are amenable to setting boundaries and constitute the largest of the five scales.

PAs are central to the conservation agenda. The tiger reserves in India include one or more categories of PAs. The features of the Tiger Conservation Plan (TCP) as set out in the Wildlife (Protection) Act 1972 and the NTCA's guideline for the purpose[12] integrate all the important elements – biological, ecological, cultural, social and economic – that are essential for effective conservation of natural ecosystems. The WII's guide for planning wildlife management in PAs and managed landscapes also in various details contributes to the cause[4]. Therefore there appears to be no dearth of scientific precepts, capabilities and strategies that could be based on ground realities. What is lacking is the enabling push that is dependent on integrated mechanisms – appropriate policies, laws, regulations and programmes that could be resolutely enforced –'the big four' – that can deliver rather than pontificate – by involving the agenda of many ministries and departments of the government and where lies the rub.

Many elements of the 'big four' are already in existence. There are laws like the Wildlife (Protection) Act 1972[6], the Environment (Protection) Act 1986[13], the Forest (Conservation) Act 1980[14], the Biological Diversity Act 2002[15], the Wetland Conservation and Management Rules 2010[16] and the Coastal Regulation Zone Notification 2011[17]. There are policies such as the National Environment Policy 2006[18], National Forest Policy 1988 and the Marine Fishing Policy 2004[19]. There are national strategies and action plans such as National Conservation Strategy and Policy Statement for Environment and Sustainable Development, 1992[20]; National Wildlife Action Plan 2002-2016[21], National Biodiversity Strategy and Action Plan, Guidelines and Concept Papers, 2000[22]. There are guidelines – Guidelines for Protection, Maintenance, Research and Development in the Biospheres Reserves in India, 2007[23], Guidelines for Integrated Management Action Plan for Wetlands, Mangroves and Corals, 2009[24]. Although the State Boards of Wildlife and the National Board for Wildlife strive towards strengthening the PA management and conservation of coastal and marine ecosystems, the coordination between the line departments remains a steep challenge. They are split horizontally along their sectoral agenda and have little willingness or mechanisms to synergise the actions towards attainment of the national ecological goals expressed by laws, policies and action plans.

Individually the elements are excellent but there is no overarching direction within the national agenda to ensure synergy and coordination between the programmes of all government agencies under the essential common frame of reference, that for the security of natural ecosystems.

India has a network of 658 PAs (all categories) covering 158,745 km^2 or 4.83% of the country's geographic area and some 22% of the RFA. Out of these only 23 PAs are > 1000km^2 in extent[4]. The average PA size works out to <300km^2, which is too small to accommodate the range of habitat attributes, and thus native biological diversity at the given geographic location or to contain sizes of environmentally fit populations – those with a wide base of genetic variability – of the wide ranging

species and others that need more space with uncertainty about how the processes of recruitment and mortality within populations of various species – plants not excepted – would affect their future. Simply stated the principles of species-area curve apply. Further PAs appear mostly as insular habitats in a matrix of non-compatible land uses. The conservation capability of PAs, the size apart is determined by their shape and the degree of isolation from other habitats, likewise by their capability for withstanding the impacts of random natural events and the high intensities of biotic pressures that they are subjected to. The sizes of PAs are extremely difficult to increase, not necessarily because for the want of suitable habitats but because of the legal restrictions on uncontrolled use of such lands. Because of this the local communities strongly resist such move. Lack of political will to translate the benefits of protected areas is also a serious hurdle. Likewise any process for creation of new PAs is severely objected to.

PAs because of stricter laws and their enforcement are expected to serve the function of *source areas* i.e. the rates of recruitment into wildlife populations are expected to be higher than the rates of mortality thus producing a surplus of individuals that are ordained to disperse to suitable habitats according to the laws of evolution which have already been proved. Since the habitats outside the PAs are penumbral and beset with many other problems these are *sink areas* i.e. the rates of recruitment into the wildlife populations are lower than the rates of mortality causing decline of species and populations. The wisdom of conservation lies in linking source areas with sinks to balance the negative pulls of the latter and thus make it possible to maintain 'large' interacting populations of various species called metapopulations over large geographic areas. Dispersal corridors connecting PAs and other existing and potential habitats of various attributes are critical pieces of this jigsaw[25].

Forests outside the PAs are managed to produce various goods and services some of which that are degraded are set aside for the purpose of restoration. Those forests with potential for producing high quality timber and non-timber forest produce (NTFP) are designated for production functions. The kinds of timber and NTFP depend on geographic locations and forest types. For example the timber in Himalayas includes deodar, spruce, fir and pine in the coniferous forest types. The NTFP includes walnut and chilgoza among the large numbers of others. In the dry deciduous forest type of central India teak and sal are the main timber species. The NTFP includes char or charoli and amla. It needs to be remembered that whatever the geographic location the list of NTFPs is extensive and what is cited here is a small example[26]. Although the wisdom of science and the system of techniques employed for managing forests might not always be understood by lay persons these can also be used to maintain, alter or create habitats (for maintenance of biodiversity) of various attributes and extent[27,28]. Thus it is possible to improve the quality of sinks and even change some sink areas into source areas. The forest department alone cannot accomplish this because of the great pressure of the rural and semi-urban sectors on the forest resources. In order to address these pressures the poorly supported and funded forest department is heavily burdened with community welfare programmes. The way out is for the large numbers of other departments charged with the welfare of people under various programmes must serve the needs of people effectively according to their mandate. This would greatly help in providing alternate livelihoods and other economic opportunities to rural communities to reduce the pressures on the forests and allow the foresters to do their job for which they are trained which management of natural ecosystems is.

To summarize the sciences of Insular Biogeography, Conservation Biology and Landscape Ecology provide the largest evidence in favour of managing biological diversity at landscape levels that includes PAs as their crucial sub-units.

Significance of Landscapes

A landscape is defined as 'a mosaic of interacting land uses with people and the impacts of their activities integral to it'[4,29]. Landscapes can have an extent of several thousand square kilometers. The interactions across and between land uses are expected to be many and complex including the positives and the negatives interpreted and centered on the short term interest of people. For attaining conservation goals sustainability of land based activities is essential. This is possible only with an integrated approach where all departments honour their mandates. Sustainability obviously implies the ecological connotation and principles that must have the highest priority – security of natural ecosystems through good practices those inevitably lead to equitable benefits shared by people – however disparate the nature of objectives of such land uses might be.

Tomes are written on the benefits derived from natural ecosystems by human societies with little or

no *quid pro quo*. The problem is that the benefits are not allowed to be understood by the interplay of politics and secondly the benefits are taken for granted and therefore find few or no advocates in places that make the difference in favour of conservation of ecosystems. It is unfortunate that politics of economy and development is based on populism. Since it is also based on attaining short term gains it is not surprising that ecological services that work on the scale of long term benefits are put at a great disadvantage. Environmental and forest laws are routinely blamed as representing legal 'hurdles' that stand in the way of 'development'. Absence of patience and willingness to understand the value of ecological services has led to heavily distorted arguments that emphasize that environmental and forest laws are against citizen's interests and that more value is placed on wildlife than on human life. The absence of priority for the security of natural ecosystems is evident in the national denial of the most dreaded force of climate change and its consequences for the wellbeing of the country[30]. The episodes of droughts, excessive rainfall, floods and cyclonic weather at different geographic locations during the past many decades have now become all too frequent. The only answer to contend with these is to respect ecological integrity through measures and efforts of all organs of the government. This will not guarantee reduction of such episodes in quick time since climate change has a global presence and it has been building up since the beginning of the Industrial Age, for the past some 250 years and therefore will need time while the human population of the world keeps rising at an alarming rate.

According the top priority to conservation of natural ecosystems does not mean any conflict of interests because the most important objectives of governance – ensuring the quality of human life and the wellbeing of the nation – the pillars of India's Constitution– necessarily ride piggyback on productive natural ecosystems. Ensuring security of natural ecosystems does not mean making sacrifices and befriending privations. It is about using modern technology and designs to reduce impacts to the minimum acceptable – both ecological and social. It is about necessarily being prepared for adopting relatively expensive but efficient alternatives that integrate the concerns for natural ecosystems and environment in lieu of those traditions that are impactive and used for maximizing profits. Above all in context of good governance it is about communicating the ecologically and economically correct signals to the constituencies of disparate political leanings without fear or favour. This approach undeniably implies a price required to be paid during the present for ensuring the future wellbeing of the country.

The approach to conservation of landscapes

There could be several approaches for setting boundaries for landscapes : (i) maximizing inclusion of forest types with special consideration to those that are most fragile – such as the rainforests; dry and moist grasslands, those that are rare and isolated, those bearing the brunt of human activities; areas of significant catchments and a scatter of wetlands, swamps, bogs, patches of primitive plants, rocky plateaus (ii) attempts at including populations of wide ranging species on account of their physical and behavioural attributes – of being large bodied, of those territorial/having large home ranges, those with seasonally separate geographic ranges, of species that are rare, populations that are small and scattered or those geographically restricted, and species that are habitat specialists – coincidentally almost all of such species would be in various categories of 'threatened species' or the other; (iii) including areas with potential dispersal/movement corridors connecting habitat patches within a landscape critically important to maintain the balance between the source and sink areas[31].

Natural drainages also called riparian systems are the most effective corridors because they run across and along contours with a dendritic pattern thus connecting all habitat types and patches along altitudinal gradients[32]. These need not have vegetation all along their length nor need they be perennial. A patchwork of vegetation and scattered pools of seasonal or perennial sources of water such as springs could serve the purpose excellently. Likewise outside the riparian systems a patchwork of vegetation, or scattered piles of large boulders depending on inter patch/inter pile distances these can serve as effective corridors working like dispersal routes paved with stepping stones. Most larger species can thus travel along these. Tall crops in agriculture areas, patches of horticulture farms that are conveniently located, and ravines are other features that allow movement of wild animals to reach large habitats. Some species overcome the risk of 'visibility' during travel by travelling long distances at night. Some species like the leopard are adapted to using minimal cover and thus can 'hop' considerable distances without being detected or disturbed. In

summary, corridors need to have features that offer security, concealment and some water. Large carnivores opportunistically feed on livestock as they move. Herbivores seek food in patches of natural vegetation encountered or in farm crops to tide over their needs while on the move[4].

Within the circumscribed boundaries of a landscape the most important legal and administrative units – depending upon their geographic location – are made up by the maximum of four legal categories of PAs and tiger reserve/s with their buffer zones along with RFAs outside the PAs all managed by the single agency of the forest department. There also could be areas declared as Ecologically Sensitive Zones (ESZ) also sometimes called Ecologically Sensitive Areas (ESA), a legally mandatory requirement under the Environment (Protection) Act 1986 around national parks and sanctuaries[40]; may be a BR as well. There also could be ESA/s that are declared independent of PAs and managed by different agencies with the forest department being one of those. These categories of lands are expected to be in shape of fragments within a large matrix of disparate and non-compatible land uses including human settlements of various sizes and numbers.

The only way to attain the objectives of conservation of landscapes – those of securing the interests of ecosystems and their services currently addressed by only a single agency, the forest department which is placed on the lowest rungs of importance among all government agencies because of being considered inconsequential in the same manner as the natural ecosystems – is through the convergence of multi- agency programmes of various ministries and departments of the government, especially those that ostensibly serve the welfare of people in rural India. The fivefold agenda at the forefront with emphasis on rural areas needs to include quality education with access to the best teachers and institutions; a vista of vocations and work opportunities; safe drinking water and its delivery to all; effective support of energy; hygiene in its true sense and sensitive healthcare. This would progressively reduce the rural community's direct dependence on forest/natural ecosystem based resources. The sectoral walls of different departments protecting their turfs continue to stand and grow stronger. The existing instruments that can help in management of landscapes are stated later. The first step in getting the 'big four' working is to undertake institutional mapping.

There are a plethora of agencies working for various purposes, sometimes at cross purposes at the levels of the Center, the States, and districts and down to the Panchayati Raj Institutions (PRI). Further there are civil societies with a large canvas of separate as well as overlapping agenda. These all are or supposed to be stakeholders in national interests. While mandates and priorities might be different there also are areas of overlaps, therefore this becomes a problem in getting all on the same page. Coordination is the biggest challenge. It is important to know who is mandated with what and the mechanisms of actions. Institutional mapping has six categories of functions under which various authorities, agencies, departments can be classified. They are : (a) those that have jurisdiction over the resources : e.g. the forest department, the revenue department, the department of fisheries, department of atomic energy, power, tourism, urban development (b) the regulatory arms : e.g. police, forest and revenue departments, municipality/municipal corporation (c) agencies with repository of knowledge and data : e.g. revenue/land records; forests; meteorology (d) agencies with functions for development : e.g. power, atomic energy, fisheries, national highways authority; municipality/municipal corporation; tourism (e) regulatory users : e.g. hotels and hospitality (f) political authority for decision making : e.g. the municipality/municipal corporation; PRI; parent ministers for districts (UNISDR/UNDP 2012). This is only an illustrative list[33].

The Northern Western Ghats of Maharashtra (NWGM)

The Western Ghats feature among the world's 34 Biodiversity Hot Spots[34]. The estimated area of Western Ghats varies from 130,000 km^2 to 180,000 km^2[35,36 and 37]. The most often quoted figure is 160,000 km^2 or 4.8% of India's geographic area. The limits are not precisely delineated hence some different versions could also exist. The Western Ghats run north to south over a distance of 1600 km along the western edge of the Deccan Plateau from the river Tapi where the Satpuras end through to Tamil Nadu. The state wise area of the Western Ghats and percentage to the total geographic area of the states/ UT concerned in which they feature are Gujarat (4400 km^2/2.2%), Union Territory of Dadra and Nagar Haveli (100 km^2/24%), Maharashtra (54000 km^2/ 17.54%), Goa (3770 km^2/99.9%), Karnataka (45200 km^2/23.5%), Kerala (38800 km^2/99.8%) and Tamil Nadu (12900 km^2/9.2%)[1]. The total extent of the

Northern Western Ghats (NWG) – three states and one UT – is 62,270 km^2. The NWGM area accounts for 86.71% of the NWG and 33.75% of the total extent of Western Ghats. Thus it is a very important tract of this mountain chain. The average elevation of Western Ghats is 1200m ASL. The northern Western Ghats up to Goa are formed of massive horizontal beds of Deccan trap. These present vertical profiles of 1000m and more along the successive series of beds that are scenically extraordinary. Around Goa the height of the Western Ghats is abruptly reduced to about 650m ASL but after Honnavar the height is regained with steep sides all around. The tallest peaks are found in this region. At 2695m height, Anamudi in Idukki district of Kerala is the tallest peak in the Western Ghats. Kalsubai (1646m) in Maharashtra is the highest peak in northern Western Ghats[38].

In terms of research thus far most attention has been focused on the Southern Western Ghats, more mountainous with many high peaks, high diversity and important catchments. This however does not diminish at all the importance of NWGM.

Forest Types

According to the system of classification of forest types by Champion and Seth[39] the NWGM is represented by seven sub-groups and 11 sub-types (***Annexure I***) as the major habitat types. Depending on species-habitat relationships these represent a large number of specific habitats within the forest sub-types in addition to those that are outside the system of classification.

Biogeographic Classification

According to the biogeographic patterns India is classified into 10 Biogeographic Zones. These are large distinctive units of similar ecological conditions, biome, communities and species representation. These have further 27 sub-units recognized as Biotic Provinces – secondary units with weightage to specific communities (vegetation and animals) separated by barriers to dispersal or gradual change in environmental factors. The Land or Landform Region constitutes tertiary units within a province indicating different landforms. The Biome is an ecological unit such as swamp/wetland or a dry deciduous forest that could be found in many Biogeographic Zones and Provinces. These can be equated to Champion and Seth's system of forest classification in addition to non-forest categories such as wetlands, the coastal and marine systems. The framework has expressly been established to ensure that each biogeographical unit including the subunits is represented by PAs. The PAs in NWGM represent the Biogeographic Zone 5-Western Ghats with its two Provinces – 5A : Western Ghats Malabar Plains and 5B : Western Ghats Mountains[2,35].

The core conservation landscape units

Land units such as the PAs, BRs, tiger reserves (TRs), the Reserve (RF), Protected (PF) and other categories of forests including private forests, Eco Sensitive Zones, and sacred groves constitute the core conservation areas on account of specific laws, rules or by their social/cultural and religious significance. Rocky plateaus characteristic of NWGM form a category that is very important and unique in its ecological characteristics. Catchments/watersheds not in the PA and forest land categories and significant floodplains including riparian zones and patches also need to be added to these as areas that provide critical ecological functions and are sensitive to disturbance. At the scale of microsites there are ecologically fragile and significant elements for maintenance of biological diversity and ecological services. These are – springs, seeps, bogs, swamps and marshes, wetlands, natural grasslands/grassy openings, patches of rocky outcrops, ravines, caves, dens, cliff faces, overhangs, ledges and cliff tops, wallows, and natural saltlicks. There are microhabitats of biological origin that are essential for many species. These are snags, hollow live trees (den trees), large crowned isolated old trees, old groves, large climbers and fallen large trees decomposing slowly[4].

The NWGM has 7 sanctuaries aggregating an area of 1593.54 km^2 but has no national park. As per the national recommendation however there are new proposals to create 2 national parks – Radhanagari and Koyna, each with an extent of 150 km^2 to be carved out of the existing sanctuaries bearing the same names and 5 small sanctuaries extending over 135.52 km^2. The 732.52 km^2 Sahyadri tiger reserve with inclusion of the Koyna and Chandoli sanctuaries is the single tiger reserve in this area[2] (***Annexure II***). It is mandatory to identify and declare Eco Sensitive Zones around national parks and sanctuaries. The Government of India in MoEF has issued guidelines for declaration of such ESZs[40].

Conservation of PAs is accomplished through management plans. The Ministry of Environment and Forests (MoEF), Government of India (GoI) does not release funds under its centrally sponsored scheme for management of PAs unless there is an approved and current management plan in place for a PA. There is a

detailed process for preparation of these plans and covers all stages of planning for which a guide exists[4]. The mere existence of a plan is not so important as its relevance, quality and application of prescriptions that are on track. Monitoring the application of plan prescriptions, taking remedial actions on setbacks and backlogs even if these are required to be addressed subsequently are crucial aspects and part of the process. Tiger Reserves are likewise mandated to be managed by plans called the Tiger Conservation Plan (TCP) as prescribed under section 38V of the Wildlife (Protection) Act 1972. The National Tiger Conservation Authority (NTCA) has established a guideline for preparation of the TCPs as stated earlier.

The three important sanctuaries in the NWGM are Radhanagari to the south and Chandoli and Koyna to the north. The distance between Radhanagari and Chandoli is approximately 60 km. These three PAs together with the patchwork of intervening forests, two large dams and several small ones form a landscape unit, some 1600 km^2 in extent that forms a part of four Forest Ranges – Panhala, Gaganbavda, Pendakhale and Malkapur. The tract has many scattered perennial springs forming small pools of water down the slopes. The connectivity or the corridor between Radhanagari and Chandoli is along the Crestline defined by several flat rocky plateaus that might appear bare of vegetation during summer except for small groves of typically stunted trees festooned with moss. During the rains and winters these plateaus are covered with many species of grasses, herbs and small shrubs. As per a survey conducted in the landscape during 2007 it was estimated that the area has a potential for supporting a population of 20 tigers. The survey listed seven sites that need to be managed as mini core areas – Udigiri (95 km^2), Amba (160 km^2), Gelavade dam to Anuskura (51 km^2), Barki (27 km^2), Vashi-Padasali (43 km^2), Kode-Asraf-Wesraf (57 km^2) and Gaganbavda-Padmasetti (70 km^2).

Unregulated tourism in the Amba area and unregulated firewood extraction by people from Amba and Manoli for supply to some 20 tourist resorts is a grave threat, particularly since the Radhanagari-Chandoli corridor is barely 500m in width along most of its extent. The connectivity north of Chandoli to Koyna has a much better status[41].

The World Heritage Convention of UNESCO has inscribed a World Heritage Sub-cluster in the NWGM among those in addition to the southern tracts of the Western Ghats. This includes the Sahyadri sub-cluster with four site elements located in Maharashtra and includes the Kas plateau with unique ephemeral floral features, the Koyana, Radhanagari and the Chandoli sanctuaries. Eight main rivers along with numerous tributaries flow out of this region. Besides there are catchments of 8 dams including the largest hydro-electric dam in the Western Ghats on the Koyana River[42]. The National Register of larger dams of India reveals the existence of 165 dams in the region of NWGM[43]. This suggests the critical need for protecting their catchments and watersheds.

The Forest Survey of India (FSI) states the forest cover extent in the Maharashtra's Western Ghats (NWGM) at 18966km^2[1]. The report states loss of area under dense forests category which has increased the area (by transfer) under the medium-dense and open forests categories. This indicates that the forests are under great deal of pressure. The causative factors can be varied-from local community dependence on resources to 'development'.

The Pune based Wildlife Research and Conservation Society (WRCS) in its report of 2013 on the status of private forests in the northern Western Ghats[44] have estimated the extent of private forests at 12043km^2 of which 6020km^2 are under tree cover while the remaining area is in the category of scrub and open forest. An area of 5794km^2 of private forests is vested in government (forest department). Uses of these forests include felling of trees for firewood for household use as well as for sale; lopping for rab burning (lops and tops of trees spread across cultivation area and setting it on fire to prevent regeneration of weeds and to enrich the soil by minerals released in the ash); pasture and for shifting cultivation. Kolhapur district is among three districts that show poor quality private forests. Soil erosion is commonly seen and larger threats include sale of land to businessmen, for construction of resorts and farm houses, conversion to plantations of coconut, banana, rubber and pineapple. The findings indicate that there is loss of forest cover as well as significant tracts are under degradation. Considering the acknowledged fragility of the WG there is urgent need to remedy the situation.

The recorded forest cover of NWGM is made up by 12 Districts of which some have >50% of their areas in the NWGM and some have <50%. The district wise forest cover is depicted under ***Annexure III***. However since the areas of partial inclusions in NWGM could not be ascertained the figures are higher than those reported by FSI[1].

The flat plateaux of the northern Western Ghats

have evolved from intense physical and chemical weathering of basalt flows, often exposed with thin soil cover. The annotations on topographic maps often identify these features as 'rocky scrub', 'stony waste' or 'sheet rock'. Since the plateaux have poor vegetation cover, especially of trees they appear as open spaces in satellite imageries. The Wasteland Atlas of India by the NRSA and Ministry of Rural Development show extensive tracts under category 22-barren, rocky, stony waste areas in the NWGM. In reality the rocky plateaux have high biodiversity values. The 'waste land' status conferred on them makes these plateaux highly vulnerable to exploitation for activities that work against their ecological fragility. High level ferricates are located between 800-1400m ASL along the crest line of the NWGM in Kolhapur, Satara, Ratnagiri andSindhudurg districts but not south of it. Thus these geological-ecological features are restricted in their distribution. Their conservation values are based on a study at 67 locations in 6 districts of Maharashtra. Thus far 188 species of endemic plants have been recorded on the rocky plateaux and though many species are not exclusive to the rocky plateaux, these features serve as habitats for a large number of endemic species. It is acknowledged that rocky outcrops make a significant contribution to the local and regional species richness. High endemism and recent records of many new endemic species in disparate taxa from the rocky plateaux (67 sites) indicate high conservation significance. The ecosystem services are often neglected in making decisions on land use because these are free and taken for granted. Specifically about the rocky plateaux-they serve as water catchments. The lithomarge promotes underground water channels that are expressed as springs along and below the plateaux. Seasonal mass blooming of plants offers abundant food for the pollinators. This is important for crops and orchards in the surrounding areas at the appropriate time[45,46].

There are four independently notified Environmentally Sensitive Zones within the NWGM under section 3, subsection (1) clause (v) of the Environment (Protection) Act 1986. These are (i) Mahableshwar-Panchgani region covering 237.28 km^2 with details of its administrative units, villages, the forest zone and the green zone[47] (ii) Matheran and surrounding region of 214.73 km^2 with a buffer zone of 200m all around the area. The inclusions are likewise detailed[48]. Both of these regions are required to be managed under their respective Zonal Master Plans. The expectations and conditions are specified. A high level monitoring committee for each of these regions has been appointed to ensure the implementation of actions and regulations (iii) Dahanu taluka of Dahanu district is declared as an ecologically sensitive and fragile area and in line with the concern there are restrictions imposed on setting up industries which have detrimental effect on the environment. The industries are classified as Red, Orange and Green categories. The regulations and actions are enforced through a Master Plan/Regional Plan with the expectations spelled out[49]. (iv) In Murud-Janjira area of Raigadh district there is prohibition on locating all industries carrying on operation or processes in a block of one kilometre from the high tide mark of Revdanda creek up to Devgarh Point near Shrivardhan as well as in a one kilometre belt along the banks of Rajpuri creek up to Mhasla except those industries that promote tourism and those permitted by the Central Government after the due process of EIA[50].

There are 67 sacred groves within the NWGM[51]. The largest near Kolhewadi village in Junnar taluka of Pune district has an extent of 263 hectares while the smallest of 12.04 hectares is near Bidwad village, Kankavli taluka of Sindhudurg district.

There are two reports namely of the Western Ghats Ecology Expert Panel (WGEEP)[43 and 52] and by the High Level Working Group on Western Ghats (HLWG) [53 and 54]. Both these reports have been nationally commissioned. These are widely disseminated and need no introduction. Only the cogent content as relevant to the ecological fragility of the WG in general and NWGM in particular are cited. These are quoted mostly verbatim.

The report of WGEEP

The WGEEP has adopted 3-layered approach and attempted to assign relative levels of ecological sensitivity to areas based on 8 parameters using 9x9 km or 5'x5' grids. WGEEP recognized Three Ecologically Sensitive Zones (ESZ) – ESZ1, ESZ2 and ESZ3 based on a scoring system assigned to the states/variants of each of the 8 parameters on a scale of 0-10, and average score for each grid was calculated. Similarly the average scores of grids of PAs were calculated and ranked in descending order in each state. If the average score of the grid was equal or higher than the lowest rank grid of PAs then it was treated as ESZ 1, and about 25% of grids having average scores of grids equal to lowest rank grids of PA were treated as ESZ2 and the remaining ones were

treated as ESZ3. This was based on the stipulation that protected areas (PA) +ESZ1 in each state should not exceed 60% of the total area and PA+ ESZ1 +ESZ2 should make it 75% of the total as forest cover. Using an algorithm the grids were assigned to different ESZs[43 and 52]. The report has assigned 41 talukas from 9 districts to the three ESZ categories those either fully or >50% by their areas fall within the NWGM and 30 talukas from 11 districts have been assigned to ESZ2 and ESZ3 categories those having <50% of their area falling within the NWGM. Of these areas of 4 talukas appear in both the ESZ2 and ESZ3 categories. These are cited under ***Annexure IV***. Guidelines are proposed for sector wise activities for 24 sectors for all the three ESZ categories.

The report has further identified Ecologically Sensitive Localities. These include Lonavla-Khandala; a cluster of 25 villages from Sawantwadi and Dodamarg talukas and has recommended ESAs around the PAs.

It is on record that the Government of India in the Ministry of Environment, Forests, Wildlife and Climate Change (MoEFCC-changed designation from the previous MoEF) has announced that it is processing the HLWG report – here it is not about questioning such decision or debating the merits of the two reports or the differences but to emphasize the fragility of the Western Ghats underwritten by the two reports of which the NWGM is a tract.

The Report of the HLWG

The HLWG approach for the delineation of eco-sensitive area starts with the natural vegetation consisting of major vegetation types. Primarily, the only fine scale, spatially consistent information on plant species distribution for the Western Ghats is the vegetation type map. These vegetation types are generated using multi-spectral remote sensing data in conjunction with suitable ground inventory of plant species. Finally the spatially consistent species surrogate information that vegetation types provide, is used as the basis for estimating landscape level metrics such as biological richness and forest fragmentation.

The HLWG effort for the identification of ecologically sensitive areas (ESAs) based on landscape level indicators have utilized the layers generated from the national project on landscape level biodiversity characterization under the collaborative study of the Department of Space and Department of Biotechnology, founded on multi-season IRS LISS-III data. It provides spatial information on the vegetation types consisting of natural and managed vegetation. The satellite image elements were correlated on ground with the sampling intensity varying from 0.002% to 0.005%, depending upon the vegetation heterogeneity. Details of the study methodology, sampling technique and biological richness modelling have been published. Besides the remote sensing data, other collateral databases used include phytosociological data collected from 16,578 field sample plots (Out of the 7596 plant species documented 648 species are endemic, 23 are endangered or threatened – correctly called the 'Threatened Species' under the IUCN recognized categories of threats[55], 1879 are medicinally important and 2803 are economically important species. The popularly used terminology – endangered, rare and threatened (ERT) is incorrect and needs to be discarded). The datasets were collected during 1998-2010 under the Department of Biotechnology and Indian Space Research Organization joint programme that is mentioned earlier.

The project combined the spatial information generated on vegetation types with the species level information and landscape level parameters to generate modelled layers on biological richness and disturbance regimes. The spatial database of these layers have served as the baseline data for habitat suitability assessment, prioritization for micro-scale habitat studies, corridor connectivity and landscape planning, identification of species-rich areas, and conservation methods for protection of rare species.

The geospatial analysis for identification of ESA uses two of the landscape level spatial layers – forest fragmentation and biological richness. The fragmentation layer provides insights into the effects of forest fragmentation on landscape patterns, biodiversity and ecological processes. The biological richness layer identifies areas that should be treated on a priority basis for the conservation of biodiversity.

The landscape indices (biological richness and forest fragmentation), derived from the geospatial analysis of IRS LISS-III satellite data include details on species richness of vegetation, endemicity, ecosystem uniqueness, disturbance indicators, adjacency and patch characteristics. This enabled delineation of ESAs in an objective and scientific fashion at a much finer scale with village as a unit and thus paved the way for actionable and implementable approach for the conservation of ecology and equitable and sustainable development of WG, as envisaged by WGEEP. Wildlife habitats are not explicitly included in the demarcation of ecologically sensitive areas; the

forested and natural landscapes are the best available fine resolution and spatially consistent proxies in the absence of high resolution data on faunal distributions.

The report has included 2053 villages in 56 talukas of 12 districts as ecologically sensitive areas. The details are cited under ***Annexure V***.

It will thus be observed that the core conservation units of the landscape are identified and described with justification. There are proven scientific practices and techniques for addressing their security in a Guide that includes PAs, forests outside the PAs (managed forests) and forested landscapes for the purpose. There are units that have been delineated as ESAs by law with guidelines to take the actions forward and there are two scientific reports of the highest standards that further lay the foundation for defining fragile ecosystem units and provide strategies and actions for their security. What is now needed is, at the risk of repeating, the convergence of multi- agency programmes – the pooling of knowledge, skills, capabilities and resources and mechanisms for synergistic working – with security of ecosystems, habitats and species over the given geographic extent as their common frame of reference. It would appear that new laws or appropriate amendments to the existing laws and policies are a necessity-an improvement based on better scientific knowledge but not dilution. It is also necessary to change the populist and extremely dangerous perception rapidly gaining ground that 'development' is the last word for national happiness without conveniently defining the inclusive nature of 'development' by leaving it to all and sundry to interpret its meaning by the numerous and incompatible vested interests rooted in the irresponsible and tragic statement that environmental and forest clearances are 'hurdles' to development.

The overarching principles for addressing ecological security at the landscape level are enshrined in the concepts and actions under Ecosystem Based Management (EBM)[33]. This approach is tailored for application to various subunits of the landscape. It differs from a single species or a single sector approach to management by engaging complex interactions between the living and non-living environment and people in multiple scales of space and time. The principles of EBM are to sustainably manage both target and non-target species involving a three pronged approach of protection, conservation and restoration of habitat quality to maintain ecosystem functions and services. The features of EBM goals are :

- Emphasizing connectivity within and between systems i.e. attempting connectivity between habitat patches through a network of corridors aiming at large landscapes. This would include PAs and production forests on land and between terrestrial habitats, inland wetlands, estuaries, coasts and the sea.
- Emphasizing protection and restoration of ecosystem structure, functions, and processes
- Focusing for the purpose on the consequences of human actions within a specific ecosystem/ management area
- Incorporating social dimensions of resource use and ecosystem values into management
- Integrating biological, socioeconomic and governance perspectives
- Recognizing the high level of uncertainty and variability in the dynamics of ecosystems
- Reflecting a common vision among stakeholders
- Attempting informed adaptation from learning based on science and local knowledge

With all the proven evidence of modern science heavily in favour of protecting and conserving the remnants of ecosystems, natural habitats and species there still would be sceptics and not surprisingly in majority questioning its wisdom. They would do well to read the disastrous consequences of improvident use of renewable resources chronicled dispassionately, truthfully supported by brilliant and incontrovertible research that spans the history of human societies from the fourth to the twentieth century in different parts of the world in a book that has the title of equal weight – 'Collapse – How societies choose to fail or survive' penned by one of the most erudite scientists of our time-Jared Diamond[56].

Annexure I

Major Forest and Habitat Types in NWGM

Sub- group/sub-type	Distribution	Indicative vegetation
1A. Southern Tropical Wet Evergreen Forests		
C_4 West coast tropical evergreen forest	Ratnagiri southwards, RF 1500-5000mm, high humidity, alt. 250-1200m States: Karnataka, Kerala, Maharashtra, Tamil Nadu	*Calophyllum spp., Hopea spp., Machilus macrantha, Aglaia roxburghiana, Caryota urens, Strobilanthes, Leea and canes*
2A Southern Tropical Semi- Evergreen Forests		
C_2 West coast semi-evergreen forest *altissima,*	A narrow strip between wet ever green and moist deciduous. Hill slopes,	*Terminalia paniculata, Lagerstroemia lanceolata, Artocarpus hirsute, Vitex*
zeylanicum,	sometimes plains. Vulnerable to destruction. RF 2000-2500; alt. 450-1050m	*Tetrameles nudiflora, Pterocarpus marsupium, Canarium strictum, Cinnamomum*
	States: Kerala, Maharashtra, Karnataka, Goa, Tamil Nadu	*Albizzia odoratissima; bamboos and reeds, Clerodendron, Strobilanthes, Entada phaseoloides, Dioscorea spp.*
E_3 Moist bamboo brakes	Locally throughout the SEG and MDD forests, more or less continuous cover States: Kerala, Karnataka, Maharashtra, Tamil Nadu	*Bambusa arundinacea*
E_4 Lateritic semi-evergreen forest	On lateritic sites. *Xylia xylocarpa* is the characteristic species States: Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu	*Xylia xylocarpa, Pterocarpus marsupium, Terminalia spp, Bridelia retusa, Calycopteris floribunda, Strychnos nux-vomica, Adhatoda vasica, Holarrhena antidysentrica*
3B South Indian Moist Deciduous Forests		
C_1a Very moist teak forests	Low percentage of teak<10, very dense EG undergrowth, eastern side of the crest of WG. RF > 2500mm. States: Gujarat, Kerala, Maharashtra, Goa, Tamil Nadu.	*Terminalia paniculata, Grewia tiliaefolia, Lagerstoemia lanceolata, Dillenia pentagyna, T. bellerica, Tectona grandis, Xylia xylocarpa, Kydia calycina, Bambusa arundinacea, Dendrocalamus strictus, Oxytenanthera monostigma, Clerodendrum sp.*
C_2 Southernmoist mixed deciduous forest	All along the WG, usually in the valleys. States: Gujarat, Goa, Kerala, Karnataka, Maharashtra, Tamil Nadu	*Tetrameles nudiflora,T. paniculata, T. tomentosa, Madhuca indica, Dillenia pentagyna, Adina cordifolia, Syzygium cumini, Xylia xylocarpa, Strychnos nux-vomica, Bambusa arundinacea,*

		Dendrocalamus strictus, Zyzyphus oenoplia, Z. rugosa, Saccharum spontaneum and other grasses.
$_2S_1$ Southern secondary moist mixed deciduous forest	Whole length of WG. Origin attributed to shifting cultivation, livestock grazing and fires. States: Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu	*Mangifera indica, Bombax ceiba, Lagerstoemia lanceolata, Schleichera oleosa, Alstonia scholaris, Sterculia villosa, Careya arborea, Feronia limonia, Carissa carandas, Saccharum spontaneum.*
$_4$C Tropical Freshwater Swamp Forests		
FS_2 Tropical hill valley swamp forest	Low crowned branchy trees, dense growth of *Calamus*. States: Karnataka, Kerala, Maharashtra, Tamil Nadu	*Syzigium spp., Pandanus, Alpinia*
4E Tropical riparian fringing forests		
RS_1 Riparian fringing forest	Along the banks of larger streams as a narrow linear strip. States: Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu	*Bischoefia javanica, Terminalia speciosa, Terminalia arjuna, Mangifera indica, Syzygium cumini.*
5A Southern Tropical Dry Deciduous Forests		
C_3 Southern dry mixed deciduous forest	Drier localities and sites. RF 875 to 1500mm, subjected to annual fires States: Gujarat, Kerala, Karnataka, Maharashtra, Tamil Nadu	*Anogeissus latifolia, Terminalia tomentosa, T. chebula, T.bellerica, Hardwickia binata, Zizyphus xylopyrus, Gardenia latifolia, Acacia chundra, Santalum album, Dendrocalamus strictus*
8A Southern Sub-tropical Broadleaved Hill Forests		
C_2 Western subtropical hill forest	Northern WG, Maharashtra above 1000m. e.g. Mahableshwar. RF 1500-6600mm. States: Karnataka, Maharashtra	*Syzygium cumini, Actiodaphne hookeri, Terminalia chebula, Memecylon sp., Flacourtia latifolia, Canthium dicocium, Pogostemon plectranthoides, Carvia spp., Capparis pedunculosa, Zizyphus rugosa, Pavetta indica.*

Source: Champion Sir Harry G. and S.K. Seth 1968

Annexure II

Protected Areas in NWGM

The Existing and Proposed National Parks, Sanctuaries and Tiger Reserves

Province	Existing	Size Km^2	Proposed	Size Km^2
		National Parks		
05A	—	00.00	—	00.00
05B	—	00.00	Radhanagari*	150.00
			Koyna*	150.00
Total	—	**00.00**	**2**	**300.00**
* These are portions of the existing sanctuaries by the same names				
		Wildlife Sanctuaries		
05A	Karnala	04.48	Vikhroli	07.00
	Phansad	69.79	Karnala Extension	07.52
	Tansa	304.81		
05B	Bhimashankar	130.78	Mahableshwar	50.00
	Chandoli**	308.97	Rajmachi	70.00
	Koyana**	423.55	Mula Mutha	01.00
	Radhanagari	351.16		
Total	**7**	**1593.54**	**5**	**135.52**
**These have been included in the Sahyadri Tiger Reserve				
		Tiger Reserves		
05A and 05B	Sahyadri	732.52	—	00.00
Total	**1**	**732.52**	**—**	**00.00**

Source: India's Green Book, Forests and Wildlife, Wildlife Institute of India, Dehradun (2009)

Annexure III

Western Ghats: District-wise Forest Cover

District	Geographical Area (GA) km²	Very dense Forest km²	Mod. Dense forest km²	Open Forest km²	Scrub km²	Total km²	% to GA
Dhule	7189	0	70	251	103	424	5.89
Kolhapur	7685	65	1038	672	88	1863	24.24
Nandurbar	5961	0	418	796	30	1244	20.86
Nashik	15530	0	351	738	319	1408	9.06
Pune	15643	0	757	975	493	2225	14.22
Raigarh	7152	13	1248	1603	70	2934	41.02
Ratnagiri	8208	33	1911	2255	2	5001	51.16
Sangli	8574	0	95	49	156	300	3.49
Satara	10480	119	569	588	365	1641	15.65
Sindhudurg	5207	89	1372	1112	47	2620	50.31
Thane	9558	0	1281	1631	222	3134	32.78
Total (11)	101187	319	9110	10670	1895	22794	22.52

Source: India State of Forest Report 2013

Annexure IV

Assignment of Talukas within the NWGM to the various Ecological Sensitive Zones Categories as per the WGEEP Report (I)

District	Talukas in ESZ1	Talukas in ESZ2	Talukas in ESZ3
	Talukas with >50% area within the NWGM		
Ahmednagar		Parner	Akola
Kolhapur	Radhanagiri, Gargoti, Shahuwadi, Panhala, Bavda		Ajra, Changad, Gadhinglaj
Nandurbar			Navapur
Nashik	Nashik, Peint, Dindori	Surgana	Igatpuri
Pune	Ghod,Paud, Bhor, Wadgaon		Junnar, Sasvad
Raigarh	Mhasla, Pali, Poladpur, Roha, n.a. (1657), Pen, Mahad, n.a. (1634)		Mangaon, n.a. (1572)
Ratnagiri	Devrukh, Chiplun	Mandangarh	Khed
Satara	Medha, Patan, Mahabaleshwar, Wai	Koregaon	Vaduj, Dahivadi
Sindhudurg	Kankauli, Savantvadi		
Thane	Murbad, Mokhada, n.a. (1482), Jawahar		Shahapur
	Talukas with <50% area within the NWGM		
Nashik	Kalvan, Chandvad, Sinnar	Chandvad, Sinnar, Satana	
Sindhudurg	Kudal, Vaibhavvadi		
Sangli	Shirala	Atpadi, Kavathe, Mahankal, Tasgaon, Vite	
Thane		Bhivandi	
Dhule		Sakri	
Ratnagiri		Dapoli, Guhagar	
Solapur		Malsiras, Sangole	
Pune	Rajgurunagar, n.a. (1612)	Rajgurunagar, n.a. (1612), Shirur	
Kolhapur		Kagal	
Ahmednagar	Sangamner	Sangamner, Ahmednagar	
Satara		Karad, Shirwal, Phaltan, Satara	

Annexure V

The Numbers of Villages Assigned to the Ecologically Sensitive Status in the NWGM as per the Report of the HLWG Committee (Volume I)

District	Numbers of talukas	Numbers of villages
Ahmednagar	1	42
Dhule	1	5
Kolhapur	7	188
Nandurbar	1	2
Nashik	8	157
Pune	9	336
Raigarh	7	356
Ratnagiri	5	292
Sangli	1	24
Satara	6	201
Sindhudurg	5	192
Thane	5	261
Total (12)	**56**	**2056**

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Management of Forests in the Northern Western Ghats

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Abstract

The Western Ghats in India are a UNESCO World Heritage Site and one of the "hotspots" of biological diversity in the world. Looking at the physiography and climate of the Northern Western Ghats, the region should support Tropical semi evergreen (on Crestline) to moist deciduous type of forest (on Eastern end of spurs) as 'climax' type of vegetation. But it is seen to be variedly degraded and fragmented due to use by local people for cultivation or intrusion by outsiders for commercial gains over the last two centuries, as well as modern developmental pressures within the last few decades. The original forest cover and biodiversity is seen only in pockets of notified protected areas or within semiprotected areas like scared groves. Rest of the landscape is degraded to various seral stages depending on the degree of disturbance and is reflected in six major vegetation classes namely Rocky outcrops, Open grasslands with Scrub, Dense shrubbery, Dwarf canopy forests, Riparian forests and Tall mature forests. Composition of species pertaining to each of these classes is more or less definite with some overlaps. The current article tries to illustrate the reasoning for each of these stages along with the dominant species associated with each stage, mainly flora and birds. Of these stages, the last one is the protected 'climax' vegetation, which is the only support for 'habitat specialist' species, some of which are threatened as per IUCN. No other seral stage can support this biodiversity. From an ecological point of view, there is an urgent need to conserve these pockets and provide buffer for them. A detailed study may need to be undertaken to know the exact areas under such climax forest and develop a policy for their protection.

The article also suggests landscape-based management strategies for conservation in the Northern Western Ghats, based on ecological role and potential of each land class. This can be achieved through various restoration techniques like soil water conservation, plantation, habitat development etc.

Keywords : *Western Ghats, Forests in India, Landscape-based management, Ecological Restoration*

I. Forests in Northern Western Ghats and their ecological significance

The Western Ghats is a mountain range that runs along the west coast of India right from Vindhya – Satpuda in the North till Kanyakumari in the South covering about 1600 km in length. The part of Western Ghats in Maharashtra is popularly known as Sahyadri. Due to its physiographic and climatic conditions, this part supports "**Tropical semi evergreen type of forest**" (Champion & Seth, 2005) but due to years of human intervention and other biotic interventions, this mountain range is variedly degraded and fragmented.

The most important aspect which needs to be considered in case of the Northern Western Ghats (NWG) is the '**fragility of ecosystem**' shaped due to climate, especially along the main crest line. The western escarpment receives the full force of southwest monsoon resulting in heavy rainfall and dense fog during rainy season. Due to severity of climatic and erosional processes, the ecosystems of this region may be called 'fragile'. Due to prevailing specialized conditions, life forms adapted to such conditions may not be able to survive if their niches are disturbed in any way. Similarly, life forms from outside the region may not be able to replace native life forms or colonise due to their inability to adapt to such specialized conditions. This region, when disturbed, thus suffers on two counts. That is why it

Location of Western Ghats

should be treated as a fragile zone. (Gole, Survey of birds of Bhimashankar wildlife sanctuary and formulation of managment guidlines for their protection, 2000)

Physical features of this range are also very important. This mountain range also serves as **catchment to all major rivers** feeding the entire Indian peninsula. Looking at the river ecology, physical conditions (abiotic conditions) and forests (biotic resources) near the source shape the quality of water to a great extent. Also these are the major **soil producing areas**, supplying soil to downstream. Due to high rainfall, processes of soil formation are relatively faster than low rainfall areas on plains, though happening at geological time scale.

All these special physical features have created unique habitats which have been supporting **endemic**

Rivers originating in NWGs

Above : Tropical semi evergreen forests on slopes, Koyna. Below : Forests Degraded to open grassland with scrub, Mulshi.

biodiversity. With the background of fragile ecosystems, this biodiversity happens to be extremely important and precious. Though the complete WGs area covers barely five percent of India's land, 27% of all species of higher plants in India (4,000 of 15,000 species) are found here, of which nearly 1800 are endemic. This is why it was declared as **biodiversity hotspot** (Norman, Meittermeir, Meittermeir, da Fonseca & Kent, 1999). But this very fact is neglected by current developmental trends and government policies. Pressures in these areas have been increasing since last few decades. The specialist biodiversity is disappearing very fast and being **threatened** day by day.

Various anthropogenic activities, both traditional and modern, have been degrading the forests in WGs.

Threatened biodiversity from NWGs - Malabar Giant Squirrel, Great pied Hornbill, Royal Bengal Tiger.

Glimpses of the original landscape are seen in the form of a few sacred groves and protected or inaccessible forest patches. These are the only patches left in the landscape which support fragile biodiversity. A few of these areas are so sensitive that if disturbed, those species are likely to get extinct. So these patches have got biodiversity heritage value. Looking at the developmental trends in the surrounding landscape, such areas need buffer for its long term survival and need proper management to let the humans enjoy those resources in long run. Another very significant aspect of these patches is they serve as **reference ecosystem** which gives a definite direction to evolve a management plan to restore forests in this landscape.

Along with the ecological services provided in terms of soil and water, Western Ghats also support livelihood of tribals, through native biodiversity and forest products in terms of timber, fruits, nuts, oil, vegetables, medicines, honey, wax, gum etc.

II. Current status

Current status of the landscape of Western Ghats is the outcome of years of use by local people since last two centuries, as well as modern developmental pressures within the last few decades. The analysis of current status begins with the **overview of socio-cultural history**. To know the earlier history one has to read through older literature like gazetteers or talk to elderly experts and researchers. After a brief study, it can be said that environmental history of this region can be traced back to 1830s.

For many years after the beginning of British rule in this region (1818), the comparatively **small population** and the limited area under tillage made any special measures for **preserving forests unnecessary**. Forests were in quite a healthy state along with apex species of animals like tigers and panthers. In 1855 General Davison, a British executive, shot bears and panthers within a few miles of Poona. (Gazeteer department, 1885)

Clearing the large area under trees and brushwood for tillage was one of the most pressing administrative questions of the time. It was mainly with this objective that when (1836-37) **the revenue survey was introduced** into the west of the Pune district, almost all hill-sides were divided into plots and offered at little more than nominal rents. About twenty years later, the population had greatly increased. After the railway was opened through the ***Bor* pass,** the great demand for wood and the ease with which it could be sent to market were rapidly stripping the area of trees. (Gazeteer department, 1885). **This documentation is supposedly the first record to document the cutting of *primary forest in the NWG region*.**

Even then, **passive conservation** was happening by local communities due to taboos, right to use specific patches of forests by specific castes etc. Tradition of preserving sacred groves was one of the most important practices from the ecological point of view. It is followed by the locals even today.

In 20th century, **modern water management** was initiated by the British rulers in the form of large **dams**. This was continued even after India achieved its independence. Today, almost all rivers originating on the crest line of Western Ghats and flowing towards East are dammed, either for power generation or irrigation. So the original landscape with intact river courses is hardly seen anywhere. Repercussions of these man-made changes on the ecosystems were manifold. Of late, doubt has been cast on the quality of benefits that accrue from such projects. (Gadgil, 1979)

Due to the backwaters of these dams, settlements along rivers, fertile paddy fields, and the forests on lower slopes got submerged. Local people were given compensatory land somewhere towards east of the districts within NWGs (mainly Pune, Satara, Kolhapur) in low rain fall areas. Many of them were not ready to move out, so they shifted to upper contours and formed new settlements i.e. *wadi*. Those who had moved out and couldn't acclimatize to the new lifestyle also returned and joined others. Now

that these people had lost their fertile land, they had to cultivate on slopes. First, the forest was slashed and burnt to make the land patches appropriate for cultivation. They started cultivating hill millets (namely *Nachani, Varai* and *Teel*) consecutively for three years. But slopes being inappropriate for cultivation and yielding persistent production, they had to leave this patch fallow after three years, i.e. let it rest for few years to allow nutrients to be put back into the soil, while the vegetation grew. They had to shift to new patches on the slopes. Eventually all the forested slopes were degraded to secondary vegetation. The rich wildlife including Sambar, Barking deer and Wild boar was threatened with loss of tree cover and accessibility to urban poachers (Gadgil, 1979). This practice has continued till today, as seen in catchments of all dams or rivers located within NWGs, to name a few, Mulshi, Varasgaon, Panshet, Radhanagari etc.

Add to this other biotic pressures namely **grazing** and **cutting for fuel wood**. Cattle of local people freely roam all over the slopes (including steep slopes) eating up tender regeneration which would have formed the future forest. Trampling also leads to soil hardening and degradation of soil quality. Selective cutting for fuel wood and harvesting of specific food

Shifting cultivation patch near Rajgad Fort

Exposed areas, Neera Deoghar dam, Bhor

Effect of various stresses like shifting cultivation, fire, grazing leading to degraded landscape without forests at Varasgaon and Bhor Catchment

crops has also been changing the composition and density of forests. Few species of *Ceropegia*, one of the plant species, being harvested for its edible tubers, are extinct or threatened just because it is harvested at a tender stage, much before flowering and fruiting (Negi, 1993) (KSR Murthy, 2012). This actually stops its natural spread by seeds.

Effects of modern development like farm house scheme, wind mills and bauxite mining @ Mulshi catchment, Koyna catchment and District Kolhapur

Fire is another significant threat to entire NWGs. It must be noted that it's *not a natural fire*, but it is set deliberately or set due to ignorance by local people. It obviously arrests natural succession of secondary vegetation i.e. degraded ecosystem towards mature ecosystem. Moist deciduous vegetation with dominant *Terminalias* is not able to progress towards evergreen vegetation due to regular fires, all over the NWGs.

All of the above practices have been causing **forest fragmentation** in Northern Western Ghats, which has caused **loss of habitat** for specialist or indicator species and displacement of such biodiversity. Forest fires, fragmentation and their synergisms may be driving deforestation processes that are fundamentally altering landscapes and biodiversity in WGs. (Kodandapani, Cochrane, & Sukumar, 2004). The specialist species prevalent earlier, are being replaced by generalist or common species. Many species are getting **threatened** day by day. To name a few - bird species like Great pied Hornbill, Forest Owlet, Oriental dwarf Kingfisher, Mammals like Giant squirrel, Mouse Deer, are now most rare species from NWGs.

Another very significant threat to the Northern Western Ghats is that of **modern development** sprawling on the hill slopes in the form of farm house project schemes, new "hill stations", new roads, widening of existing roads, industrial complexes, or township development. Slopes are terraced with the help of excavators. All earlier vegetation is removed being irrelevant to the urban man. New non-native species of plants are planted to recreate the greenery. This is weakening the already fragile ecosystems. Fragmentation of landscape is accelerated at a rate never before earlier. The changes which took place in

Representative land classes in NWGs

last two centuries have accelerated many times just within the last two decades. Big projects like mining, wind mills, etc. are also threatening the ecosystem structure and increasing its vulnerability.

To summarize the earlier two sections, it can be said that landscape in Northern Western Ghats should support semi-evergreen type of forest. But years of human interference have degraded it to various levels depending on intensity of the activities. **This interference is many times governed by land classes and its accessibility.** This is how the present quality (or structure) of landscape is reached.

Broadly, across the entire Northern Western Ghats, the following main land classes are observed –

Paddy, Gradual slopes, Steep slopes, Cliff or Cliffside rock fall areas and Plateaus.

1. **Paddy** – This is found in the flat terrain mostly in the valley bottom or on plateaus at various levels. This is a modified land class. Mostly stream sides are made into terraces or even instream terraces are formed. Settlements are also seen nearby these paddy fields.

Paddy, Bhor catchment

2. **Gradual Slopes** – Behind the paddy start gradual slopes, which have been slashed and burnt regularly for shifting cultivation of Hill millets. So these gradual slopes are degraded to open grasslands or scrub. This is because, being easily accessible, these slopes have experienced many cycles of shifting cultivation. Due to a short fallow period, the ecosystem couldn't reach back to the state of developing a forest cover. Also, being near the villages, fuel wood extraction has been a regular practice, so was grazing by cattle. Due to all these factors these slopes are under continuous stress and so the stage of open patches with grasslands is arrested since many years.

Open Gradual slopes @ Mulshi

3. **Steep slopes** – Slopes leading towards tops have moderate to steep gradients. These were also cultivated till few years back until 1990s. But villagers stopped cultivating here due to various reasons : either they sold these lands or migrated to cities in search of jobs. Those staying in villages are not capable of cultivating larger lands on slopes. The result of this change is semi-protected areas with dense shrubbery or trees. Again the density of vegetation depends on the years under protection. If it has been protected for 3 to 5 years, it has sparse to dense shrubbery. If it has been protected for more than 10 or 15 years, a kind of dwarf forest is developed. These slopes are in regenerating states and have great potential for restoration of forests.

Steep slopes with forests @ Bambharde, Mulshi

4. **Cliff or Cliffside rock fall areas** - These areas are very near to the mountain tops with vertical cliffs and are the most inaccessible areas. Due to its geological pattern, heavy rainfall, wind pressures, etc., big boulders escape and fall on the narrow belt just below such cliffs, so the name rock-fall areas. This area has been protected since centuries. So it experiences a mature, tall evergreen forest with big, old growth trees. These are specialist species which need a special micro-climate that is maintained just because of inaccessibility. In certain patches this

Cliffside rockfall areas @ Ghutke, Mulshi

kind of vegetation is also seen on gradual or steep slopes primarily because those are owned by the forest department. This indicates that the entire landscape can have such tall mature forest if protection is assured. Interestingly, many Sacred Groves are located in these patches. Sacred groves are the forest patches preserved after the name of some deity.

5. **Plateaus** - Plateaus are located at various elevations in Western Ghats. If any plateau is nearby any settlement and has a good soil profile, it is seen to be under cultivation of either rice or hill millets. If it is a rocky outcrop, it is mainly used for grazing cattle. Such areas mainly have seasonal grass or herbaceous cover, with endemic species.

Plateau @ Kurtwadi, Panshet catchment

In short, all these land classes are used by local people as per their need and convenience. Human interference is altering the status of natural resources and biodiversity in the surroundings.

III. Analysis of landscape with respect to biodiversity

Biodiversity is an expression of - 1. Climatic factors, and 2. Current ecological processes shaped by current practices on the land. It is observed that biodiversity changes as per the land class and its use or degree of degradation and/or protection. So biodiversity can be used easily to judge the status of the landscape elements. Due to a **definite *traditional* land use pattern** in NWGs, broadly six **seral stages or vegetation classes** are observed, namely, Rocky outcrops with seasonal herbs, Scrub with intermittent coppiced trees, Dense shrubbery, Dwarf canopy forests, Tall mature forests and special Riparian vegetation along with four *human induced* land elements namely paddy, settlements, roads and modern developmental projects.

Associations of faunal groups, especially birds, are used as an additional indicator. Indicator species can be called as **'habitat specialist'** species pertaining to one particular habitat whereas **'habitat generalist'** species occur commonly in many habitats.

1. **Rocky outcrops** : Rocky outcrops are a special land class in NWGs, and is an **important habitat to many endemic, rare and endangered species**. These are either lateritic or basaltic in origin. Scarcity of soil and harsh physical conditions lead to formation of vegetation dominated by grasses and herbaceous flora along with habitat-specialist amphibians and reptiles. (Watve, Rocky Plateaus, 2010) Also they offer a number of ecological services to nearby villagers. Being reserves of bauxite, the Lateritic plateaus are under serious

Lateritic plateau, Chalkewadi

threat due to mining.

Biodiversity changes significantly as per seasons. Because of monsoon, regeneration of ephemerals, i.e. plants with short life cycle of 2 to 4 months, is initiated. They are mostly mass blooming herbs with bright colors favoring insect pollination. So monsoon brings life to these plateaus. After monsoon, all these ephemerals die and their seeds remain dormant till next monsoon.

Dominant Plants in the rocky outcrops *include* herbs like *Eriocaulon, Utricularia, Smithia, Impatiens, Murdannia, Neanotis, Habenaria* etc.

Birds like the Pied Bushchat and Malabar Lark are seen throughout the year whereas specialist species like Horse shoe shrimp, Caecillian are observed during monsoon.

2. **Scrub** : Scrub dominated by grasslands are seen mostly on gradual slopes near the valley bottom. Intermittent coppiced trees, as an indication of earlier canopy forests, are seen all over these areas. Being most exploited and disturbed, these areas have mostly hardy species indicating degradation.

Open grassland with scrub near Tailbela fort, Mulshi

Dominant plants include grasses like *Themeda, Heteropogon, Apluda* along with shrubs o*f Carrisa congesta, Meyna laxiflora, Gnidia gluaca,* and sparse trees o*f Terminalia elliptica, Mangifera indica, Syzygium cuminii etc.*

Birds like the Pied Bushchat, Sunbirds, and Bulbuls are easily seen.

These are **all habitat-generalist species** being established in the newly generated habitat than the original habitat.

3. **Dense shrubbery** : Dense shrubbery with intermittent trees is observed on part of the gradual slopes and on the transitional belt in between gradual and steep slopes. These are old shifting cultivation patches, which have been left fallow since 7 to 10 years and have habitat- generalist species, with a dominance of shrubs.

Dense shrubbery, Pavana catchment

Plants here include *Carissa congesta, Meyna laxiflora, Gnidia gluaca, Catunaregam spinosa, and trees like Terminalia elliptica, Bridelia retusa, Syzygium cuminii, Lagerstroemia lanceolata, Ixora brachiata etc.*

Birds include Common Chifchaf, Jungle Babbler, Brown Cheeked Fulvetta, Red whiskered Bulbul, Paradise Flycatcher along with all the common birds seen in grasslands.

These are termed **as regenerating patches**, because the vegetation structure is in a regenerating state and is a potential stage for restoration of forests. **Occasionally found floral and faunal species** are also seen in such patches.

4. **Dwarf canopy forests** : The dwarf canopy forest which is mostly seen on gradual to steep slopes includes **habitat generalist tree species with much more density of trees**. These are old shifting cultivation patches, which are left fallow for more than 10 years. Their composition is more or less similar to dense shrubbery except for the increased density of trees forming dwarf forest canopy, with **few additional tree species pertaining to canopy**.

Canopy forests @ Koyna catchment

Plants include *Terminalia elliptica, Terminalia chebula, Syzygium cuminii, Lagerstroemia lanceolata, Ixora brachiata, Ficus racemosa, Memecylon umbellatum, Xantolis tomentosa etc.*

Birds include Yellow Browed Bulbul, Paradise Flycatcher, Black naped Monarch, Large Green Barbet, Orange Headed Ground Thrush, White Bellied Blue Flycatcher, Black eagle etc.

These patches being protected for a long period are now **serving as safe sites for shy and specialist birds** like Grey Jungle fowl, Flycatchers etc.

5. **Tall mature forests** : Tall Mature Forest is seen along cliffs or steep slopes with rock fall. **All Habitat-specialist species** are seen in these protected areas as they are saved from cutting, fire, cattle interference, or any other human interference. As the name indicates, it contains specialist biodiversity and is very delicate. **If their habitats are disturbed, such species may vanish or leave that habitat.**

Mature forests @ Ghandad, Mulshi

Plants include *Olea dioica, Dimocarpus longan, Ficus nervosa, Garcinia talbotii, Beilschmedia dalzelli, Gnetum ula, Holigarna grahamii, Entada rheedii, Tetrameles nudiflora, Knema attenuata, etc.*

Birds include Yellow Browed Bulbul, Large Green Barbet, Black bulbul, Malabar Whistling Thrush, White Bellied Blue Flycatcher, White Rumped Shama, Eurasian Eagle owl, Besra, Great Pied Hornbill etc.

6. **Riparian vegetation** : Riparian vegetation i.e. vegetation along stream courses is very significant from the ecological point of view. Those are the most potential **corridors** in a degraded landscape. Corridors are the vegetated belts connecting two patches in a landscape. They also **host specialist species**. Being a difficult area for any human use, it is a safe site for many animals. Many specialist

Riparian forests, Tamhini, Mulshi

orchids are seen in such patches, along with endemic species of amphibians and reptiles. These patches are excellent nesting sites for many birds. They also contain larval host plants for many butterflies.

The plant composition is similar to the seral stages Dwarf canopy forests and Mature forests, with dominance of *Syzygium cuminii, Ficus racemosa, Dimocarpus longan, Xantolis tomentosa, Cinnamomum zeylanica, Ancistrocladus heyneanus etc.*

Birds include Large Green Barbet, Malabar Whistling Thrush, White Bellied Blue Flycatcher, White Rumped Shama, Ultramarine flycatcher, etc.

Endemic Amphibians include Reddish burrowing frog - *Fejervarya rufescens,* Humayun's Night Frog - *Nyctibatrachus humayuni,* Marbled Ramanella - *Ramanella mormorata* along with Leaping Frog, Fungoid frog, Kokan Bush frog etc.

All the above vegetation classes have some 15 - 20 commonly found species of mammals distributed more or less throughout the landscape. Among these, Striped Hyena, Leoprad and Pangolin are Near Threatened (NT) and Sambar deer and Indian Bison are Vulnerable (V) as per IUCN. Jackal, Porcupine, Barking deer, Wild Boar, Civet, Bats, Mongoose are among the commonly seen species. Keystone species like Malabar Giant squirrel or Slender Lorris are seen only in mature or canopy forest patches and their habitat is continuously stressed and shrinking.

In addition to the above vegetation classes, the following four land elements are worth considering. These are induced due to mainly intense human interference, as compared to all above.

1. **Paddy** : During the monsoon season, paddy fields support minimal biodiversity like a few amphibians and reptiles. But once the crop is harvested many ephemerals i.e. seasonal herbs

regenerate and attract many bees and other insects. A few paddy fields, carved in riparian patches have active sub-surface water flows till summer. They form a nice moist ground habitat for insects especially during dry conditions. Many of these herbs like *Alternanthera, Blumea, Hygrophila* etc. flower after monsoon and serve as fantastic food plants for insects.

Traditionally, paddy fields were not harming or changing the native/original ecosystems beyond certain extent. It had its own threshold governed by controlled population needs and physical limitation of human labour-based agriculture. But with technology like excavators reaching out to the *wadis*, people prefer to terrace on bigger areas, which is not appropriate in hilly terrain. Obviously, it leads to soil erosion and landslides, which needs serious attention.

2. **Settlements** : As mentioned initially, all catchments of dams have settlements on lower or upper slopes. Often, there is a certain arrangement of these settlements as per the caste system. Obviously, use of resources from the surrounding forest gets more or less distributed amongst them. Many a times old settlements have old growth trees around them namely Mango, Jackfruit, Jamun, Kokam etc. which also serves as habitat for many animals, especially birds like Barbet and Thrushes, along with other common species like Bulbul and Sunbirds. Ecologically appropriate traditional housing makes modern engineers marvel at how a grass thatch can waterproof a hut. But now the locals, thanks to their urban aspirations, do not wish to continue to live in those grass-thatch houses, but choose to build *pakka makan* - cement concrete houses. Their children, who have migrated to cities and earning a better income, are getting enough money to transport modern materials from outside and build such houses. Also many locals are selling out lands, especially fallow lands, to urbanites and in return getting the money to live an urban lifestyle independent of forests around. A great shift can be seen from earlier forest-dependant livelihood to the money-driven market economy. Often, only elders and possibly women, are seen to be living in these villages. Young men are migrating towards the nearby taluka place or city in search of jobs. Such settlements lack habitat for biodiversity, being human-dominated areas.
3. **Roads** : Roads has been an instrumental tool to connect all remote areas to urban areas. Ring roads along the catchments have helped contractors to enter the forest, buy it for timber or non-timber value or make it into coal and sell it in the cities. Roads have fragmented the good forests patches, even Sacred Groves, at some places. Roads have dissected corridors of many animals. If not engineered properly, roads prove to be the cause for instability of any slope, ultimately causing landslides or erosion.

Road through Sacred Grove @ Chalakewadi, Satara

4. **Modern developmental projects** : Apart from all such human-induced pressures on the landscape, another considerable stressor, which is multiplying the adverse impact many times, is modern development in the form of farm houses, townships, mining, or power generation projects. This kind of pressure is severe in some pockets of the NWG and sprawling all over the landscape at quite a fast rate.

Based on the current developmental trends, the government's perspective, standards of governance, and current policies, it seems difficult to stop such kind of development completely. The only way is to offer management strategies considering all of the above and set up a system to implement such strategies step by step.

IV. Management

Protection and conservation of the forest is the principal management option in Northwest Western Ghats. (Gole, Survey of birds of Bhimashankar wildlife sanctuary and formulation of managment guidlines for their protection, 2000). However, the forest here is distributed in patches and is not a continuous habitat. Hence, **management needs to**

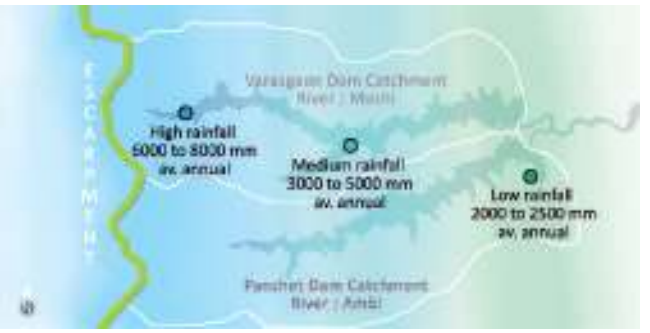


Diagram showing indicative approximate rainfall zones within dam catchments

have the *landscape perspective*. The entire landscape can be looked upon as a mosaic of habitats. There are interactions among different habitats in terms of energy, mineral nutrients and life forms. The degree to which each habitat is exposed to threats also varies depending on anthropogenic, climatic and erosive processes. These will affect movement of life forms, availability of life support to them and their reproductive potential.

We recommend that such landscape-based management take into account key dimensions like rainfall zones, river catchments, and land classes.

Macro - Management :

Strategy as per river catchments, rainfall zones and fragility of ecosystems within catchment :

As discussed earlier, there are a large number of river catchments in NWGs due the several dams that have been built, particularly on rivers flowing East. Thus it may be appropriate to shape management strategy based on ecological status of each river catchment. A common feature of most catchments in NWG is rainfall pattern and alignment of backwaters, mostly East-to-West and almost at the same longitude. (Gadgil, 1979). All the dam walls are built in relatively low rainfall area of approx. 2000 mm a. a. (average annual). Rainfall increases drastically towards West of these dams, towards crest line up to 8000 mm a. a. So, on an average, three rainfall zones are observed within catchments,

- Relatively low rainfall region with 2000 mm a. a.
- Medium rainfall region with 4000 mm a. a. and
- High rainfall region with 6000 to 8000 mm a. a. at the escarpment.

Biodiversity and ecological processes around the catchment are influenced by this rainfall pattern and also the current socio-cultural practices. High rainfall zone is terminated into the Western escarpment. This zone being most fragile ecosystem needs a carefully considered management treatment. It also serves as a **corridor** for the movement of higher fauna like Tigers, Leopards, Wild dogs etc. and supports maximum specialist species within any given catchment. So, this zone needs total protection and should be free from any human interference. Ideally it should be notified as a protected area or sanctuary and needs to be managed by the forest department.

Management as per land class :

In light of the discussion in sub-chapters I, II and III, it can be said that because of varied land classes, its use by local people and current seral stage, one single strategy for conservation may not be enough.

Ecological role and potential of each land class needs to be addressed to evolve management strategy. Landscape-based management should favor following three **key elements :**

1. It should **facilitate linkages between different habitat segments** : Scattered patches of the same habitat as well as between different habitat.
2. It should **reduce adverse effects of climatic and erosive processes** and
3. It should **control and streamline anthropogenic activities** and pressures

Let us now look at management of the landscape by specific land classes. In each case let us identify the main management objective and provide a strategy to address it.

1. Mountain Tops, Plateaus, and Cliffs :

- *Objective : To create sponge effect i.e. to restore perennial semi evergreen forests on mountain tops, and preserve it as the source of rivers.* The quantity of rain that falls in the humid tropics depends on several factors and forest cover is one of them (Meher-Homji, 1991). Well-stocked forests cause precipitation on mountain tops and let it percolate in the soil effectively than an open grassland patch.
- *Management strategy : Total protection and conservation, Restricted entry.* These mountain tops should be totally protected from biotic interferences like cutting for fuel wood or grazing by cattle. No fire should be initiated in this zone.

2. Upper Slopes :

- *Objective : To stop erosion and arrest soil and moisture, restore habitat and species diversity.* These areas, being mostly steep slopes, need special care to control soil erosion, landslides etc. Also being difficult sites for

human beings, they have the potential to serve as safe site for non-human beings.

- *Management strategy : Protection from grazing and fire, restoration techniques. (Illustrated in* next sub-chapter) Development like roads or infrastructure should not be carried out in these stretches. Assured protection along with restoration techniques, would ensure improvement in stabilization of physical landscape features along with habitat and species diversity.

3. Lower slopes :

- *Objective : To restore these areas to a mosaic of habitats useful for both non-humans and humans.* Lower slopes being nearer to human settlements, are worth converting into forests which would provide various products and services to the local people.
- *Management strategy : Restoration techniques. Alternative supportive livelihood systems for locals through management of vegetation and plantations, Grazing grounds for cattle.* Looking at the current status of these slopes, they need to be rejuvenated to have forests. Initially restoration techniques can be implemented to restore poor soil and put back nutrients. Later on, plantation of useful native plants can be done along with protection for natural regeneration. Looking at the bad effects of free-grazing cattle all over the landscape, an area can be allocated for cattle as 'grazing ground' and practices like rotational grazing can be carried out.

4. Streams and Riparian vegetation :

- *Objective : To improve landscape functioning through corridor development, recharging hyporheic zone, conservation of specialist species.* Streams are the most potential landscape element serving as corridors for movement of materials and organisms. Also due to water availability and special micro-climates, many specialist species are able to thrive here better than the degraded surroundings.
- *Management strategy : Protection and restoration techniques*. A complete ban on interventions which would modify the physical character of the stream is essential. Stream restoration should be carried out to ensure smooth functioning of physical processes and enhancement in biotic community within streams. Riparian zone also needs to be protected and enhanced with the help of plantation of riparian species.

5. Valley bottom : Paddy and Human Settlements

- *Objective : Improve the ecological potential of this matrix to mosaics.* Matrix is the area within a landscape which is modified from its natural condition due to human intervention. Mosaic is the same natural area without such disturbance. Such newly modified areas should mimic the original mosaics, wherever possible. This would create some room for local biodiversity totally but keep some room for them even within disturbed areas.
- *Management strategy : Construction in human settlements should be preferably with local materials,* Camouflaging should be the main attribute which should be applied to all possible human elements. e.g. houses made up of stone and mud and thatch roof camouflages well in the surrounding than conventional modern cement houses. *Roads should be restricted till the valley or lower slopes only along with plantations of appropriate species.* Roads if cut through the steep slopes disturbs the stability of the slopes. It becomes heavy on maintenance, so roads through upper catchments are bad for economy as well as ecology. Roads can be converted into potential corridors by planting avenue trees on both sides. Agriculture bunds also should have intermittent old growth trees to serve as 'stepping stones' for birds and other fauna.

6. Special guidelines for modern development like resorts, farmhouses, and townships :

- While planning, such schemes must consider the landscape structure, local ecological conditions and distribution of biodiversity.
- The Master Plan of such schemes must be based on ecological assessment of the area and favoring the three key elements mentioned above. 1. It should facilitate linkages between different habitat segments. 2. It should reduce adverse effects of climatic and erosive processes and 3. It should control and streamline anthropogenic activities and pressures.
- There should be some kind of strictly enforced restriction on plot size (1 acre to 10 acre depending on status of landscape : If landscape is forested with good corridors, big size plots with minimum 10 acre would assure protection to large chunks instead of fragmentation of the same in smaller plots with an acre. If landscape is too open and devoid of any vegetation and habitats, plot area could be 1 acre. This suggestion is based on market trends and feasibility), length and reach of roads and material use. Local materials harvested sustainably or materials with zero or minimum embodied energy should be used.

- Guidelines and incentives for new residents to be responsible for conservation on an ongoing basis, and penalties for failure.
- Solid and liquid waste management policies and systems to implement and monitor their execution.
- A Biodiversity Register for the landscape should be prepared every three years. Experts should review it and suggest actions to conserve species if required.
- Land acquisition in such areas should not be left to market forces alone. When market dynamics are left to rule, land from local people tends to get acquired at attractive prices for modern development projects. The monetary and lifestyle upliftment expectations of local people should be met by the policy makers through other means, including nature-centric economic policies and educational and job opportunities. Changes in land use should be slowed down with appropriate voice provided to conservationists and ecological experts. The government and policy makers need to change their perspective from an agent of modern development to also additionally include being stewards of natural resources and ecosystems. Far-reaching, values-based reforms in land acquisition, real estate industry ethics, taxation and environmental assessment of projects are essential to protect these environmentally sensitive landscapes for the sake of our future generations.

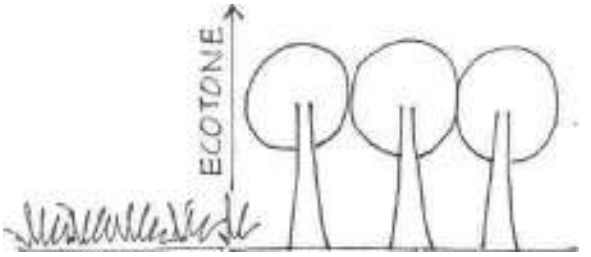
V. Conservation & Restoration techniques and activities to support ecological management :

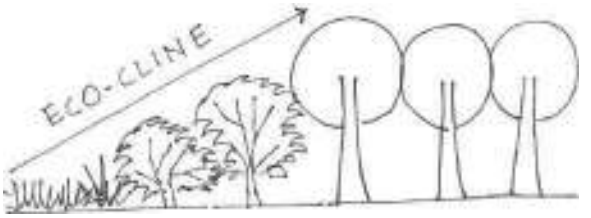
1. **Protection :** *Social fencing, dry fence, live hedge, fire lines.*
   Protection can be easily assured with the help of traditional methods like dry fence of thorny plants and live hedge of hardy shrubs which cattle do not eat. Such hedges also provide safe refuge for tiny wildlife like insects and birds. Social fencing (i.e. protecting an area with the common consent of the locals) is also an effective tool for protection.
2. **Restrictions and controls :** At any given time and for any particular area there could be a number of restrictions as a part of forest management. e.g. Ban and restriction on collection of fuel wood, minor forest produce, grazing, vehicular movement, illumination, noise, plantations of non-native species etc. are necessary to initiate and protect ecological processes which are necessary to start ecological succession on degraded lands. Restriction on cutting for fuel wood would stop coppicing of the same tree every year and would ensure its regular cycles of flowering, fruiting and seeding every year. Ban on grazing would assure protection to natural regeneration. Ban or control on street lights or any illumination along with noise control during night is necessary for movement of nocturnal animals. Total ban on introduction of non native species would save the integrity of ecosystems; otherwise it may invade large areas.
3. **Provision of alternatives :** *Common grazing grounds, Energy plantations, etc*.
   Whenever restrictions are applied on usage of resources, local people may suffer as their daily needs for fuel and fodder may not be met. Alternatives need to be provided to them to be able to continue their lifestyle in a better way. e.g. If a ban on wood cutting is applied, plantations of fuel wood species should be done at village level to fulfill the fuel need. Common grazing grounds would provide palatable fodder for cattle. This practice of reserving *gayran* (grazing land) has been there in many parts of Maharashtra. It needs to be revived.
4. **Monitoring :** *Weather stations, Old growth trees, Biodiversity.*
   Regular monitoring should be done for certain parameters like rainfall, temperatures, humidity, soil conditions, etc. Also certain ecologically sensitive features like old growth trees, springs should be monitored to record visits of fauna or to know associations. Biodiversity registers should be prepared at regular interval to record change in species especially indicator or specialist species.
5. **Waste management :** Solid and liquid waste needs to be segregated and disposed off in an ecologically appropriate and energy friendly way. e.g. Biodegradable solid waste can be composted into fertilizer, Liquid waste can be treated using botanical systems like Root zone treatment systems. Non-biodegradable waste should be sent for recycling. Systems to follow waste management policies should be in place.
6. **Special management for streams and large water bodies** if any
   As mentioned in the earlier section, streams need special management, so do any other water bodies like pond, lake, wetlands. All these smaller units of ecosystem need to be managed after thorough assessment.
7. **Restoration techniques :**
   i. Soil and moisture conservation through stone bunding, ponds etc. Simple time tested solutions can be offered to arrest soil and moisture like

loose boulder bunds, trench cum mounds etc.

ii. *Site specific treatment for erosional features* : Erosional features needs to be treated as per the status and need. E.g. headward erosion, erosional gullies, landslides etc. Each of these would have different treatment depending on various physical attributes. Soft techniques like plantation of shrubs or putting one or two stones would be sufficient for gullies. But landslides may need attention from expert engineers to calculate load of soil, know velocity of water and then design appropriate retaining structure.

iii. *Conservation of interface between two habitats : Ecotone to Ecocline* : Many times there is sudden change inbetween two habitats known as ecotone. E.g. forest neighboring a grasslands patch. Sometimes the changes across habitats are gradual and this is known as ecocline. E.g. A mature forest a has buffer of tall canopy trees followed by shrubbery and then grasslands. An ecocline condition is preferred over an ecotone condition. Management should favor development and protection towards such ecocline conditions.





iv. *Plantations : Along roads, edges of fields, hedges, bird attracting parasites, Nursery* : Plantations of native species should be done depending on the current status of the land. Best potential places for such plantations are roadsides, edges of fields etc. Also shrubs could be planted as hedge row. Bird-attracting parasites on trees may need special protection.

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Most of the conclusions and arguments in this article are based on the actual field work done by the author during last 12 years, in Northern Western Ghats.

Planning and Managing Hill Stations in the Northern Western Ghats

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(The author is Founder and Managing partner at Oikos for ecological services, Trustee, Ecological Society, Member – HLMC, Matheran (2012-2014))

Abstract

*In a tropical country like India, where the climate is predominantly hot and dry, Hill Stations have served as great retreats for summer vacations. The hill stations are mainly **service centers**, providing comfortable stay and travel for tourists. Being **tourism destinations**, the thrust is always given on increasing the number of tourists. In recent past, tourist traffic at hill stations has increased significantly and support infrastructure is being developed for the tourists.*

*The **limiting factors** that should have natural control over such development are overlooked. This has caused **irreversible damage** to the local natural resources, ecology and support systems. Unless a limit on the total number of visitors is enforced at every destination and followed meticulously, it would not be possible to maintain aesthetics, atmosphere, sound infrastructure and ecology for these destinations. Importantly, desires and aspirations of local people with their skill set should be integrated in the overall plan.*

*In Maharashtra, majority of existing and upcoming hill stations are in the **Western Ghats**. Considering the ecological fragility of Western Ghats and various life supporting services given by this mountain range, ideally it is not recommended to have any large scale developmental projects. For projects that have already been approved, interventions to reduce current degradation & restore the near original ecosystem in the area are now urgently necessary. It is important and possible to cater to the needs of local communities and ecosystems and create models with economic benefits in a different way than promoting large scale area development projects. All future progress should be purely in the interest of maintaining **ecological integrity** and not short-term economic value. This will need more detailed studies and change in policies.*

This article uses case studies of two such hill stations, which are also notified ESZ (Ecologically Sensitive Zone) in Maharashtra to illustrate the above considerations. The article also evolves a 'Planning and Management Strategy' that could be useful as foundation for upcoming destinations to integrate the ecological perspective in the process of planning and development.

Keywords : *Hill stations, Ecology, Western Ghats, River origins, Natural resource management, Sustainability*

Preamble

Prof. Prakash Gole was instrumental in some of the pioneering work in ecology, ornithology and restoration. His understanding about history and economics combined with the landscape, ecology and human activities have put forward 'Landscape-based planning' appropriate for the Indian context. Hill stations by their character depend upon all these factors and their sustainable development will happen only if such factors are considered in totality. It is important to look at the Landscape in a holistic way and evolve Development Plans (DP) without compromising the preservation of ecological order and environment. Modern development must consider ecology as an integral part of the economy.

Prof. Gole was actively involved in preparing a Regional Plan for the Mahabaleshwar – Panchgani Eco-sensitive zone in 1983-84 for the period 1984 to 2001. He also guided a report on the Environmental

Conservation of the Matheran Plateau. These reports and Prof Gole's teachings is the inspiration behind this article.

Introduction

The term 'Hill station' is used mainly in tropical countries where a break is needed from regular heat, especially in summer season. The varied topography in India with seven main mountain ranges provides ideal locations at heights suitably higher than plains in almost eleven states. There are about 70-80 old hill stations, situated mostly between altitudes of 1000 to 2500 m, barring a few, which are newly developed.

The hill stations were originally established and developed in British period as their summer capitals, while a few were developed by Indian rulers mainly for leisure. Being visitor centric, these destinations are well connected, have a central 'market area', and many have beautiful water bodies. This is predominantly a service industry with some peculiarities of products, locations or services specifically associated with each such destination.

Hill stations are popular as gateways for holidays mainly because of the aesthetics and natural beauty, situated at higher altitudes, climate, solitude and being away from city crowds. Interestingly this character of being peaceful places is now being substantially disturbed by the inflow of unrestricted number of visitors. Each state of India has a different mountain range and correspondingly a different character for each of its hill towns. In peninsular India, Western Ghats offers a beautiful landscape that houses many of these destinations. In Maharashtra, all the hill stations except Chikhaldara are located in Sahyadri, which is a part of Western Ghats.

Precipitating hills, plateau forests and tourist resorts at Mahabaleshwar

Salient Features

The two hill stations under consideration in this article, Matheran and Mahabaleshwar-Panchgani region are situated in Western Ghats. Both are notified ESZ and have a strong policy to safeguard the ecological integrity. It must be considered and accepted by all stakeholders that it is the 'aesthetics' and 'climate' at these places that will keep attracting visitors. To ensure this, ecological development of the whole region must be the most important concern.

'Region' in this context means a larger mix use area under notification. Each village or place has a different character according to respective location.

Matheran Hill Station

Matheran literally means 'forest on the head'. The Government of India vide notification No S.O. 133 (E) dated 4th February 2003 declared Matheran and the surrounding region in the State of Maharashtra as the 'Matheran Eco-sensitive Zone (ESZ)'. This imposed restrictions on industries and developmental activities in the zone.

This Eco-sensitive Zone covers an area of 214.73 sq km and a 200 m buffer zone and includes the area of Matheran Municipal Council and its environs, comprising a total area of 251.56 sq km. The Matheran plateau is situated at approximately 760 m on a mountain top in a hill range separated from the main range of Western Ghats. It is about 48 km east from the Arabian Sea shore, and about 20 km away from main Western Ghats range and experiences similar climate as Western Ghats because of the higher elevation than surrounding region. The average annual rainfall is approximately 5000 mm. The region has basalt as the predominant rock while the plateaus are capped with Laterite, a soft, porous rock having average thickness of 12 to 15 m. The plateau has mix of Laterite outcrop and weathered soil profiles. The entire zone comprises hill topography, plateaus, free falls, slopes and deep ravines. Overall it receives high rainfall and has well-drained stream networks. Apart from the streams and rivers as water sources, this region, and more specifically the plateau has numerous springs.

The area is a mix of various forest types changing according to soil, altitude and rainfall, ranging from Moist deciduous to Semi-evergreen. This forest ecosystem supports a variety of flora and fauna

Densely populated areas in Matheran, year 2013

typical of the fragile Western Ghats ecosystem. Owing to all this, the biodiversity is very rich and so is the fragility of this ecosystem.

It is the only hill station where vehicles are not allowed. Most places have to be reached on foot or horseback. With this uniqueness, the area offers a very different experience amongst dense forests, which is the prime factor responsible for attracting visitors. It also has a mini-train which has heritage value.

The history of this hill town traces back to 1850 when it was first discovered by one Mr. Mallet. Until this time it was an isolated hill untouched by human habitation. After its discovery, this destination was developed as a hill resort in a systematic and planned manner. Almost all the present roads were laid out by 1854 and construction of many houses was started that included private houses, churches, infrastructure, etc. Charlotte Lake, the main water source for the resort was completed by 1858. As the resort started functioning, locals in the surrounding area migrated in search of jobs and settled in the area. By 1900 Matheran was an established 'hill resort' with a bazaar, hotels, houses, church, water supply, etc. The Matheran train started in 1907 that connected it to Neral which made the movement of tourists much easier. Such steady growth was seen with changing political and cultural conditions until 1975. However, the physical structure and architectural character remained quite similar to the original. This period of almost 125 years saw a change from dense tree canopy to a hill town nestled in a forest. After 1980, the area started developing according to the Development Plan in response to increased tourist flow and corresponding increase in density of built forms. This started changing the character of this Hill Station (Unwalla & Samant).

In recent years, the plateau has seen uncontrolled growth putting pressure on resources with more extraction, pollution and waste. The local population started increasing after 1960s, and reached up to 5139 people as of 2001 census (Census). This number however decreased to 4393 in 2011. The floating population of tourists continues to increase every year. According to references, the annual floating population increased from 1.67 lakhs in 1991 to 2.51 lakhs in 1999 (Patwardhan). The growing economy through tourism industry refuses to respect the ecological limits necessary to ensure the natural integrity of the area on which it entirely depends.

Mahabaleshwar – Panchgani Region

The Government of India vide notification S.O.52(E), dated 17th January 2001 declared Mahabaleshwar and the surrounding region in the State of Maharashtra as the 'Mahabaleshwar – Panchgani Eco-Sensitive Zone' (ESZ). It is spread over 237.28 sq. km covering 58 villages.

Unlike Matheran, Mahabaleshwar has been inhabited since 13th century. This also includes the old temple at Kshetra (Old) Mahabaleshwar. There were many additions in later period by successive rulers. In 17th century, Maratha rulers conquered the area and built the fort Pratapgad near Mahabaleshwar. There are records of thick, dense forest cover in Jawali (*Jawaliche khore*) since Maharaja Shivaji's time. During British rule, Mahabaleshwar was colonized as a summer resort in the early 19th century. General P. Lodwick explored the area in 1824 and the first cottage was built in 1826 by Col. Briggs. After 1828, this area started attracting civilian visitors. This triggered the planned development of public buildings, which was started by the King of Satara. Interestingly, a treaty was signed between British government and the King of Satara to exchange the plateau with two villages in the plains. (Planning Board, July 1984)

Mahabaleshwar–Panchgani is spread on top of the main range of Western Ghats and is one of the highest areas in Sahyadri with highest location at 1436 m above MSL at Wilson Point and overall altitude of the region at approx 1200 m. The region is wide enough to support a variety of development. The elevation, hilly topography, river valleys, ridges and plateaus with dense forests makes it a unique destination for natural beauty and ecology. The Mahabaleshwar plateau is a

source region for five major rivers in Maharashtra: Koyna, Krushna, Venna, Savitri and Solashi.

Owing to the elevation, this region has very high rainfall and a cool climate throughout the year. The area in Mahabaleshwar is covered with continuous clouds and heavy downpour in the monsoon season with average annual precipitation of 5900 mm. It has lush semi-evergreen forest. In Panchgani, the conditions are slightly different, it being farther East of the main Western Ghats range. With lower rainfall than Mahabaleshwar of about 1865 mm average annual, Panchgani has a different forest character, mainly moist deciduous with some semi-evergreen patches. Panchgani, being in rain-shadow of Mahabaleshwar, has less forest-covered areas compared to Mahabaleshwar. This means that the forest character in this whole region changes according to the location, protection, and use by human population.

View points - Lodwick point in Mahabaleshwar

Presently this region has two main urban centers namely Mahabaleshwar and Panchgani. There is a steady growth in the resident population over the last few decades, with population of Mahabaleshwar rising from 10564 in 1991 to 13393 in 2011. (Census)

Ecological Value

Is it worth preserving the ecological value of our hilly areas?

The mountain ranges and hill areas of India have a crucial role to play in determining the climate and physiography of the country and are prime determinants of socio-economic development of plain areas as the rivers have their genesis here. The protection and climatic control they provide have enabled India to sustain its position as an economic power. (Planning Commission, April 2008)

The two major services offered by the Sahyadri mountain range or the Northern Western Ghats to humans are,

- Source of pure water: Major rivers originating in the Sahyadri provide water to plains in peninsular India. A majority of water volume is contributed by Western Ghats region. There are about 50 major dams all along the Western Ghats. Metro cities in Maharashtra i.e. Pune, Mumbai, Nashik survive entirely on the rainfall in Western Ghats.
- Soil resource: Being ideal for soil production, this region which is a narrow 20-25 km strip provides the soil and essential nutrients for farming in the plains.

Other than this, services provided indirectly by the ecosystem like maintenance of climate, pollination, medicines, food, timber, etc are numerous. It is significant to know and recognize these services at landscape level while developing a plan on the scale of a hill town. Unless the ecological integrity of the landscape as a whole is preserved, the desired effects will not be seen.

Analysis and Problems

With this brief account of the physical, ecological, and historical setting of two famous hill stations in Maharashtra, let's analyze the regions with respect to various associated problems.

Both Matheran and Mahabaleshwar plateaus are ecologically the most sensitive areas. Being on top and physically separated from the surroundings by precipitating cliffs, they have a very unique ecosystem. The only input it receives is in the form of torrential rains and abundant sunlight. The soil is produced here due to action of various factors by chemical and physical weathering. So it is very important to conserve it at source which is the very basis of why forests on top are so important.

The following points are common for many of the hill stations in Maharashtra including Matheran and Mahabaleshwar. A majority of these destinations are in Western Ghats, which is not just a biodiversity hotspot but also an ecologically sensitive area (BVIEER, October 2010). The topography offers various scenic points and panoramas, overlooking the precipitating cliffs and river valleys below and includes waterfalls, old temples and forts, among other points of interest. More than 50 % of the area is covered with evergreen forest ecosystem supporting

rich biodiversity, which also represents the fragility of Western Ghats ecosystem. Freshwater lakes have been specifically built as a water source and now serve as major tourist attractions. Numerous springs, many of them perennial, provide water throughout the year for the local population. Such aspects are considered as 'natural heritage'.

Major source of water - Venna lake, Mahabaleshwar

The 'Land use plan' for both the regions has a mix of private leased plots, residential and commercial areas, gaothan (village centers), hotels, supporting public infrastructure, agriculture and forests. Considering the history, both areas have many sites of archeological importance and thus come under 'Built heritage' worth preserving. Interestingly, these built forms, whether roads, culverts or buildings, were responsive to the local conditions of ecology and climate, and continue to stand valid as 'time tested technologies' even after a century, despite high rainfall and rugged topography. Planning and execution of such built heritage reflect the planner's ability to understand surrounding and design with environmental integrity in mind.

History suggests that hilly regions cannot support large human populations since they have limited plain areas, limited availability of water and limited area for cultivation. The very character of hills cannot support large-scale infrastructure. So the population in hills has always been low with small settlements of one to fifty houses in a 'wadi'. This entirely depends on space and water availability of each settlement site. Springs have been developed by villagers since last few generations for domestic and farm irrigation purposes. The highest spring location in the Koyna valley was found at an altitude of 1,340 m a.s.l. at Old Mahabaleshwar (Naik, Awasthi, & Mohan, 2002). In other parts of Western Ghats too settlements have developed around springs.

There are several issues and problems related to Hill Stations that have been studied by various groups and researchers. There is a lot of related data available with individuals, government bodies, NGOs, and academic institutes, though in a fragmented form. Many have also tried to give appropriate solutions considering the ecology of the regions.

Here are a few factors impacting the ecology of the hill station destinations. Some of them are specific to Matheran or Mahabaleshwar, while some are general.

1. Poor implementation of Policy : Even though there are policies and laws to protect ecology, the execution of these regulations is a serious issue. It is seen from many examples and the current situation that rules are not properly followed, creating large scale impacts on surroundings. As an example, it is mandatory to have efficient waste management systems be it Matheran or Mahabaleshwar. However, in Matheran, the sewage created is just let down the cliffs or sent to septic tanks at almost all sources. One must note here that septic tank is not a treatment solution.
2. Increase in the annual number of tourists : The increase in number of tourists has now gone much beyond the 'carrying capacity' of almost all such destinations. The sheer increase in numbers demands more infrastructure and support services. This directly or indirectly damages natural resources, increases pollution and decreases aesthetic value of such places of interest.
3. Change in Land use pattern : More support structures for tourists results in substantial change in land use. Comparison of land use at these hill stations over last few decades shows obvious change from agricultural use to non-agricultural use like holiday homes, second homes, resorts, investment plots, etc. It continues to cause severe degradation of nature and natural resources. Land, once inexpensive, is becoming more and more expensive with the increased purchasing power of the buyer. The attractive financial returns in property development accelerate the squeeze on natural ecosystems even further, thus resulting in a disturbing cycle of degradation.
4. Increase in construction : The tourism industry needs a lot of infrastructure like means of transport (roads, rail, ropeway, air, water, etc), lodging-boarding facilities, entertainment options, food, etc. Creating this support infrastructure for increasing number of tourists

has an adverse impact on natural surroundings.

5. Real estate development : In recent past, concept of ownership over land and resources in these destinations has increased. This also means that developers bring business, employment, provide investment options to urban population and provide economic growth. This conversion of agricultural land to non-agricultural (NA) is as per law; however it is also converting natural landscape (slopes or agricultural fields and forests) into an urban-scape. It results in removal of biodiversity or at least reducing it substantially, increasing overall temperatures, soil erosion, and more such impacts.
6. Pollution : Both solid and liquid wastes have increased causing permanent damage to the ecosystem and aesthetics. A study conducted in the Charlotte lake catchment in Matheran revealed that the BOD and COD levels of feeder streams were higher as compared to the control sample. BOD of the control sample was 49 mg/L, that of the feeder stream 92 mg/L, that of the lake was 81 mg/L while the acceptable limit for drinking water is only 30 mg/L. (Ecological Society, January 2007) This clearly indicates introduction of sewage most probably by the resorts in upper stretches. Matheran does not have any system of waste water treatment and all the waste water is either released into forest areas after septic tank overflow or let down the cliffs. The same is the fate of all solid wastes created in Matheran that land up unsorted and untreated in forests, streams, cliff-sides or in the dumping area within forest. The degradable part mixes with soil while the plastics and other non-degradable materials either piles up in surroundings or are burnt, generating the toxic fumes.
7. Mismanagement or violation of rules and regulations : This creates impacts of various intensity at all levels. At both Matheran and Mahabaleshwar breaking of laws and policies is seen by all stakeholders. There are examples like illegal constructions, keeping mules in forest areas at Matheran, extraction of wood, throwing solid wastes, illicit parking, cutting of vegetation, land leveling and many more.

How much is enough is always an elusive question for humans. We humans seem to want 'more' all the time and nature cannot and will not be able fulfill such wants. So, along with analyzing the effects of various wrong actions by humans, one may need to check what is at the root cause. The problems these hill station destinations are facing are due to underlying issues like :

Plot development regardless of topography or nature

Solid waste dumping at Matheran is within forest and near a natural spring, causing health problems and forest destruction

1. Continuously increasing individual wants and self-centered approach of people at large
2. Vested interests of individuals and groups
3. Ineffective implementation of policies
4. Lack of long-term vision that will consider the sustainability for future generations and even the immediate future of present generations
5. Apathy of visitors to follow the rules
6. Sheer increase in population at hill stations and mismanagement leading to decrease in resource availability
7. Lack of civic sense, e.g. keeping these places clean

These factors have direct or indirect impacts on landscape and ecological integrity. A majority of us humans fail to understand that nature in fact is the very basis of our life. Importance of Hill stations is not just because they are tourist attractions but even more because they are the key sources of 'Natural capital'. A good example is of Mahabaleshwar, which is home to 5 rivers which provide water to almost all of western Maharashtra.

It is also a trend in recent years to open new hill station destinations due to the earlier ones falling out of favor of tourists – primarily on account of overcrowding and degradation. As an example, Lonavala, which was a favorite hill station for people of Pune and Mumbai, has lost its charm due to over-development and saturation. The holiday homes / second home schemes, villas, expressway, resorts have come up in a very haphazard way resulting into a boost in property prices and degrading the natural beauty. Nobody would have imagined traffic jams in Lonavala few decades ago.

In a similar way, Mahabaleshwar has changed its character already and summer seasons witness water shortage and traffic jams. This is leading people to find a new peaceful destinations such as Amboli, which is now becoming a hotspot of tourism and also real estate. If history is what we go by, the fate of Amboli is already sealed. The Government of Maharashtra had also planned to develop 'New Mahabaleshwar'. It is mentioned in their report for 'Tourism and Entertainment' that 'the main source of revenue generation will be through sale of land'. (MIS, 2002)

The hill stations discussed so far are all public

Inappropriate construction & farm house schemes, Amboli

Serene backwaters are the next destinations for new hill stations - Mulshi catchment

destinations. With the 'Hill station policy', notification No. TPS. 1896/1231/CR-123/96/UD-13, dated 3rd September 1996, private developers are able to purchase and develop hill towns. Two such developments are already in place: the Amby valley and Lavasa. These private hill towns aim more at property development for sale, even while they lack the hill station character of catering to the needs of floating population that other hill stations have as public destinations. Lavasa in fact has marketed itself as a new 'city' ideal for business, education, hospitality and retirees.

So, it can well be observed that the tourism on which the economy of hill towns depends in the first place, is putting substantial pressures leading to degradation of the destination. Moreover, marketing a destination as hill station and then rampantly engaging in it's full-scale urban development has become a new business tactic.

The clear reason for all this development is financial potential of tourism and property development.

Ecological Impacts

Any developmental activity by man will cause modification in the natural landscape. Various activities that take place as support structure of tourism have direct or indirect impact on surrounding landscape and ecology. These activities are carried out as present need, sometimes happen due to negligence or even because of lack of knowledge and understanding of natural resources and processes. Sometimes the impacts of a small activity are aggravated due to topography and climate. Further section proposes to explore how better planning and management can limit such side effect of human actions on nature. Few of the impacts are,

1. Increase in tourism increases extraction of fuel

wood, being a cheap source of fuel. Even today, majority of cooking and water heating applications use wood as a fuel. This requires felling of trees and removal of dead wood. This slowly changes the vegetation character and degrades the area.

2. Mismanagement keeps on adding to ill-effects of any activity towards development. One such example can be seen at Matheran where majority of transport happens over horseback. Here, it is observed that trees die due to horse urine and dung, affecting a larger area of good forest land. There are more horses than allowed at Matheran which adds to the stresses of mis-management. While not using vehicles at the hill station is a good thing, there is a need to manage the way people move around better in view of queer problems like the one cited above.
3. The road networks hamper movement corridors of fauna. There have been several animal deaths while crossing the road due to collisions with vehicles.
4. Effect on wildlife : There are many unseen, unknown impacts on local biodiversity while few are visible. Monkeys and langurs get attracted to the waste dumping sites for leftover food and animals are known to swallow plastics causing serious injuries. Open dumping also increases stray dog population which starts preying upon small wildlife like bird eggs. Although there are hardly any studies or statistics on this particularly for hill stations, there are many photos, records & newspaper articles that prove such disturbance.
5. Increase in solid and liquid waste in and around the resorts and public places at hill stations has become an unmanageable problem. Many a time, the solid waste is just dumped down a slope or burnt without any precautions, which is even more dangerous, as it introduces toxins in the air, soil and water. Further impact on the aesthetics of the surroundings is also another significant side effect of growing development on the hill stations.
6. The aquatic life in these mountain streams has hardly been studied in depth, and the impact studies are also lacking. This means one cannot say for certain, what are the impacts associated with such introduction of waste to the streams.
7. A general increase in infrastructure is result of popularity of a particular destination. This directly increases construction and related activities like excavation, quarrying, terracing, leveling and grading. The increase in dust pollution and dust accumulation over the flora is a significant undesirable side effect.
8. Construction companies often take shortcuts like dumping construction wastes in the forested areas. This waste cannot be digested and has a very long life. This causes further deterioration of soil quality.
9. Increased number of vehicles also means need of more space for parking. This needs additional clearing of the natural forest areas. Even then an adequate parking space is not provided in most hill stations. This means illegal parking on road sides and further challenges to traffic movement. Such ongoing growth will eventually lead to losing very large portions of the natural understory to creating parking spaces.
10. Any change in the original topography done without understanding and planning will have adverse impacts on soil by initiating soil erosion.

Massive gully formation, soil erosion initiated due to unscientific road work, Matheran

Langurs visiting waste dumping site - not healthy for the wild animals, Mahabaleshwar

Solid waste thrown over cliffs, Matheran

Matheran has seen massive landslides and associated soil erosion. This is primarily due to roads and rail network, which provide access to the hill station.

11. Change in wildlife behavior is also an important impact that we must be aware of. As an example, monkeys, who really do not need any food from humans, are tempted due to relatively easy access to such food thus changing their food habits.
12. There are many micro level impacts on biodiversity and ecology that go unnoticed as Western Ghats are understudied for biodiversity. Long-term studies that measure such impacts are not undertaken. Apart from just being data deficient, it is quite hard to go through the benchmarking process as the so called developmental activities proceed at fast pace. This means that the area and biodiversity keeps on changing continuously.

The question is can we manage these hill stations better from the development perspective and retain the natural beauty of these areas? Can we maintain through sound management principles, charm and peace in all such destinations? It seems a distinct possibility if we base our planning on aspects of Landscape and 'Resource availability'. It is tantamount, that the rules for development and use of facilities and infrastructure are indeed followed strictly. Could such hill stations be economically viable, while maintaining the ecological integrity of the area? Even though this is not the subject to be covered in the current scope, it is certainly necessary to initiate studies on how to maintain 'ecological integrity' with 'economic benefits'.

Planning and Management

With the understanding that maintaining the ecological value will ensure healthy hill station communities, let's see what are the various planning and management considerations for existing or new hill stations.

The most prominent difference in old hill stations and new hill stations is the older ones were settled by clearing primary forests, while the new ones are being developed over secondary forests and open scrub areas.

Basic planning of any such destination must consider various factors of ecology, its spatial distribution, opportunities created by nature and limitations imposed by the terrain. The development responsive to such aspects will then have much lower impact on nature.

Each destination has a **'carrying capacity'** that needs to be carefully considered while preparing any developmental guideline for such area. This carrying capacity depends upon a number of factors; the first two key factors are 'water' and 'space' availability. Apart from this, it is also important to consider aspects like support infrastructure (mainly roads, public utilities, other essential facilities), maintenance of aesthetics, waste handling capacity, pressure on resources and ecology. All these factors together will derive the number of resident population, number of tourists per year and respective support structure. Also, the type of tourism and visitor attractions needs to be responsive to overall character of the destination.

Management and Policy guidelines for ecological conservation

Policy framework

A review of existing policies shows some contradictions in objectives, specifically for Western Ghats. E.g. there is a guideline for 'Catchment area

treatment' framed by the Central government for irrigation projects, which safeguards the dam life by controlling soil erosion in catchment. It is mandatory for the project proponent or respective government agency like Forest Department to submit a plan along with the total project plan for the dams (Badrinath Forest Division). But with policies towards development like the Hill Station policy which in same dam catchments increases development & induces soil erosion.

Fragile biodiversity is found in protected areas (PAs) as well as outside on private lands. So it is important to frame a set of guidelines for areas outside PAs where land development over privately owned lands is taking place rapidly. These guidelines should focus on ecology & biodiversity conservation but should not impose them on the local communities. If innovative ways of 'pay-back for conservation' like green cess, waiver in income tax, use of CSR funds, etc are developed then people will willingly participate in conservation. But these pay-back options should be available to local, non-polluting, non-destructive, small-scale proposals than large-scale area development projects. Some organizations are already initiating such mechanisms on a small scale; they must be supported by the Government.

Even in the EIA clearance procedure, there are many aspects that need improvements. The Government should proactively impose rules to conserve nature while giving various permissions to projects. It is also necessary to review the minimum area criteria for developmental projects like farm houses specifically in Western Ghats. Otherwise a large number of small units will still end up degrading more than a single large-scale development. There are examples of such small schemes spread over an area of 20 to 100 acres happening in Mulshi catchment near Pune, Maharashtra, where NA plots of 2000 sq ft size are sold as investment plots with all amenities of roads, water, and electricity. Such development patterns have negative impact on existing ecosystems and do not add in any way towards betterment of environment of the region.

Drafting more comprehensive policies will require detailed understanding of ecosystem dynamics, inter-relation with humans, current ecological status, restoration potential, use of restored landscape for fulfillment of human needs and its tourism value.

Sometimes it is also important to understand the local nuances related to hill stations. E.g. the residents at Matheran hardly appreciate it being a pedestrian-only hill station. For the locals, it is really cumbersome to live in an area which cannot be reached on motorized vehicles while watching a world with modern amenities and urban aspirations. This makes us question why have permanent populations in areas like Matheran where the policy demands protection of environment and ecological integrity while the ground conditions are totally opposite. Such flaws in policy and ground realities are difficult to eliminate quickly. But it is essential to re-think and take a position if the natural ambience at Matheran needs to be maintained for attracting tourists.

Existing Hill Stations

Following current policies and regulations and forming new regulations essential for conservation will ensure healthy environment for existing Hill stations.

1. Control on number of tourists per day: This will also mean that there has to be a tourism management plan in function with an aim to distribute number of tourists evenly over the year. Proper planning will not reduce the economic benefit created by tourist inflow and will reduce the stress on environment.
2. Efficient transport management: At Matheran, which is a special case being the only hill station that is vehicle free, private cars are parked at Dasturi (the last point where vehicles are allowed). The existing parking plan is not sufficient for ever-growing numbers of cars. Also the parking land is under the purview of forest department being a forest land. Many have suggested alternatives to this like ropeway, parking at Neral, shuttle service to Dasturi, use of goods trains, etc which will reduce the sprawl of in parking forest areas. A goods train is now running within Matheran which has reduced pressure on Mules and hand-pulled carts and is proving beneficial for local residents.
3. Provision of alternative fuel sources. It is observed that fuel wood extraction for serving local as well as floating population is high at any hill station. This keeps on deteriorating forest areas as well as the degraded areas for extraction of fuel wood. If fuel wood is a basic need, then a large scale fuel plantation on open lands should be undertaken to reduce pressure on existing forests. Also other appropriate fuel sources like biogas from solid waste or biomass, improved chulha, etc must be considered.
4. The government DP (Development Plans) should

be responsive to the ecological factors and keep the aesthetics intact. As an example, in the proposed DP of Matheran region, the most sensitive Matheran plateau is shown as 'Urbanisable zone' which is a contradiction to the above-stated need of protection to existing fragile ecosystem from developmental activities.

5. Environment friendly techniques of use, reuse, and recycle for water sources and use of local water resources.

   a. Hill stations in the Western Ghats region receive very high rainfall (ranging from 3000 to 6000 mm average annual) so water is abundant during the four months of monsoon and then there is acute water shortage during summer. So there has to be a multi-source use method for catering to the fresh water needs of the entire year that will be based on seasonal variations in water availability and use. For example, direct use of rainwater is possible during monsoon with small storage devices at multiple locations. Similarly, rainwater can be stored in larger structures that will be useful for winter, and finally for the summer season other centralized sources like lakes, rivers can be tapped. Such systems will require careful planning and awareness amongst users.

   b. Encouragement to use local water sources and improvement in the quality and sustainability of these sources must be undertaken to reduce water crunch in summer seasons. Many times it is seen that during hill station development, existing open wells or springs are totally neglected and lost in the process. E.g. there are many ancient wells and perennial springs in Mahabaleshwar-Panchgani region. These were harvested and used by the villages. Even the Old Mahabaleshwar Temple where 7 rivers are believed to originate was based on perennial springs. But new uncontrolled water guzzling developments of resorts in this area have depleted these natural resources. There are many such examples in the region e.g. spring in Godawali village in the vicinity of Panchgani table land where over extraction of ground water have led to zero discharge from the old spring on which the village and surrounding farming was dependent. Protection and management of natural springs and streams is necessary for future water security and must be taken as priority for the planning process (Kulkarni & Buono, 2014). Spring and stream development should also consider the needs of local biodiversity.

   c. Generally as high as 90% of the fresh water is released as waste water. Re-use of treated waste water for uses other than drinking will reduce the need of fresh water to a great extent.

6. Nature-based, ethical tourism and local participation is perhaps the only sustainable way for management of hill stations and it makes sure the benefits of development will reach local people. Both have different advantages but will ultimately safeguard the ecology. Due to the direct benefit to local community, it will encourage them to conserve their surroundings as the base for attracting tourists. It is possible to encourage participation of local people through home stays, hotels, restaurants, taxi, etc. In fact, if more of the tourist share is handled by home stays, the ecological footprint related to hotels and restaurants will be reduced. A good example is set by Choukul village in Amboli where villagers have started home stays for visitors on a small scale.
7. There should be guidelines for appropriate types of entertainment. For example, having night clubs, pubs and bars, casinos, and water parks at hill stations will surely change the culture, type of tourists and indirect use of resources which is totally opposite to the ideal character of development at any hill station. Instead, entertainment like nature trails, food joints, boating, horse riding, etc which is less impacting on character and ecology of the region should be promoted.
8. Tourist information and awareness is a very effective tool for better management. Along with the tourists, education of residents, owners and even the property developers is required in such sensitive areas. An 'Awareness Program' considering aspects like ecology, landscape, biodiversity, cleanliness, waste management, and land management will prove to be useful in management.
9. Aesthetics is important but unfortunately there are hardly any guidelines on the character of buildings, signage, roads, and stalls. Recently, the Matheran Municipal Council developed a manual specifying do's and don'ts for street furniture, signage, compound walls, etc which is a very positive move and it was also supported by the Heritage Committee. This manual is for reference by anyone who wishes to develop

property at Matheran. Similarly, the Draft Regional plan for Mahabaleshwar-Panchgani region, published in 1984, referred to the 'Removal of haphazard and ugly signage' and about the need for the local unregulated stalls to be well-placed and better-designed. (Planning Board, July 1984)

10. Control of vehicular traffic has been widely discussed. It must be noted here that there are very few flat areas in the hilly terrain, so transportation problems must be addressed with a proper plan. A 'Public Movement Plan' needs to be developed for all the hill stations to avoid traffic jams. Vehicular traffic not only puts pressure on roads and add to pollution but also destroys undergrowth of forest areas for the sake of parking space. Parking is not considered a necessity during design stage at any of the destinations. Thus, unofficial parking space is posing a serious threat to forest ecosystem around scenic view points, in hotels or restaurants and in public attraction places. The ideal path, of course, is to eliminate or minimize transportation as much as possible in these areas.
11. There are people who continue with agriculture and horticulture for cereals, fruits, vegetables, etc in the Hill Station areas. Some regions have their own specialty e.g. Mahabaleshwar is famous for it's strawberries. But in the recent past, people have started using plastic mulches for growing strawberry and impact of general apathy of farmers to manage the wastes created after use or harvest is seen in fields, along roads and trees, even on overhead electric cables. One can notice black polythene fragments lying and being blown away by strong winds in most parts of Mahabaleshwar. If this system of cultivation is managed with environmentally sustainable practices then the destinations could be self sufficient in terms of food. It is necessary to develop organic farming that is local and leverages biodiversity. This will reduce the pollution and negative health effects due to modern farming that uses harmful chemicals such as fertilizers and pesticides.
12. It is known that hill stations have rich forests. In 1983, the Mahabaleshwar region had 52 % forest cover as per the land-use analysis. Scientific 'Forest Area Management Plans' must be developed in consultation with experts and local forest departments. In such plans, restoration of degraded areas, protection of existing high quality forest patches, plantation of native species, etc must be considered. People at all levels, from local municipalities to visitors, need to be made aware for the need and ways to conserve forests.
13. The awareness for using only native plants for all aspects of plantation must be adopted and widely spread amongst the hill station community. A good example of wrong species selection is seen at Mahabaleshwar where the council has planted *Bougainvillea* and *Datura arborea* right at the edge of forests along the roads. The question is will this enhance beauty of already existing dense forest or suppress the beauty and growth of the forest as *Bougainvillea* is known to spread wildly over trees. Effects of non-native species are already seen in Mahabaleshwar forests and road sides. Plants planted in gardens e.g. *Datura spp* or as fences like *Duranta spp* can become invasive over a period of time. The herb *Ageratina adenophora* has become invasive and replaced the original forest shrub wayti (*Thelepaepele spp*). There are many such examples where various stakeholders, including government departments are not aware of problems of introduction of non-native species and keep on planting such trees and shrubs for all sorts of plantation needs. So awareness of preferring the native, beautiful plant varieties for any plantation or gardening is essential and required for preservation of ecological order.

Proposed new destinations

With upcoming large-scale, hill station type developments in line, it is important to take a fresh approach for new destinations.

To start with, any new 'hill station' project, proposed in our ecologically sensitive areas like Western Ghats, should be simply re-evaluated whether it is even necessary. Such projects provide short-term pleasures like bungalows, hotels, and tourism for a wealthy few among us. In the process, the entire long-term future of a fragile ecosystem gets severely compromised. If the project is indeed going to benefit only the rich and has no other benefits for the environment or society at large, it should be cancelled as a policy decision on environmental and social grounds. There should be no ambiguity that protection of environment and continuing welfare of local communities is a much more important priority than developing yet another destination for fun and display of wealth by city-dwellers. It should be noted

Bouganville plantation at road edges, Mahabaleshwar

Ageratina adenophora - invasive herb now competes with local vegetation, Mahabaleshwar

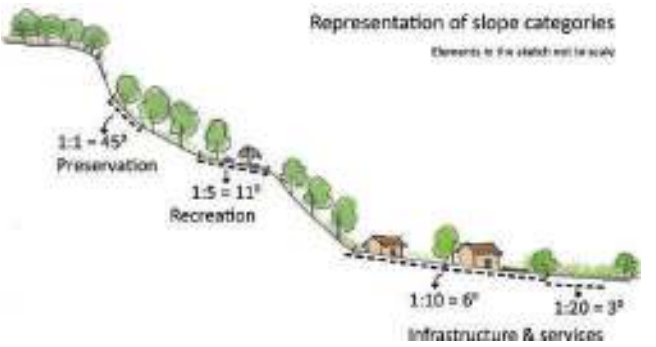
here that there are many other forces and reasons that have been causing disturbance to Western Ghats right from local livelihood activities to present market-driven development. For safeguarding the local environment, different policy approaches can be developed that will ensure environment protection along with the welfare of small local populations that reside in Western Ghats.

Despite such a clear, unambiguous evaluation, if a new hill station project is still approved, a strict planning methodology should be followed to develop the hill station with integration of existing ecological conditions and maintaining or restoring the area as closely as possible to the original working ecosystem.

By referring to the following guidelines, planners can carve out suitable spaces for low scale development expected at any hill station. Here, the ratio of human development i.e. infrastructure with open spaces has to be very low, as this development cannot be like cities where nature is allowed to take a complete backseat. But the settlement has to be surrounded and merged with nature else it can't be called as a hill station.

Suitability matrix : Restrictions for better experience

1. Larger wilderness areas : The ratio of open areas to built-up should be defined. Considering the ecological value of these areas, large proportion of land must be kept inviolate of any developmental activities. As a general guideline, the area under natural forests (if existing or to be developed under project) should be more than 50% for older destinations and minimum 35 to 45 % as per the terrain for private projects.
2. Slopes : This is the most important and dominating feature of hilly terrain. The available slope to plain area ratio will determine footprint of human-centric development. Tending slopes in hills is always risky in the long run. For example any ghat road has risks of landslides during monsoon which happens due to instability created by cutting the hill. Even simple leveling of land in sloping, high-rainfall areas creates soil erosion problems. It also disturbs a number of



A schematic suggesting ideal land-use for respective slopes

landscape units creating fragile areas for humans and nature. So any infrastructure development should be planned on slopes from flat land i.e. 0^0 up to a gradient of 6^0 which is a developable slope, ideal for infrastructure like road, construction. Areas other than 0 to 6 degrees of slopes i.e. slopes higher than 6 degrees spread over moderate to steep slopes can be put to uses other than infrastructure. Considering hilly topography, this means that the settlement will happen in lower portions, on flat areas on spur tops and in mountain top plateaus. These areas are small in percentage, which actually suits the kind of development hill stations suggests.

3. Water : Water availability is always low in hills. As the terrain is sloping, water tends to flow to lower parts and there are fewer chances of natural storage. As a strategy, small water holding tanks with decentralized approach should be planned. This will also reduce the impacts of creating huge distribution system on surrounding. Considering all this, the number of units and extent of development will be decided by the available sources and quantity of water. This also means that treatment and recycling of waste water should be of high priority.
4. Landscape units : This dimension is added to planning due to micro features on land.
   a. One of the main units is the 'stream network', the drainage pattern of an area. Being a high rainfall region, there are numerous small to large streams that are carriers of fresh water. They become an important feature for both nature and humans. It will be appropriate to say that if streams are managed for nature, they will provide many services to humans like, recharging of water, flood management, and a congenial atmosphere.
   b. Second important unit will be 'Areas with special biodiversity'. This could be a single old growth tree, a rare orchid or a patch of dense shrubs or Sacred Groves. They are important to be preserved just for biodiversity value.
   c. In some areas there are few special ecosystems like the rocky plateaus (Watve, 2013). Two such popular places are Kaas and Panchgani table land. Both represent this special ecosystem and Panchgani table land has deteriorated due to tourist activities. These are areas of special scientific interests and in need of highly-controlled tourism which is essential to consider in planning. These areas are flat and could well be considered easy for 'development'. Hence the temptation to build these areas out must be consciously avoided.
   d. Scenic View points : They serve as tourist attractions and can be developed carefully without hampering natural beauty. Examples are Arthur's Seat or Lodwick Point at Mahabaleshwar. Many times these points are crowded due to hawkers and illegal stalls owing to short-term commercial gain.
   e. One more important unit is agricultural fields. It is known that it takes 500 to 1000 years to form a 1-inch layer of soil. In hilly terrain it is difficult to find cultivable areas with good soil. So, conserving such areas for future food security is wise.
5. Open space management : Treatment of open spaces will decide the aesthetics and overall ambience of the destination. Looking at the ecological needs, all the open spaces should be planned to have maximum tree canopy vegetation, be it a garden in a bungalow or resorts or public gardens.

The above factors will primarily decide the land-use, layout and overall character of the area. Add to this historical and cultural aspect like temples, forts, and old settlements. Their character too will define the overall layout to some extent. This suitability matrix is based on a general understanding, which needs to be made site-specific for each destination with deep understanding of local ecology.

With the above principles driving the base layer of a general zonal plan, further detailed planning should consider the following points :

1. Use of local and eco-friendly technologies which are not intense on the use of electricity or fossil fuels
2. Understanding local needs and providing ways to use natural resources in sustainable way
3. Role of local communities, their traditional wisdom and aspirations
4. Preservation of unique features like springs, ponds, and forts
5. Identification and integration of wildlife needs and their corridors
6. Restoration of denuded areas
7. Architectural character responsive to climate and ecology that facilitates low use of resources
8. Themes, activities and attractions based on nature or selection of amenities that doesn't go against nature

9. Effective waste management systems
10. Promoting 'near-nature' lifestyle through planning and space utilization
11. Using appropriate techniques for green areas like selection of native plants, energy – resource friendly landscapes, leading chemical free gardens, creating habitats
12. Activities and opportunities for awareness creation for tourists beyond enjoyment
13. Understanding of construction and operational phase, respective activities, their impacts and mitigation measures should reflect in planning

For this type of planning, a team of experts in geology, biology, ecology, biodiversity, GIS, and planning need to come together and conduct an all-seasons detailed Ecological Assessment (EA). The EA should include :

1. Assessment of existing natural conditions of hydrology and strata
2. Mapping of resources
3. Detailed survey of biodiversity and its seasonal variations
4. Detailed mapping of biodiversity
5. Identification of special and rare biodiversity with correct locations
6. Integrating survey results to create a map showing natural resources and biodiversity with Landscape Ecological perspective

This final mapping along with the details of the study should be used as a base for all further planning. It is easier and essential to follow such a planning methodology for newly developing destinations. It may also be used suitably for existing hill station destinations to assess what ecological value can still be saved, what type of controls should be introduced on tourism and development, etc. From an ecological balance standpoint, some of the existing hill stations have gone almost beyond repair at present. Matheran and Mahabaleshwar are fortunate to have a strong policy framework but for others like Amboli, the local leadership needs to play a very important role.

Conclusion

Consideration of ecology in planning all aspects of hill stations through public or private effort, will definitely benefit both development and nature. It will protect a landscape which will be sustainable over the long-term and provide a rich experience to local residents and visitors.

It is necessary to accept that aesthetics is the magnet that attracts visitors to a hill station type destination and will continue to be so. Aesthetics means the beauty of the region with the climate and the ambience it offers as experience. Such aesthetics cannot be developed through manicured gardens, man-made plantations, or typical entertainment concepts. The ambience is easily ruined by haphazard development. Our existing hill stations have been victims of gross negligence towards preservation of landscapes and nature.

Restoring the focus on ecological integrity and aesthetics means change in policies, formulation of new laws and active involvement of the public. It is not necessary to destroy ecology for development but both can go hand-in-hand with thoughtful land use and integrated planning.

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Apart from following references, this article is also based on author's own experience during last twelve years in ecological land management and providing consultancy for two large scale area development projects, extensive travel in Western Ghats and at hill stations, also as team member for preparing the Environment Conservation Plan for Matheran, and as Member of the Matheran High Level Monitoring Committee (HLMC) for two years.

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Urban Riverfront Management

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Abstract

The plight of the rivers in India is pathetic, especially in the cities. Rivers flowing through the cities are polluted and filthy. They have become dumping grounds for waste. Therefore the health of the citizens is at risk.

Rivers are modified to a great extent by constructing dams, channelization, changes in the flow etc. This results in loss of their ecosystem functioning and natural services to man. The services given by the river include fresh water source, fishing, washing, swimming, sand as a raw material for construction, and many more. The esthetic use and relaxation on the river banks is an intangible service but important to the common man. All these services given by river are free of cost.

Present situation demands immediate attention to improve conditions of rivers. The solution is restoring the natural river system and re-developing river fronts sites based on ecological considerations. This involves stream channels, stream buffers and banks restoration. The restored river system contributes to a healthier environment and improves conditions for stream related human activities.

Typical plans for redevelopment of a river front are integrated and mixed-use, including public amenities such as parks, trails, cultural attractions like open theatre, wildlife watch-towers, preservation of historic structures like ghats and temples, and commercial establishments. However, the health of the river itself will not be restored if the following factors are ignored: alternative solutions for sewage, improvement in water quality, restoration of vegetation and habitats within the river and along its banks. In the redevelopment, access to river bank for common man is also an important element.

Such successful examples are so far seen in American and European cities. It is now high time to have holistic environmental planning in India.

Keywords : *environmentally sensitive planning and design, mix-use development, access to river for common man, revitalization of river system, ecological services given by river*

1. Introduction

Human society benefits from the services provided by the river. It is difficult to get these services if the river system is disrupted. Many a time, an urban riverfront is substantially modified due to human intervention. However, it is possible to revive the function of such rivers, if the riverfront is subjected to holistic and ecological management.

Human intervention causes river modification in several ways, such as channelization of flow, clearing of riparian vegetation and construction on the bank. These interventions become barriers for the river system to function as a biotic system, adapted to the physical elements in that landscape. The smooth functioning of the riverine ecosystem is also important for the biodiversity, which is a positive feedback for the ecosystem to function normally.

It is quite important to understand the river ecosystem in general and its relationship with the physical, geomorphic, geographic and climatic aspects as much as the biota it supports, before we jump to the question of how we manage urban riverfronts in the best possible way. The background will help

substantially, when we discuss strategies for urban riverfront management and its impacts upstream and downstream of the river.

2. Background

The most ubiquitous physical features over the land surface are streams and rivers which are a major source of water for terrestrial living beings including humans. The Indian Territory is endowed with more than 29,000km of riverine resources (MPCB, 2011). In addition, river basins are closely associated with other elements such as mountains, hills, upland plateaus, floodplains and deltas among others. The streams/ rivers have an elongated/longitudinal continuum which can be called 'corridor'. Riverine corridors are of great economic, social, cultural and environmental value.

The watershed structure of rivers is composed of a network of streams and tributaries that feed the main river. The typical physical set-up of a riverine system consists of a source region in the hills or mountains, middle region of floodplains and mouth region characterized by deltas and estuaries. The river system evolves through long geological time to drain rain water. The physical geomorphic processes operating in the watershed are erosion, sediment transport and its deposition. The scale of these processes depends on the climatic regime and changes in the climate through geologic time. The scale and character of the physical features created by rivers differs from region to region depending on the type of climate and geology of that region. The combination of river processes along the river channel and geomorphic processes beyond the channel banks result in the hill-valley landscape commonly observed around us.

3. Importance of River Systems

However rivers are not just physical structures to drain rain water. As most of the rivers are flowing for past thousands of years, characteristic biological communities have evolved in the river water and in their vicinity. The biological communities conform to the physical conditions. The rivers are complex ecosystems. The relation of physical processes and the biotic community has been lucidly described by Prakash Gole (Gole, 2007) in the excerpt below:

'Life of a stream is characterized by flow and flood. The corresponding physical processes that get established due to a regime of flow and flood are: erosion of the surroundings, sediment transport and sediment deposition. The mixing of organic matter and minerals enriches the flow with nutrients on which many biological communities thrive. As the flow encounters physical barriers such as rapids and riffles, dikes and depressions the velocity of flow and sediment transport and deposition changes giving rise to different habitats in-stream and in the riparian zone with its characteristic vegetation. These habitats give food and shelter to a variety of producers into (plants), consumers (aquatic animals) and decomposers which utilize and recycle nutrients, imparting the flowing water a self-cleansing ability. In the head waters of the stream the channels is a receiver of nutrients and a breeding and nursery ground of fish and aquatic animals, while in the lower reaches, the stream channel is the donor of nutrients and the flood plain is their receiver. It is in the flood plain and the delta region that the major biological and wildlife value is concentrated, the stream therefore, comes to develop an organic relationship with land that it traverses.'

4. Functioning of River Ecosystem

The rivers evolve in response to surrounding ecosystems. Changes within a surrounding ecosystem will change the physical, chemical and biological processes occurring within a stream corridor. For example change of land use in the watershed such as increase in land under agriculture and pasture by cutting forest may lead to more erosion, sediment load and sediment deposition. It will create changes in the stream bed habitats and therefore changes in biological community. A river system normally functions within natural ranges of flow, sediment load, sediment transport, flood variations and other variables and has its 'dynamic equilibrium'. When changes in these variables go beyond their natural ranges, dynamic equilibrium may be lost. The changed character of the river may not fulfill social needs such as sufficiency of water resources.

Water, materials, energy and organisms meet and interact within a river over space and time. The influence of flow extends beyond river channel especially during floods. It extends into a riparian zone which is a space between slope processes and channel. The river channel and the riparian zone together provide critical functions essential for maintaining life in the river. The important functions are nutrient cycling, absorbing and gradually releasing flood waters, maintaining fish and wildlife habitats, recharging ground water so that aquifers release water in the channel during dry season. However biological functioning changes when there are significant changes in the physical processes.

These changes may be natural or man-made. Many a time biological communities are unable to adjust with extreme physical disturbances. Therefore, it becomes difficult for the river ecosystem to function in equilibrium. Now let us see how natural and man-made disturbances affect the river ecosystem.

Besides physical functions there are biological functions. The riparian zone presents a series of aquatic and terrestrial vegetation bands or eco tones, through which matter and water exchange takes place. Energy is naturally dissipated as a variety of vegetation grows in the riparian zone. It adds vegetation debris to the flow providing food for aquatic organisms. The biotic component of the river filters contaminants in the flow. Figure 1 illustrates efficient interaction between aquatic and terrestrial ecosystems that enhances the self-cleansing ability of the river.

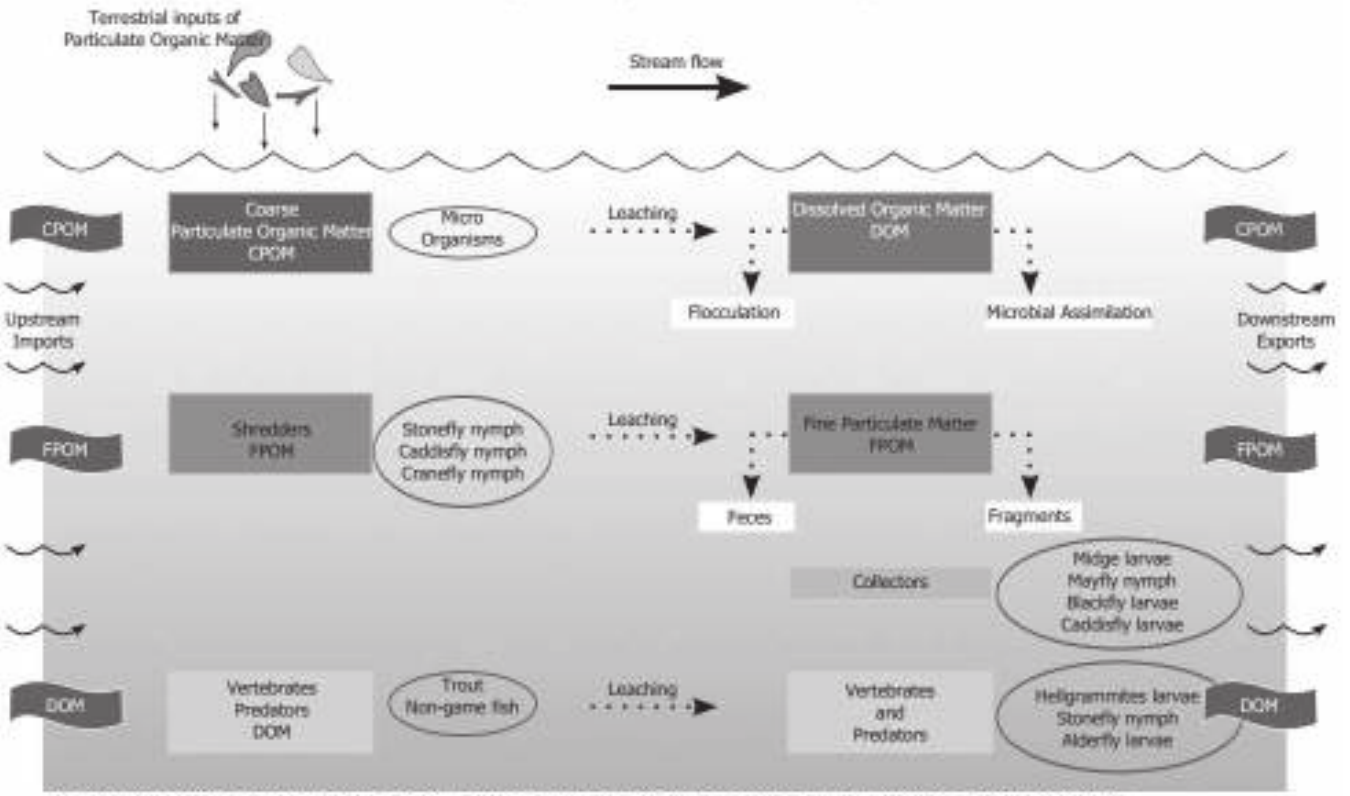
5 Disturbances to River Systems

5.1 Natural Disturbances

Disturbances in the river flow bring about changes in the river ecosystem. The disturbances can be natural or man-made. Natural disturbances include earthquakes, volcanic eruption, landslides of a major scale, forest fires, and spread of diseases in the forest. However the most common disturbances affecting the river flow are climatic events. The quantity (intensity), timing, and distribution of precipitation often cause major changes in runoff and the sediment load it carries.

The Indian monsoon climate is erratic. The nature of river flows studied by a group of geomorphologists describes it as follows : ''High magnitude of floods during the monsoon season is considered to be India's recurring and leading natural disaster. Such large floods are extremely important events, not only in terms of human impact, but also from the standpoint of geomorphic effectiveness and geomorphic work. The flooding in such large rivers profoundly challenges flood-hazard management, because of limited instrumental records and large spacio-temporal variations. It is therefore imperative that the design engineering community in India incorporates the geomorphic, sedimentologic [sic] and botanic

Figure 1
Role of Riparian Vegetation in Stream Ecosystems



Adapted from : California Riparian Systems: Ecology, Conservation, and Productive Management. By Allen W.Knight and Richard L.Bottorff

information in the planning and design of water resource development project." (Kale, 1994)

The erratic climatic factors also affect patterns of soil and vegetation in the landscape.

Natural climatic events such as storms, floods, temperature extremes, cloud bursts, droughts etc. are relatively regular events, especially in monsoon type of climate. Thus the natural events disturb structure and functions in the stream corridor. In such a situation certain species of plants have adapted their life cycles to the occurrence of destructive high energy disturbances such as alternating floods and droughts. An example is the tropical willow (Salix tetrassperma) which grows in the riparian zone of the rivers in Western Ghats, Maharashtra enduring the standing water of floods. Though there is significant distraction of the river ecosystem, channel and riparian biotic features are resilient to these natural events. They possess the quality of being in the dynamic equilibrium as a biotic community.

In modern times, man-made interventions to the riverine ecosystems are overpowering and are clearly seen as seriously interfering in the natural functioning of these rivers. This means there is a need for active management, which would not be required if man-induced disturbances were minimized in the first place. An overview of these disturbances and corresponding effects is in order before we come to the specific subject of Urban Riverfront Management.

5.2 Man-made Disturbances

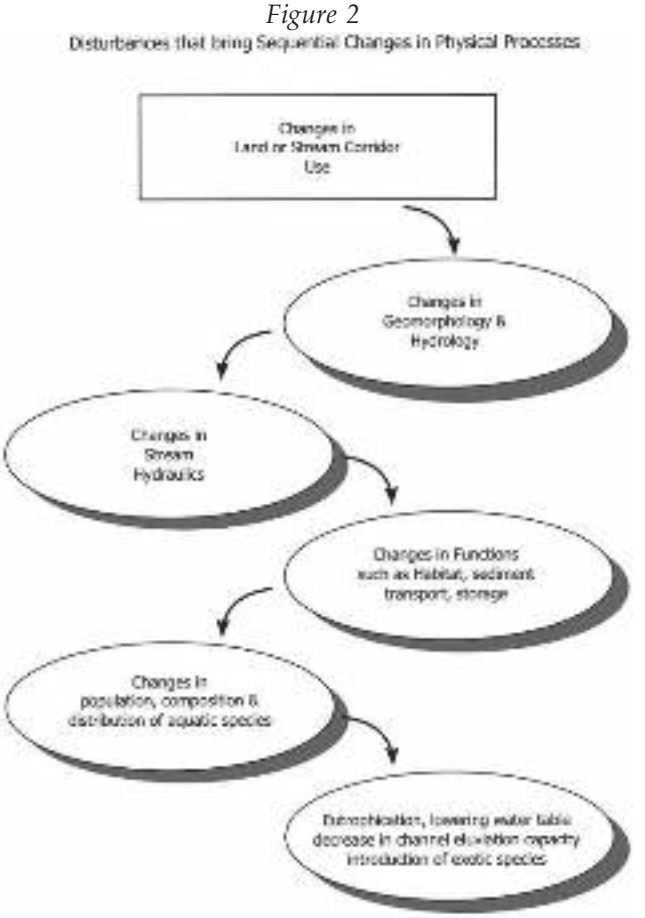
Today's man-made disturbances have a very large scale. Man has manipulated the river systems for a wide variety of purposes. Modern human society is banking upon water resources for economic and industrial development. The water demand for industry, commercial agriculture and domestic use in big cities has increased tremendously. This has resulted in building of dams, and creation of big reservoirs to provide water through canals for these purposes. Almost all the rivers are now altered by man. The words of HBN Hynes(1998) are very relevant : "Human activities have profoundly affected rivers and streams in all parts of the world, to such an extent that it is now extremely difficult to find any stream which has not been in some way altered and probably quite impossible to find any such river". The modern system of water distribution not only contributes to changes in dynamic equilibrium of rivers but has completely devastated the natural drainage network of rivers.

Let us see how the interventions of construction of dams and changes in the land-use in the catchment area of the rivers affect river ecosystem. The changes are sequential and have a multiplier effect. Cumulative effects of these activities result in changes in the structure and functioning of the river ecosystem. The effects include changes in the flow regime, loss of habitat for fish and other aquatic flora and fauna, degradation of water quality, and decreased aesthetic value. Rivers no more carry potable water. The spread of exotic species of aquatic plants have hampered functioning of the river ecosystem. The usual sequence of changes is shown in Figure 2.

5.2.1 Effects of dams, channelization and flow diversion on river channel geomorphology

A major change takes place in river flow and discharge once a dam is built across the river. The river water is stored behind the wall. The river flow is then completely controlled by the new water supply and irrigation system. The river flows become irregular, sometimes very low discharges, or even dry

Figure 2



channel conditions. The water released in the river changes according to the demand for water by agriculture, industry and cities. This erratic nature of river flow affects hydrology and hydraulics of the river. The rainfall-runoff relation and channel's adjustment to these natural events is lost. Thus the velocity of the river flow, the character of the sediment that it carries changes significantly. The sediments coming from the upper catchment area are now deposited in the reservoir created by dam. Thus the river flow below the dam contains less sediment.

The current literature provides abundance of figures concerning the percentage of fine sediment which becomes trapped within the reservoir. Figures stated are commonly over 95 percent and have reported to be as high as 99 percent. References below from a literature survey are discussed ahead (Childs, 2010)(Leopold and Wolman, 1994; Butting and Shaw, 1973). "While flow released from the dam which has been termed as 'clear water' (Park, 1997; Kondolf, 1997; Brierley and Fryers, 2005) has excess energy due to transporting less sediment than it is capable of. Thus the river gains sediment by eroding channel bed and bank." (Petts, 1984; Annandale, 1987; Rosgen, 1996; Kondolf, 1997). All the geomorphic and hydrological studies show that the balance between erosion and deposition is lost because of hydrological changes caused by dam. This results in loss of valuable habitats such as sand bars, gravel beds and riffle and pool. The stream channel becomes incised. The stream incision may lead to lowering of local water table. The channelization and diversion of water also affect channel morphology. The lack of flood events can result in channel aggradation, the narrowing and infilling of secondary channels.

5.2.2 Effects of geomorphic changes in the river channel on biotic community

The rivers and streams are a continuum. It is a passage which joins distant areas. Therefore it acts like a highway for movement of flora and fauna. In case of plants seed dispersal takes place along the river corridor, and many aquatic organisms, especially fish, migrate upstream for spawning. The construction of dam obstructs the movement of resident and migratory fauna. This in turn affects the food chain associated with stream functions. Alteration of water quality affects biotic community in the river. Constant temperatures in the reservoir may not be suitable for species dependent on temperature variation for reproduction and maturation. Water released from the reservoir into the stream has low dissolved oxygen. It is also relatively cooler, due to which native species of fish may not adapt. Sediments coming from the higher parts of the watershed settle in the reservoir, however attached to this suspended sediment is organic material which provides vital nutrients for downstream food web. Thus the downstream food web is deficient in vital nutrient supply. (Refer to Figure No. 1) Sequential changes in channel bed habitat were observed after major forest fire by Barry Hecht (1982). According to his observations, massive fill of sediment temporarily buries most of the limited habitats with finer material, largely sand. This hampered spawning activity of fish (Hecht, 1982). The effects of channelization and diversion of water are significant. The channelization increases stream velocity causing stream bed erosion. It reduces habitat diversity. The riffle-pool complexes[1] are needed at different times in the life cycle of certain aquatic organisms. These riffle-pool complexes are destroyed by channelization. The process of channelization removes obstacle if any in the channel. The large woody debris which supports aquatic macro invertebrates is removed.

In September 1981, California State Universities conducted conference on "California Riparian System, Ecology, Conservation, and Productive Management". The research papers covered various aspects of the riparian system. The paper "The importance of Riparian systems to amphibians and reptiles" was presented by J. M. Brode and Burry (1981) in this conference. Paper elaborates activities which affect riparian system adversely have their greatest effects on amphibians and reptiles. According to Knight(1981) amphibians and reptiles form a structural diversity of riparian system.

5.2.3 Effects of changes in land-use

Commercial agriculture is replacing traditional agriculture with the availability of canal irrigation. Change in the type of crop and greater area under agriculture results in greater soil erosion. This type of agriculture results in chemically defined disturbances to the river ecosystem. Pesticides and fertilizers used in agriculture leach out in the river water with surface

1. Pools are formed in a meandering stream on the outside of the bend due to scouring of the bed by higher velocity flow and deposition (riffle) is formed on the inner side of the bend

runoff. Agricultural chemicals attached to sediments increase soil salinity.

Another significant change in land use is urbanization. Cities are growing at a rapid pace. As far as rivers are concerned, cities change rivers through addition of sewage water to the adjacent river in very large quantities. The fresh water component in such rivers is totally altered. River water utilization for fishing, bathing, washing, etc. is not possible. In many cases rivers become dumping areas. Municipal waste contaminates river water. Activities such as mining add acids and heavy metals to the river course. All the above mentioned activities have potential to disturb natural chemical cycles in the stream and thus degrade water quality. Widespread logging operations and road building severely alter soil moisture, soil nutrients, soil temperature, and subsoil water movement that are critical for persistence of the biotic community.

The scale of disturbances presently is very high. It results in irreparable destruction of the river ecosystems. The natural riverine ecosystem provide resources and services to man. Resources include water, fisheries, aquatic plants etc. and services include recharging ground water, distribution of soil in the landscape, amelioration of local climate, navigation and aesthetics, etc. All these attributes are valuable and make the river ecosystem self-sustaining. The low cost of maintenance and availability of the resources to all sections of the society is the beauty of this natural system.

The present situation of the rivers in India appears very pathetic. Government of India had to set up a pollution abatement program for rivers in India. As stated below in WHO water sanitation report: "It started in 1985 with Ganga Action Plan (GAP) and generally extended to other polluted rivers through National River Conservation Plan (NRCP). The current programs covered under NRCP include works in 172 towns along polluted stretches of various rivers spread over 20 states. The UNEP (R Helmer & I Hespunhol, 1977) guide to the use of water quality management principles document says, "In the recent past, due to rapid progress in communications and commerce along the river Ganga, the river is no longer only a source of water but is also channel, receiving and transporting urban wastes away from the towns." This clearly calls for the rethinking of river management. However these programs are limited to river water pollution abatement. Revival of natural river ecosystem receives scant to no attention. Restoring river ecosystems contributes to a much greater extent to a healthier environment and improves conditions for ecosystem as well as human society. While the main service of the river ecosystem is providing clean water, it also supports activities such as fishing, boating and swimming. Other possibilities of creating multiple-use facilities such as parks, trails, cultural attractions like historic 'Ghats' built along the river increase river value in both aesthetic and commercial sense. Historical identity gives character to the river corridor. For example the town of Wai along the river Krishna is identified by a series of beautiful Ghats and temples, and the famous Krishna river festival is unique in its kind.

As we have seen the modern water distribution system of dams and canals and other man made disturbances have disrupted the natural ecosystem of rivers from source regions to the river mouth. Thus rivers are no more functioning as an ecosystem. As a result we are losing their natural value and also diminishing their economic function. For the revival of rivers comprehensive policy changes at the national level are urgently needed. However the scope of the present article being limited to ecologically sound riverfront management, let us now assess some of the ways in which urban river fronts could yet be managed to improve its health for urban dwellers and river organisms and ecosystem.

The new concept of improving urban riverfront areas is participation in planning and development by various stakeholders, government administrators, NGOs, citizens at large, and industry and commerce. The integration of natural values as well as facilitating commercial activity and providing amenities to citizens is essential. There are many examples of such kind of management in USA, European countries and even Asian countries. Malaysia is now focusing on mixed-use development and recreation for riverfront management. Let us see and review the early effort of ecologically sound riverfront planning of Mula-Mutha river of Pune city by The Ecological Society.

6 Case Study of Conceptual design for Mula-Mutha Riverfront management

In 1983 the concept of ecological planning was in infancy even abroad and in India difficult to accept for citizens and government authorities. The early effort by the Ecological Society to develop an eco-development plan for riverfronts of Pune city was thus highly unique. Documented as "The Survey of the Rivers in Pune City Based on Ecological Factors, in order to prepare an Eco-development Plan to Improve the Riverfronts of Pune" (Ecological Society, 1983),

this eco-development plan takes into account physical characteristics of the Mula-Mutha channel and its basin, the water quality, aquatic and riparian flora and fauna. The relation between the flora, fauna and the habitat quality was examined to understand ecology. The survey included observations about actual use of river by the citizens. The ecological observations were used as indices while suggesting a management and development plan.

6.1 Highlights of the 1983 Survey

Physical Character

The detailed survey describes various stretches of the river between Vitthalwadi and Bund garden. The habitat diversity was identified.

Water Quality

The water samples were analyzed. The results of the analyzed water samples showed very high bacteriological pollution : at Garaware bridge 2.5 x 10^6 per 100ml, while below Shivaji Bridge and Bund garden area 3.5x10^6. This indicated that the water flow of Mula-Mutha was mostly sewer water. Water was not of the quality of washing clothes and bathing.

Flora

The vegetation survey was carried out according to habitats. Aquatic habitats like partly submerged, marshy places, plants growing along the drains and effluents, plants from dry places, plants growing in rock crevices, and bank vegetation were surveyed. The count came to 156 species. This is a significant reduction in species number compared to Dr. V.D. Vartak's survey of 1954-55, which recorded 400 species. Presence of invasive species like 'Eichornia', popularly known as water hyacinth, was not recorded in the 1954-55 survey. The 1983 survey indicates higher content of fecal matter and deterioration of water quality.

Fauna

The faunal survey was done in great detail. Ranging from small forms of insects like water bugs, mollusks, beetles, etc. to various types of fish and birds. The habitat quality was assessed by observing biodiversity and ecology. To assess the water quality from wildlife perspective and general status of the river ecosystem, bird distribution of certain indicator species were used as an index. The distribution of egrets, stilts, grebes and gull-billed terns showed that they were numerous at places where streams loaded with fecal matter flow into the river.

Human Activities

Human activities were observed from two perspectives: a) activities of citizens which contribute to maintenance of river ecosystem and b) destruction of the river environment. The services provided by the river to citizens were observed. These observations show :

- River no more provides drinking water.
- Citizens are washing clothes, cattle, vehicles in the polluted water.
- River is no longer providing remunerative fishing.
- Residential buildings have encroached upon open spaces on the river bank. No room is left for structural design of the river bank.
- Uncontrolled activities in the proposed green zone.

Based on these observations an ecologically sound river front development plan was proposed. The plan was developed taking into account feasibility of the suggested action.

Plan highlights

1. Restoration of habitats along both the channel bed and bank were suggested. The details of the type of action and sites were given. For example, preservation of rocky and marshy places near Vittalwadi or deepening of channel at the confluence of Mula and Mutha rivers.
2. For cleaning of sewage water a new concept of detention basins was suggested. In these basins sediment would settle and water will be partly free of fecal matter. This is a low cost solution. The detention basins can have multiple uses. They can store flood water and then release during dry summer season. They act as wetlands with all its associated advantages. The wetland will increase habitat diversity of the river ecosystem and environmental value. The purified water could also be used for municipal and private gardens along the river front.
3. How the use of the river by citizens is to be regulated with very little disturbance to the river system while still allowing citizens to benefit from the river was taken into account. The proper places for various activities such as clothes, cattle washing etc. were chosen.
4. Tree plantations on fallow private lands which form riparian zone of the river was suggested. Similarly, to develop parks and trails through the natural parks, taking over of private lands by municipal authorities was suggested. Some open

spaces were suggested to have playgrounds which are essential as open space for playing is becoming scarce.

Thus, the riverfront plan included abatement of pollution at low cost, facilities to citizens, preservation of natural character, functioning of the river, and beautification of the river. However, this plan didn't include any commercial activity along the riverfront.

Several favorable circumstances existed in 1983 for the proposed ecologically sound river front plan.

a. The river channel was more or less naturally flowing and there were minimum interventions.

b. Within the river basin and over the bank many open spaces were available. At places even riparian vegetation existed. The settlements or commercial buildings were not touching the river basin.

c. The scale of sewage water in the river was relatively less as there was no development of new residential areas in the western part of the city. As the city is growing, proportion of sewage water coming in the river is increasing significantly.

The present situation is far more complex and worse.

a. There is pressure on the open spaces; most of the open spaces along the river are now built and high rise buildings are coming up. Thus there is no space left for riparian vegetation.

b. Within the river basin there are many changes. The naturally flowing river is channelized. Thus, it has lost its ecosystem value.

c. The space created along the channelized flow is utilized for commercial purposes like letting it out for circus since all other open spaces in the city have been lost to construction. Roads have been built on both the right and left of the river channel within the basin to avoid traffic congestion. Thus, the river corridor which used to bring in fresh air from the west is now distributing polluted air in the city.

d. Bank and riparian vegetation is completely lost.

With such a situation, to develop an eco-sensitive plan is a big challenge. However, the new concept of integrated management may be possible. There are very few open spaces along the river Mula-Mutha. The corridor of open space along the river, below the 'Bund Garden Bridge' exists. This place was proposed for the Mula-Mutha bird sanctuary. If revived, it will provide a facility for citizens to experience nature. Similarly small pockets of plantation in the riparian zone, with indigenous trees can be created at various places. E.g. near the Vittalwadi temple. A strong will on part of citizens, efforts by NGO's and active groups of citizens can bring about a dramatic shift in the situation. The thoughts of Sri Prakash Gole about urban design paradigm shift are appropriate to cite here. "Design needs to shift from a paradigm of transforming nature to one of transforming society by improving life quality and relationships between all living things and built environment" Gole, (2008).

7 Challenges to plan Integrated Riverfront Management in India

How is such a paradigm shift to be achieved? There are many difficulties: How to change political, administrative mind-set/ and view towards such planning? As the open spaces are very valuable to commercial interests in the urban areas, there is a conflict between commercial interests and the need for space for natural elements and processes as prescribed by ecologically sensitive planning. It is hard to bring together stakeholders, NGOs, administrators and funding agencies. It is challenging to make citizens aware of the pathetic situation of the rivers and reasons behind it. Even if citizens are made aware, it is difficult to translate their interest into action. Similar difficulties and challenges were faced by the developed nations and various models for improving river fronts in urban areas have been developed in these nations. Let us now review some of them.

7.1 Models of Riverfront Development

It may surprise readers today to learn that the condition of rivers in the USA was around the 1940s very similar to the conditions in India today. The following passage quoted from American Planning Association's planning advisory service report No. 518-519 says :

"In 1948, a water pollution law[2] was introduced in the USA that helped in executing basic treatment of raw sewage before dumping it into rivers. In the 1960s the environmental movement galvanized the masses. In 1972, landmark environmental legislation was passed by the US Congress; the Water Pollution Act and Clean Water Act. This Act created massive spending programs to construct wastewater treatment facilities and reduce the volumes of raw sewage flowing into the nation's waters. The EPA estimates that since the passage of the Clean Water Act more than $1 trillion has been spent to upgrade and expand

2. Federal Water Pollution Control Act of 1948

wastewater treatment facilities (U.S. EPA 2001c). Industry and other municipal dischargers were required to clean up their effluent and obtain permits for the first time. These efforts have led to enormous improvements in water quality. Previously, industrial pollution, sewage, and decomposing algae fed by the waste had turned many urban rivers into stomach-turning cesspools. Few people were interested in standing near these rivers, much less dining or enjoying an open-air concert on their banks. The cleaner urban rivers that emerged by the 1980s were not just aesthetically appealing; they were healthier and thus able to sustain a wider diversity of fish, birds, and other wildlife. These improvements drew the public to the water's edge to walk, bike, boat, fish, and observe wildlife. As people returned to the river, they expressed a stronger interest in protecting and restoring natural areas and wildlife habitat" Otto, McCormik, & Leccese, (2004).

The renewed attention to waterfronts in the 1970s coincided with a growing interest in historic preservation and with efforts to counteract suburban flight by reviving the urban core. These early urban riverfront initiatives thus sparked a redevelopment trend that accelerated in the late 1970s and boomed in the 1980s and 1990s. More recently a desire for more park space and greenways as well as growing appreciation for "green infrastructure" benefits has led further initiatives in riverfront redevelopment.

The early efforts to create example of riverfront development were from Baltimore, Boston and Toronto (Canada). These cities are often cited as early leaders in this trend. Baltimore's highly successful Inner Harbor Redevelopment is a model that has been studied and copied throughout the world (Otto, McCormik, & Leccese, 2004).).

The concept of riverfront development include: A place that contributes to the quality of life in all of its aspects-economic, social and cultural. In riverfront development the following aspects are included, environmental, historic, cultural, recreational, working etc. However the main objective is to make degraded river ecosystems functional. The river bank space is mixed-use. The mixed-use includes mix of retail, housing, offices, restaurants, open space etc. It is a dynamic space containing various activities blended to complement each other.

The example of Guadalupe River is a typical one (Texas Government, 2014). The Guadalupe River has a long history of winter flooding that has repeatedly damaged adjacent homes and businesses, in San Jose, California. The flood protection, coupled with the community's desire for open space, resulted into Guadalupe River Park. This was developed by the city of San Jose in conjunction with a federal flood control project. It is a three mile long stretch of park along the river. The project provides recreational amenities to the local community, and an ecologically sound system of flood control and habitat restoration. While protecting the ecological integrity of the river, the system will have the capacity to divert significant amount of flood water to an existing floodplain. Extensive mitigation plantation of indigenous species is part of the project. An extensive system of recreational trails extends and links neighborhoods. Play grounds, picnic areas make the park a center of active urban life. Integrated into plazas along the trails are interpretation centers on history, ecology, and hydrology of the river to inform and educate the citizens that use the river trails for walking, bicycling, jogging and other recreational activities.

This is a good example of integration of mix-use planning. The concept of riverfront development is expanding all over the world. There are examples from Europe as well as Asia. The Vidin city in Bulgaria decided to improve riverfront of the Danube River. The conceptual design was first created in collaboration with the city of West Carrollton, Ohio State, USA. Under the Bulgarian Technical Program, the conceptual design provided a development strategy for next 5 to 10 years. The project adopted a systematic approach to solve problems. The team visited USA to see various waterfront parks which gave them a broad picture of Park development in USA (Development of a Conceptual Design for Vidin Riverfront Park; ICMA 2002).

Another example is from Malaysia. In Malaysia the trend of riverfront development is popular, and many cities have riverfront development. The riverfront development goals and guidelines are monitored by Malaysian Government and its effectiveness was studied by Tun Hussein Onn University students. According to the study, the implementation of the riverfront projects is driven more by investment needs than by community and environmental needs. Most of the developers were familiar with the guidelines for riverfront development concept proposed by the Malaysian Department of Drainage and Irrigation. The majority did not support the guidelines for many reasons including its ineffectiveness in controlling environmental problems. (Azlina Binti; Md Yasin).

All these examples show mixed results and hard efforts needed to complete the project. There is one example from India. Government of Gujarat has an experimental riverfront development project of Sabarmati. This project was initiated by Ahmedabad

Municipal Corporation, to develop the Sabarmati riverfront in the city of Ahmedabad. The project is undertaken with the prime objective of environmental improvement and provision of housing for the poor who live in life threatening conditions along the river bed. It is being developed by Sabarmati Riverfront Department Corporation Ltd. (SRFDCL), funded by central Government of India, established in 1997. A seed capital of Rs. 10 million was given to SRFDCL. The main problem in the riverfront development was of hutments in the river channel. The rehabilitation was the main issue. The project has been planned as a self- financing project. The SRFDCL decided to utilize and sell the riverfront space to raise funds. 10 percent of the space was reserved for rehabilitation of slum dwellers, 21 percent for residential and commercial purposes and rest for promenades, like informal markets, gardens and to extend road network. One curious fact is that the floor space index (FSI) has been raised up to five and this may lead to higher density of built up area along the river front. To develop the riverfront SRFDCL had also uniformly narrowed the channel to 275 meters.

Looking at the project report it appears that the prime objective of environmental improvement has been sidelined. There is no mention of any ecological improvement, or habitat improvement, except development of gardens in the project report. Unless there is determination to restore river system, such riverfront projects would continue to focus only on the built environment. The examples of American, European and Asian riverfront development show a similar view, with some exceptions like the Guadalupe River Project. The river bank spaces are utilized mostly for mixed-use. The development of parks along the river is not a revival of the riparian system.

In order to overcome these problems, ecologically sound riverfront development principles must be strictly followed. In addition, to execute the riverfront development project formation of a systematic group is essential. It is now high time for the wave of ecologically-sensitive riverfront revitalization to come in India. One such effort which has recently been initiated is the revitalization of Mula-Mutha River in Pune called "Jeevit Nadi" (Living River). One hopes many more such groups sprout in other cities around India.

We attempt to state the basic principles of ecologically-sensitive riverfront development that we hope will prove helpful for such groups working in riverfront development at the design stage. These principles are taken from American Planning Advisory Service Report No. 518-519. (Otto, McCormik, & Leccese, 2004).

These basic principles are developed with a view that planners can achieve much greater environmental as well as social and economic success if urban riverfronts are designed with ecological principles in mind.

The General Principles of Ecologically Sound Riverfront development include :

- Ecological goals and economic development goals are mutually beneficial
- Protect and restore natural river features and functions
- Regenerate the riverfront as a natural realm
- Compromises are necessary to achieve multiple objectives
- Make the process of planning and designing riverfronts broadly participatory and transparent

These principles are self-explanatory. To actually plan a design, the designing group has to take into account certain planning principles. The following planning principles should be integrated into master plans and implemented through zoning and building codes, engineering standards and site plan and design.

The Planning Principles

- Demonstrate characteristics of city's unique relationship to the river in the design
- Plan for a scale larger than the riverfront
- Minimize new floodplain development
- Explore if existing riverfront development can be moved to create more space for the river to function through use of buffer zones
- Provide the public access, connections and recreational uses
- Calibration of the river's environmental and cultural history and education

All the above principles are guidelines and provide methodology for planning the riverfront design. In addition riverfront planning must reconcile development and recreation with environmental designs and strategies. Every riverfront requires a unique combination of environmental strategies. The strategies must take into account the following characteristics of the specific river corridor :

The intensity of current development: Intensity of development can be classified according to percentage of hard surfaces like roads. Ultra urban = 80 to 100 percent, urban= 40 to 79 percent, suburban= 10 to 39 percent.

Infrastructure: Planners must be sure to identify all infrastructure features, like network of cables or drainage pipes. Planners must identify infrastructure such as network of roads, sewer pipes and electrical cables and incorporate them into riverfront plan.

Watershed Planning: The health and the vitality of a river cannot be improved without the comprehensive treatment of storm-water and other erosion and pollution sources across the watershed. This also calls for understanding the upstream situation and explore how one can tackle the catchment and command areas of any upstream dams existing at the time of planning.

Geometry and constraints of riverfront: Planning purpose and management should take into account community's views, planning solutions appropriate to unique conditions of the riverfront. River size and its geometry and river classification is also important.

Getting Organized

To start the process of planning, interested groups must get organized. The US Federal Interagency Stream Restoration Working Group has suggested certain strategies for effective organization, which can be paraphrased as follows :

- Setting geographical boundaries
- Forming an advisory group
- Establishing technical teams
- Identifying funding sources
- Establishing points of contact
- Facilitating involvement and information sharing among participants
- Documenting the process

The complex nature of stream corridor development and restoration requires that any such initiative be approached from an interdisciplinary perspective. Specialists from a variety of disciplines can provide important input for this effort. The following list of specialists could prove important :

Forrester	Soil Scientist
Botanist	Ecologist
Microbiologist	Landscape architect
Fish and Wildlife biologist	Engineer
Economist	Geomorphologist
Real estate experts	Legal consultant
Sociologist	Hydrologist

8 Conclusion

The article hopes to provide necessary minimal background for policy makers who are interested in creating livable urban environment, where riverfronts are possibly the most important yet the most neglected areas. The paper also provides some cases where riverfront management has been attempted with mixed success.

To ensure that the future of our cities is far better than its recent past, there is an urgent need to improve both ecological and human health in urban areas. One way to realize this goal is to restore our river ecosystems at large and more specifically urban river fronts.

The author hopes that these management guidelines will provide a good starting point for the interested citizen or a policy-maker to lean towards the ecological restoration of urban river fronts for the benefit of the society.

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Lessons from Velas : Assessment of Eco-tourism as a Model for Conservation in Konkan

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Abstract

The potential of ecotourism in the economic and social development and its potential to conserve and nurture natural resources of the region, have been validated in many programs in the world. While the government of India has lately been using this term profusely in its Incredible India campaigns, internal acceptance by the state tourism boards towards it seems to be weak. This paper studies the Velas model of ecotourism and compares it with that in Murud. Both the places being on the Konkan coast in Maharashtra, offer a similar situation for study. Using observation and interviews, the two villages were studied and compared. The paper analyses the reasons of success at Velas and offers recommendations for Murud.

Keywords : *ecotourism, konkan, conservation, sustainability, Indian coastal ecosystems*

1 Introduction

Maharashtra is blessed with a coastline of about 700 km. Sandwiched between the Arabian Sea on the East and the Sahyadri mountain range on the West, Konkan, as it is called, is a strip averaging 70 km in width. This region produces rice, coconuts, cashew nuts, and betel nuts and the sea provides a variety of fish. However, it is best known for the Alphanso mangoes which grow here. Konkan has rich deposits of bauxite and iron ore and the ports facilitate its transport to other parts of the world. Over the last decade, Konkan has grown as a tourist attraction and has witnessed uncontrolled development. Pristine beaches now offer 'second homes', agricultural fields have given way to 'farm house plots' and forested hills are being cleared for sea view bungalows. The economic prosperity of Mumbai and Pune has fuelled an increasing demand for such properties. The commissioning of the Konkan railway in 1993 further opened up trade and tourism leading to rapid changes in land use. The railway line construction demanded tunnels, *ghats* and viaducts which were cut through forests and across rivers in this difficult and fragile region. In the entire length of the Konkan railway, 59 stations, 179 major bridges and 1,819 minor bridges have changed the landscape dramatically (Garg, Naswa, & Shukla, 2013). Opening new sea ports has made way for mining, which require removal of forest cover, building roads and increased transport activities, all of which has had serious effects on the environment (Gadgil, 2010).

Revenues from tourism continue to grow and form a significant portion of incomes of the Konkan residents. Even as its environmental impacts become increasingly noticeable, little is being done at policy level to reduce the burden. The objective of this paper is to compare the impacts of standard tourism practices with those of the eco-tourism model followed in Velas village. For this purpose, two popular tourist destinations in Konkan were studied over a year. Murud, in Ratnagiri district and Velas in Raigad district were chosen for this study. Murud's popularity is on account of its beautiful beach, serene village atmosphere and proximity to Pune, while Velas's fame is due to the prolific visitors – the Olive Ridley turtles - who breed here.

2 Methodology

For an understanding of the land, its culture and the biodiversity in the early 1990s, a review of literature was undertaken. A book on Murud published in Marathi *Murud - Aithikasik ani Sanskritik*

(Ganu, 1958) documents the region, its people, their economic activities and social life during 1950s. This gave a snapshot of Murud and its people. Along with this, another publication proved invaluable. This was the path-breaking research conducted by Prakash Gole and his team in 1997, of the Konkan region. Sponsored by the World Wild Fund for Nature, India, the report carries detailed documentation on flora and fauna, identifies eco-sensitive areas and hot spots and studies the status of mangroves in Konkan. Gole proposes guidelines for conservation and management of biodiversity and for land use in this sensitive region. This report was later printed as a book (1998) and gives a colloquial interpretation of the survey. Extant literature on eco-tourism in other countries helped develop the primary research.

After the literature review and compiling the secondary data, two teams carried out detailed surveys in Murud and Velas for collection of primary data. The teams met resort owners, shopkeepers, school children, college youth and the village *Sarpanch*. Several resorts and home-stays were visited by the team. Tourist feedback registers were studied. Influential persons in each village were interviewed as well. Interviews with key village persons have been video recorded. Some interviews are voice recorded and the sampled resorts and villages have been extensively photographed.

3 About Konkan

The land

To the east of Konkan, the Western Ghats rise up to about 1200 meters and create a natural barrier to give it the highest rainfall in Maharashtra. The eastern face of Sahyadris, as they are known in Maharashtra, gives birth to some important rivers. The shorter west-flowing rivers drain into the Arabian Sea and bring rich biomass and soil from the Sahyadris. Their estuaries are highly productive ecosystems and a source of livelihood for many communities. Tracts of dense mangrove forests line many of the estuaries. A variety of coastal ecosystems, like salt marshes, mudflats, mangroves, wetlands, estuaries and bays are all seen in Konkan. They create habitats for a large variety of flora and fauna. Over centuries, local population has learned to use and manage the resources to their benefit due to which the narrow Konkan strip has been inhabited for thousands of years.

The People

The physical characteristics of the Konkan region have played a vital role in shaping the biodiversity of the land and consequently the livelihoods of the communities living there. Traders from afar have reached its shores, settled and mixed with local populations and this has shaped the cultural mélange evident today. Fishermen and sailing communities like the *Kolis, Gabits* and *Bhois* live on the coasts and have an intimate knowledge of the sea as they depend on it for their livelihood. The *Agris* were traditionally salt makers and tillers and today, they grow mangoes and cashew nuts. Some of them also own restaurants and resorts. The *Kunbis* are mainly agrarian and one of the most hard-working communities here. Their women work in the field and men are labourers. Very few own land and most *Kunbis* till on land owned by either Brahmins or other castes. The *Bhandaris* produce local alcoholic drinks like *tadi* and *madi* which is sold in the Mumbai and Pune markets. Of late, Bhandaris own hotels while others are engaged in trading with commercial centers like Mumbai. Among the *Brahmins*, the *Chitapavans* probably came here during the Peshwa supremacy. Most own land and are among the more educated in the region. The temple pujaris are *Brahmins* who also practice religious services which are in great demand here. The Muslims are traced back to the Arabs who landed on the coast line. At that time they built boats while today, they are mainly engaged in selling meat, bakery products, fishing supplies and as agents for land broking. The other communities include the *Marathas, Nahvis, Sonars* and *Christians*. Between them they speak a variety of dialects of Marathi, Konkani and Hindi and lend the rich cultural diversity to Konkan. The diversity in religions and castes and their preferred economic practices, has survived for over a hundred years. With the onslaught of tourists and the promise of increased incomes which they hold, the once diverse and sustainable economic practices are making way to meet the tourist demands. Due to this, many communities have been switching from their traditional sources of income to the lucrative tourism business.

The Biodiversity

The intertidal zone, the area between the highest high tide and lowest low tide, supports various forms of life. The width of the intertidal zone varies from a few meters to over 1 km. Bays and creeks are part of the intertidal zone. The dry sand beaches are mostly

covered with shrubs like Kevda (*Pandamus utilis)* and creepers like *Ipomea biloba*, while the sand provides shelter to various crabs like the ghost crabs, hermit crabs and fiddler crabs. Rocky beaches, on the other hand support various algae like the blue-green algae, green algae, sea lettuce or the ulva, and brown algae like Sargassum. Rocky beds trap sea water which creates habitats for sea urchins, sea cucumbers, and sea anemones.

Areas away from the coast are under cultivation. Government owned areas around streams, rivers and hills are wooded with a native tree cover. Many of these have medicinal and food value and are culturally embedded in the lives of different communities. However, few such areas are protected and are threatened by increasing economic activities. Roads, bridges, tunnels, industry, and expanding towns need space and the flora has to make way for it. Konkan has its share of *devrais* (literally sacred groves) or forest patches protected by social fencing – deeply rooted traditions which disallow cutting, gathering or removing anything from the *devrais*. This has helped preserve centuries-old forest patches which today serve as gene-banks. Most *devrais* are now relegated to a few acres and are shrinking rapidly (Figure 1). Additionally private forests are common in the Sahyadri-Konkan corridor as evident in the survey of WRCS (Kulkarni & Mehta, 2013). These are interspersed with reserved forest, agricultural land and habitations.

The mangrove forests could be the densest forests remaining in the Konkan region (Shindikar, 2009). Few species of flora have adapted to be salt-tolerant and these dominate the estuaries where tidal currents bring in marine water which mixes with fresh water. These are highly productive ecosystems and provide home and food to an enormous number of species.

Tourism in Konkan

The magnificence of the ocean, the diversity in landscape and the cultural concoction in Konkan have always attracted tourists. The numerous places of worship too draw visitors here. Consequently, tourism has, over the last few years, turned into a major source of income for residents. Coastal towns like Vengurla, Tarkarli, Ratnagiri, Ganpatipule, Guhaghar, Murud, Velas, Murud-Jangira, Alibag, Kihim are some of the popular destinations. The ones further inland – Sawantwadi, Amboli, Marleshwar, Pawankhind, Chiplun, Lote-Parshuram, Rajapur, Lanja, Dapoli, Pen and others too have witnessed increased tourism. Tourists create a demand for local agro- horticultural produce, homemade food products and industrially processed fruit products further contributing to the local economy. The economic potential has been a strong driver for the Maharashtra state government to allot INR 500 million budget towards improvement of rural tourism in Konkan (Pawar, A, 2013). The increasing tourist activities are greeted with haphazard. Villagers' homes are converted into tourist resorts. Once deserted beaches thrive with food stalls, parasailing and dolphin boating. Weekends are particularly busy as Mumbai and Pune residents flock to the beaches. In villages which rarely saw cars, traffic jams and parking problems are now common. Tourism has also triggered roads and construction activity impacting the land use.

Figure 1 : Kudavale Devrai near Dapoli

Plastic garbage stuck in mangrove roots

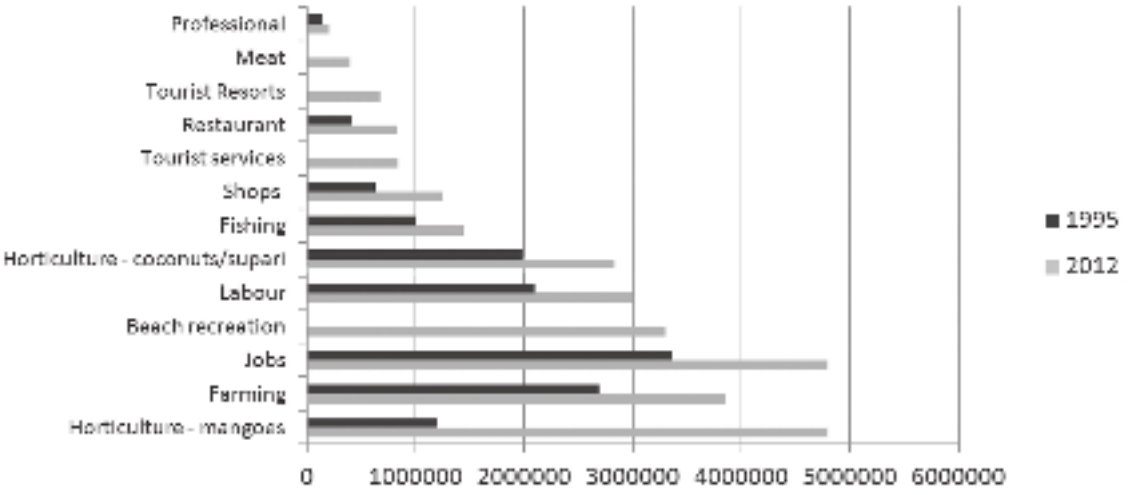
Tourism and Eco-tourism : the differences

Travel undertaken for the purpose of recreation or leisure is generally termed as tourism. Such tourists place a demand for services and products which may not be easily available or not usually consumed at the place of residence. On the other hand, eco-tourism is ecologically sustainable tourism with a primary focus on experiencing local, natural things for appreciation of history, geography or culture of the region. Weaver (2001) defines eco-tourism on three counts (a) natural and cultural attractions (b) Educational and learning experiences (c) Environmental, economic and socio-cultural sustainability. Eco-tourism requires understanding by and efforts of the buyers and sellers. In several countries, eco-tourism has been promoted by the government through awareness and education campaigns[1]. One of the debated points in eco-tourism is what scale is appropriate for this sector. Being an alternative to mass tourism, this is necessarily a much lower scale.

4. Murud – the journey from a sleepy village to a tourist attraction

Murud, in the 1990s was a typical coastal village with a population of a few thousand. As with most other coastal towns in Konkan, Murud has one main road running parallel to the coast. At the centre is the Durgadevi temple – the village deity. On both sides of this temple are the *wadis* or houses belonging to Brahmin families. The houses range from about half an acre to even a few acres. Each house has a small farm, plantations of coconuts, betelnuts and mangoes and an open well for fresh water. The principal economic activities of Murud were agriculture, horticulture and harvesting sea produce (Ganu, 1958). Graph 1 shows a comparison of economic activities in 1995 with that of 2012. The horizontal axis is an estimation of the revenue generated from the occupation. Three new economic activities are seen in 2012 – tourist resorts, tourist services and beach recreation. Mango farming has grown by 75% while restaurants and shops have grown by nearly 50%.

In 1995, and more so earlier, the diversity in occupations placed a more balanced demand on available resources since the activities served needs based on the economic conditions of the locals. In the graph of 2012, tourism related occupations increased significantly leading to a skew in the demand on resources. The more affluent tourists place demands unusual to the local markets but which yield higher incomes. As increasing number of tourists flock to Murud , tourism is now a primary source of income for many. On the village main road, over 30 resorts



Graph 1: Economic activities in Murud over last 17 years
Data Source : Calculated with assumptions and approximations from data collected in the study.

1. *http://www.ug.undp.org/content/uganda/en/home/ourwork/environmentandenergy/successstories/promoting-eco-tourism-to-fight-environmental-degradation/*
http://www.bmb.gov.ph/index.php?option=com_content&view=article&id=255

have come up and are a favorite haunt of visitors from Pune, Mumbai and even Nasik.

Economics of "Resort tourism" in Murud

The tourist season at Murud peaks between October/November (Diwali) and January. Besides the months of summer and heavy rain, most weekends too draw tourists to Murud. This offers a 150-day window for the resort owners to conduct their business. Rooms are priced between Rs. 900 to Rs. 1500 and the occupancy is nearly 50% in the 150 day season which translates to potential revenue of Rs. 75000 per room. A resort with 4 rooms would thus be capable of earning Rs. 300,000 per annum. This income exceeds the proceeds from sale of coconuts and betel nut from a 2 acre wadi and makes a compelling business proposition for the family. This is possible by making an investment in constructing rooms and purchasing requisite equipment. The operating costs in this business are low since there are no employees and cost of groceries is incrementally higher than what the resort-owner family consumes. Thus with a relatively small investment, the resort business offers assured incomes with a reasonable profitability. Consequently, Murud now has over 30 family-owned resorts with 2 to 8 rooms each. Some are registered with the MTDC and listed on their website. An affiliation with the MTDC improves visibility and helps get business. Additionally, there are 5 large resorts having 10 to 25 rooms each. This provides a wide choice for tourists with about 100 rooms at family-run resorts and about 75 rooms at large resorts, making Murud a highly competitive tourist attraction. The competition forces investments to gain a business advantage and this is evident in Murud. Table 1 lists the amenities offered in the smaller resorts and the large resorts.

Table 1 : Murud - amenities in resorts

	Amenities	Occurrence
1	Television	All resort rooms have a TV
2	Air conditioner	At least 10% of total rooms have ACs
3	Fans	All resort rooms have them. Without fans, it is very uncomfortable in summer
4	Tubes and decorative lights on campus	All resorts
5	Western style toilets (WC)	The larger resorts mostly have them and about 25% of all rooms
6	Refrigerators	All resorts have at least one
7	Chest freezers for cold drinks	At least 7 resorts

The large resorts have separate kitchens and serve liquor and non-vegetarian food. They employ migrant labour from Odisha and Bihar, who are preferred over the locals, due to their willingness to work for longer hours. These migrants are culturally distant from the locals and have no connection with the land. This takes away the potential of the larger resorts to generate local employment. The large resorts sell and promote bottled water and cold drinks which have high retailer margins. Packaged snack food is widely available for the same reason. The large resorts generate more garbage per tourist, as confirmed in the interviews with locals and the group encourages voluntary beach cleaning. The family-run resorts have no dedicated employees and offer either homemade food or do not offer meals.

The tourism is supported by several services rendered by families not in the resort business. These include boating, dolphin trips, car hire, local sightseeing, parasailing, beach buggy rides and others. *The Kunbhis, Bhandaris* and Muslims are involved in providing these services, which require even lower investments and no special skills. This income supplements the primary source for their families. With the influx of tourists, their demand for purchasing land has increased spawing another business – land broking. Many young males have taken up dealing in land as a full time occupation. With growing land prices, this is a lucrative business. Often, tourists are voracious shoppers and this has spawned several shops. The shops stock what is demanded by tourists - bottled water, snack food, beer and wine, cosmetics, Chinese toys and even diapers. These products have higher retail margins, unlike what is demanded by locals – milk, groceries and staples.

Environmental impacts of Resort tourism in Murud

Even as the economy improved, most locals agree that the rapid growth in tourism has not been beneficial to the village. In our survey, only 2 persons did not feel that there was any significant environmental impact due to tourism. The others were aware of environmental impacts. The findings are discussed in more detail below.

a. Changes in land use – The *wadis* have a dense population of trees and building resort rooms requires their removal. The trees felled are usually Betelnut

since sale of betelnuts is not highly profitable and trees like Suru (*Casurina equistifolia)*, Ein (*Terminalia elliptica*), Sag (*Techtona grandis*) since their wood fetches good price. To get an unobstructed sea view from resorts, some sand dunes are leveled and protective strand vegetation of Kewda (*Pandanus utilis*) removed. This has altered the water drainage in the area. Those living next to the beach said that from last few years the sandy beach line fluctuates dramatically. Outsiders are buying agricultural land and converting it into bungalows. Ornamental trees and manicured lawns adorn areas which were once under cultivation. Large portions of fallow rocky outcrops with low soil cover are converted into cashew nut plantations by drilling in the rock and filling soil brought from another area. Increased demand for the local *Chira* (soft red lateritic rock used in place of bricks) has fuelled large scale quarrying on these outcrops. Highly adapted endemic vegetation of the rocky outcrop ecosystems are destroyed in the bargain (Watve, 2013).

b. Loss of biodiversity in Murud – This is most visible on the Murud beach. Prakash Gole in his report (1997) had ranked Murud beach the topmost in terms of biodiversity. His report documents Star fish, White bellied sea eagles, dune vegetation, sea cucumbers and sea urchins in 1998. During our observations, starfish, sea cucumbers and sea urchins were not recorded. Marine algae like Ulva has become rare and dune vegetation and protective cover are reduced to almost nil. These are replaced by ornamental palms and Casuarinas. The present condition of this once diverse beach is brought about by excessive tourist activities like beach buggies, parasailing and boating. Food stalls and their garbage also contribute to it. As the diversity dwindled, sea eagles are rare visitors and prefer the richer beaches of Ladghar and Kolthare.

c. Increased mango farming – As tourists sample the coastal life, many wish to own a piece of Murud. Over the last 10 years, several wadis and small land parcels surrounding Murud have been bought by residents of Mumbai and Pune. For them, the land price is ridiculously inexpensive. Several of such owners have converted agricultural land into mango farms. Agriculture, based on monsoons is being replaced with mango plantations requiring water throughout the year.

d. Depletion of fresh water in wells of Murud – Resorts with bath tubs, showers and western toilets have high water consumption. It is common for visitors to have their cars washed in the resorts. Tourists from Mumbai and Pune are used to high per capita water consumption. These resorts impose a huge additional demand of fresh water on the local wells. In our survey, atleast 3 individuals have purchased small transport vehicles fitted with Plastic water tanks. They buy water from wells in Murud and sell it to the large resorts. Prior to the tourist boom, fresh water wells of Murud lasted well into May and almost upto rainfall. However, in our observations, most wells dried up by February.

e. Increased demand for energy– Resorts are energy guzzlers. Competition among them leads to enticing customers with luxuries like airconditioners, refrigerators and chest freezers for cold drinks. Bright lights decorate the resorts and pathways to the sea are well lit. This imposes high demand on energy. Uninterrupted power supply is brought about by generators and battery backed power supplies. High energy demands at resorts are paid for by the entire village going without power more often, since the supply network was not designed for the increased loads.

f. Garbage and sewage contamination – City tourists' capacity to generate garbage is multifold compared to local Murud citizens simply due to their high consumption habits. Snack foods, water bottles, cosmetics and disposable cutlery all are converted into garbage. Murud has had no village level waste management till now. Prior to the tourist influx, products which generate waste were hardly bought by locals and hence scarcely available in local shops. Villagers re-use most packaging in some way or the other and very little finds its way into landfills. However, the increased consumption capacity of the tourists has led to a monstrous challenge of waste for the locals. They have never separated garbage and have no idea of its potential to harm the environment. Stacks of garbage are dumped at the outskirts of Murud and burnt. Increased sewage generation has led to contamination with drinking water supplies. Our photographs documented the trash on the beach.

g. Demand for land by non-locals – On face value, this is perhaps a factor which has no role in environmental degradation. However, our study of Murud and surrounding region over the last 3 years has shown that increasing number of Mumbai and Pune residents are buying land here. They have no cultural or economic connection with the biodiversity. Most may not think twice before pulling down an old growth tree to construct a beach shack or obliterating a natural woodland to plant economically lucrative mango trees.

Undoubtedly, the economic fortune of Murud

residents has improved, but the costs are borne by its environment. As Murud's economic activities converge to meet tourist demands, overuse of local resources is apparent. Environmental impacts are hardly affecting the village life today, however, over time they will manifest itself in the economy. With every new season, the scale of tourism increases. As expounded by Jared Diamond (2000) an economy which grows by ignoring the long run impacts on the environment will eventually lead to a collapse. In the age of technology, it is not the civilizations that would collapse but environmental degradation would impose high costs of living there. Polluted sources of water, poor soil and shrinking forest resources have already increased the costs in Murud as confirmed by respondents. Moreover, several industrial inputs, hardly a feature of yesteryears, are required to improve living conditions.

5. The Eco-tourism of Velas

In contrast, Velas, a much smaller village than Murud, about 50 kilometers north of Murud, has undertaken eco-tourism. This village shot to fame when the nests of Olive Ridley turtles (*Lepidochelys olivacea*) were conserved and their importance highlighted to the locals by an NGO, Sahyadri Nisarg Mitra (Katdare & Mone, 2003). This group set up a conservation program for the dwindling number of turtles. Till 2011, over 680 nests had been protected by them (Katdare, 2012). From this turtle conservation program was born the Turtle Festival with the intention of increasing awareness of this species and linking conservancy with livelihood for the Velas residents who protect them. The Turtle Festival started in 2007 and continues every year till today, during the nesting season. The spectacular sight of hatchlings emerging from nests and crawling towards the sea draws tourists to this festival. The Velas residents offer home-stay arrangement for tourists.

Velas : Economy and people

This village is similar to Murud in many respects. The composition of the people, their religion and castes as well as their economic activities is comparable. This coastal village lies near the estuary of the Savitri River. A stream between the beach and the village offers a natural protection to the beach from the village. Cultivation and pastoral practices have been the dominant economic activities, since there are no industries – cottage or small around Velas. Mangoes, coconuts, cashew nuts and betel nuts comprise the horticultural produce while rice and

other seasonal grains are grown in fields. Whereas Murud has its own weekly market, Velas residents have to travel about 18 km to Mhapral, for the weekly market. Table 2 shows the 1962 demographic comparison of Murud and Velas.

	Aprox. Area in sq.km	Aprox. Population	No. of households
Murud	4.9	1835	383
Velas	8.3	3064	578

Table 2 : Comparison of Demographic data of 1962

Data Source: Gazetteer of the Ratnagiri District, 1962. Government of Maharashtra.

Although reliable data is not available, by 2014, the population and size of Murud has surpassed that of Velas. This was confirmed by residents. There are fundamental differences between the resort-tourism of Murud and the Home-Stay tourism of Velas. These are discussed below.

a. Resort tourism in Murud–versus–Home-stays in Velas

In Murud, the residents have built rooms for tourists away from their own homes. The rooms are built in the *wadi* as described earlier. In Velas, the model is home-stay. Tourists stay with the family, dine together and are treated as guests than tourists. This helps develop empathy and deeper understanding towards the locals themselves and also the turtles and the conservation program as practiced by the locals. Tourists get to live a real Konkani village life.

b. Recreation as the basis of tourism in Murud – versus– Conservation as the basis in Velas.

Murud's economy has moved towards a tourist based one, where tourists are encouraged to take up recreation and enjoyment that has little connection with the local natural environment. New shops, hotels, restaurants and services are designed to get a share of the tourists' wallet. This ignores key traditions, cultural practices and social fences, effectively opening the village to a city based culture. Velas, on the other hand builds tourists' interests around their family and village traditions. In these times of branded international resorts and undifferentiated luxury services, tourists experience Konkani village life. Those who experience this kind of tourism, spread the word to like minded people. This, the author believes, is the cornerstone of Velas tourism and the key reason why tourists here tend to be less interested in parasailing and sipping beer at sunsets. This survey leads the author to propose that Velas tourists spend much less but contribute much more to the conservation program and improving village and its residents.

To the author, the Velas village exhibited a deep conviction to common goals which required putting individual interests behind village interests. In his classic essay, Hardin (1968) warns that divergent individual goals based on individual aspirations will inevitably lead to ruins of village commons. This is evident in Murud and documented in the earlier section. On the other hand, collective decisions in the larger interests of the village in Velas led to the choice of ecotourism over usual tourism. This is in spite of the evidence that such tourism has a high potential for profits. Some of the key decisions that set apart the Velas tourism model are discussed below in detail.

a. Decision in favour of Home-stays over resorts – the author believes this to be very important basis for ecologically sensitive tourism. Even as constructing resort rooms like Murud has a higher income potential, this was not chosen to ensure the protection of the very reason why tourist come – the turtles. The home stays limit the number of tourists which is crucial in a conservation program. Moreover, the sensitivity of tourists towards conservation and environment can be improved through dialogues with the family.

b. Decision of not allowing construction on the beach – This too is a very mature agreement between the villagers. The highly sensitive turtles would in all probability stop nesting on a beach with tourist activity. This has been recorded in Murud, where the last turtle nest was seen sometime in 1994 (year unconfirmed). This decision too limits the revenue potential of Velas, for beach residence is valued more by tourists than one in the village. However, villagers have prioritized long-term conservation leading to lasting economic value over short-term financial gain.

c. Parity pricing in the home-stay business – All home-stays charge the same amount Rs 425 per person per night (as of September 2014). This reduces the competitive urge to offer 'more' to attract more business. This is another commendable agreement and one that is hardly seen in modern competitive economies, particularly tourist destinations. Through the various discussions with citizen of Velas, the author feels that this decision was driven by the awareness and education being spread by the Sahyadri Nisarg Mitra through their conservation efforts.

d. Generating funds through tourism for conservation efforts – The residents believe (especially the youth mentioned this in the interviews) that conservation can be economically sustainable by promoting managed tourism. This thinking has been brought about by the efforts of the NGO. Therefore, each home-stay owner voluntarily contributes 10% of the revenue towards the Kasav Mitra Mandal towards funding for the ongoing conservation efforts.

As expected, this sort of concurrence and aligned vision requires a strong leadership. Vishwas Katdare (known as *Bhau*) has played this role since the first nest conservation in 2003. Along with the Sahyadri Nisarg Mitra members, he helped the residents manage the sustainable eco-tourism program while increasing awareness and sensitivity of the villagers themselves. One resident, Mohan Upadhaye, has left his job in Mumbai and returned to Velas to manage this eco-tourism and conservancy program. Being one of the locals, he has quickly gained village approval and is an informal leader in the village conservation efforts.

6. Economics and Management of Velas Eco-tourism

The turtle breeding season starts in January and extends to April. In the 2014 season about 3000 visitors visited here and the 30 home-stays shared this business. Each of them made an average income of about Rs. 3000 per week. Products made by the self help groups and families themselves worth Rs. 50,000

were sold in the season. With no additional investments for the home-stays, this is a profitable supplementary income for the residents. A typical home-stay in Velas would just have extra beds for the guests. All other facilities are shared with the family – this includes dining area, toilet and bath facilities and the common areas. In our survey we did not find a single air conditioner in any of the home-stays.

The residents have formed committees to manage common issues. Home-stay and tourism policies and managing garbage are jointly decided. The committee manages a website which advertises the home-stays and tourists can book over phone, eliminating any agents. To make the facilities customer friendly, the home-stay families are trained in basic conversational English, hospitality etiquettes and garbage management. A handy list of commonly used English terms is displayed in the house. The family stocks bottled water for sale and the empty bottles are separated in the trash. Plastic bags are not encouraged and Upadhaye said that the self-help groups will soon offer newspaper bags to the local shops. Every home-stay has a register which helps maintain records of tourists. This system is meticulously maintained and has been appreciated by the police and Customs officials. Similarly, another register provides tourists' feedback to owners. This register is periodically reviewed for new ideas and suggestions. Such management has ensured that tourists get a uniform experience. As a result, positive testimonials are usually received from them. The beach is protected from overuse. Boating and parasailing is not allowed. In the daytime, tourists are offered nature trails with local experts. The trail follows forest walks and bird nests. This is a popular activity and is offered free. The village has formed teams of volunteers which periodically clean the beach. Junk trashed in nearby tourist beaches – Murud, Anjarle, Kelshi ends up in Velas beach and this is collected and segregated by the teams.

During this study, two local shopkeepers were interviewed in Velas. Remarkably, both were well aware of environmental issues. They had trash cans for plastic and segregated bottles, plastic and other things. The interview with Deepali Patil, the *Sarpanch* (village head), also yielded insights. She was well aware of the benefits of preserving the local biodiversity. She confirmed that the Turtle Festival was a success for villagers and provided additional income. She even commented that Velas might witness a return of villagers working in Mumbai and Pune, due to the Turtle Festival.

Environmental impacts of Eco-tourism in Velas

An analysis of environmental impacts at Murud is already done in an earlier section. For a comparison, these impacts were surveyed in Velas. A discussion follows:

a. Impacts a, b and c were not noted in Velas. The reason for this is no additional building activity and far lower number of tourists visiting Velas. However, growth in mango farming has not been correlated to tourism.

b. Impact d, e and f have been somewhat noticeable. The increasing mango prices offer a lucrative business proposition to land owners. Similarly, increased energy and water consumption is more due to changing habits of residents and less due to demands of tourists.

c. Impact f – garbage has increased noticeably and is attributed to increased tourist visits. The tourists consume bottled water and packaged snack foods far more than local residents. This was confirmed by the two shopkeepers. There is no garbage collector visiting Velas. The waste is neither burned nor used for landfills and hence the huge collection is a major problem. From this month, one garbage dealer will visit Velas but he has agreed to collect only rubber (chappals and slippers brought in by the tide) and PET bottles. Despite efforts of the villagers to get scrap dealers, there seems to be no way out at the moment,

Benefits of eco-tourism not noticed at Murud

a. Tourists are more sensitive to local traditions and environment. The Sarpanch and Mohan Upadhye both said that tourists help in conservation efforts. Children are particularly more diligent in forest trails and have helped in bird nest spotting and animal sightings. Helping residents in their daily chores is an enjoyable and educating activity. In the feedback, some tourists noted that their children gained much from the visit. A significant portion of visitors wished to make another visit. This study proposes that such tourism can offer an educating experience for tourists and one that has the potential to increase their environmental sensitivity.

b. Encourages local produce, traditions and culture. In Velas, tourists do not demand tub baths and air conditioners. Based on the feedback records, most enjoy dining and sleeping on mud floors. They want to participate in traditional activities and buy locally made stuff. The locals realize the importance their produce, traditions and culture holds for the tourists. Its preservation holds an economic

importance for them. In Velas, unnatural lighting and decoration is not required to attract attention. Tourists get to eat authentic Konkani cuisine that the family prepares. Traditional drinks like *Kokam and Ginger-lemon sarbats* are sampled. All this has ensured that Velas preserves its character inspite of the tourists. This survey discovered the opposite condition in Murud. To please tourists, resorts are built in a city-like architecture. Amenities and services offered in Murud are no different from those in cities. Menus on offer are the ever popular Chinese, Moghlai and Punjabi. Local drinks are replaced by bottled beverages. Televisions in rooms engage tourists more than connecting with nature. Other than 'being' in Murud, tourists hardly have any reason to believe they are away at a Konkani village.

c. Environment does not pay for tourist growth. The turtle conservation program has an economic value for the villagers. Similarly, the sustainable lifestyle followed by the residents for centuries now has a reason to continue. Contrary to Murud, tourism motivates them to preserve the environment and continue traditions which have worked for centuries. This, the author believes, is the real success that eco-tourism should be judged with.

7. The way ahead for Eco-tourism

Based on the detailed research conducted in 1997, Prakash Gole (1997) proposed a detailed framework for biodiversity conservation in the coastal region. The report recommended that besides the currently protected areas in Konkan, biosphere reserves (BR) and sites of Special Scientific Interest (SSI) be formed where tourism is not allowed. This author proposes extensions to Prakash Gole's eco-tourism recommendations, as discussed below.

a. No tourism permitted in any of the protected areas and proposed biosphere reserves. This should be a non-negotiable point.

b. In eco-sensitive areas suggested by the report, only tourism focused on conservation and based on 'Home-stays' be permitted. This restricts residents from making any constructions specifically for tourists – including rooms, toilet blocks, sit-outs and walkways. No trees are allowed to be removed for construction activities.

c. Preparation of a scientific management plan for private forests and promoting sustainable tourism in these areas as suggested by the WRCF report (Kulkarni & Mehta, 2013). Restrictions on construction activities and clearing of trees must be enforced in these few remaining private forests.

d. The much needed village-level biodiversity action plans (Deshmane, 2013) must be rolled out in all the districts. This aims to encourage decision making benefiting the village commons and is expected to support ecotourism.

e. A set of directive principles should be framed by the department of Tourism, Government of Maharashtra under which a village voluntary committee shall set the rules of Eco-tourism. The committee will, considering the local context and needs, prepare a voluntary code of conduct for the home-stay owners. The committee will decide the room pricing, joint promotion of all the home-stays, rules for conducting business and rules for managing garbage. This will ensure that local individuality is protected and local needs are addressed.

f. Eco-tourism is founded on collective agreement to a shared vision of managing the village 'commons' and hence based on restraint and individual sacrifice for the greater common good. The tourists are expected to comply with the rules. The rules and common goals of the village must be available for tourists for reading and agreeing with. Without communicating to them, they cannot be expected to behave in a desired manner.

g. Extending Prakash Gole's recommendation - Eco-tourism should be promoted through correct scientific information. The more the dissemination, the better is the likelihood of achieving desired outcomes. Use of social media and the internet offers maximum reach at low costs. This needs to be employed effectively. Involvement of village members, school children and tourists together could be the key to successful voluntary compliance. The villagers must experience a sense of pride and the feeling of doing something worthwhile for the environment, posterity and their long term well being.

8. Key Lessons for Murud

The key principles of ecotourism are validated eco-tourism seems to be working for Velas. Citizen of Murud can well adopt some of the tested methods of Velas, to suit the local conditions in here. Some of the key lessons suggested for Murud, by this study are :

(a) ***Tourism with restraints.*** A free market economy encourages consumption, as experienced in Murud today. This needs to be restrained by collective agreement. Setting common goals which are ecologically and economically sustainable and formulating rules and policies to reach them is the first step, one which Murud resort owners must take immediately. Since natural resources play an

important role in their lives and livelihoods, the common goal must be conservation of nature. Collective decisions should include tourist management, resource usage and waste management.

(b) ***Growing with the right customers.*** Choosing the right customers, the author feels, is the key to achieving sustainability goals. Having set the common goals for the village, tourists seeking beach activities and indulging in alcohol induced recreation should not be encouraged. Replacing the current tourist offering with cultural and nature based educative activities can drive the change. On face value, this recommendation may seem risky – would tourists buy these services at all? Current customers may be lost but they will, over time be replaced by ones who are interested in what Murud offers. The switch will certainly not be quick and simple; however, it will be beneficial in reducing the impact on Murud's natural environment, the main source of tourist attraction. Similar recommendation is given by Purva (2011) and one study in India suggests that a pattern can be seen in eco-tourists (Siva & Solomon, 2014).

(c) ***Harnessing the power of information to improve awareness.*** Disseminating information about the role of tourists in ecologically sensitive tourism. A common village website, booklets with resort owners and village signage have worked in Velas. Similarly, educating the resort owners is of paramount importance. NGOs can be helpful here, since advice emanating from village coworkers is often considered less worthy.

9. In conclusion

Many countries already have policies in existence for managing and promoting eco-tourism. New Zealand, notably, has a growing industry which supports eco-tourism and conserves natural resources of the small island country (Higham, Carr, & Gale, 2001). Similarly Sri Lanka, our neighbor, has led the turtle conservation movement since 1988 and eco-tourism has been funding it.

Growing tourism and the demand for 'second-homes' has already put the fragile remains of biodiversity of Konkan under severe pressure. While everyone agrees that the environment has paid a huge price, no one quite knows when the government will pull up its act to address the challenge. Each one of us and the generations to come are and will be affected by the changing Konkan landscape and its dwindling biodiversity. We have already experienced the fury of the Tsunami in absence of mangrove covers. Many such calamities, consequences of human interventions, may yet be lurking below the surface. Eco-tourism has the potential to benefit residents, tourists and the environment, provided each stakeholder makes some sacrifices. This, according to this author, seems to be the pragmatic way ahead, instead of waiting for the government to extend a 'command and control' regime.

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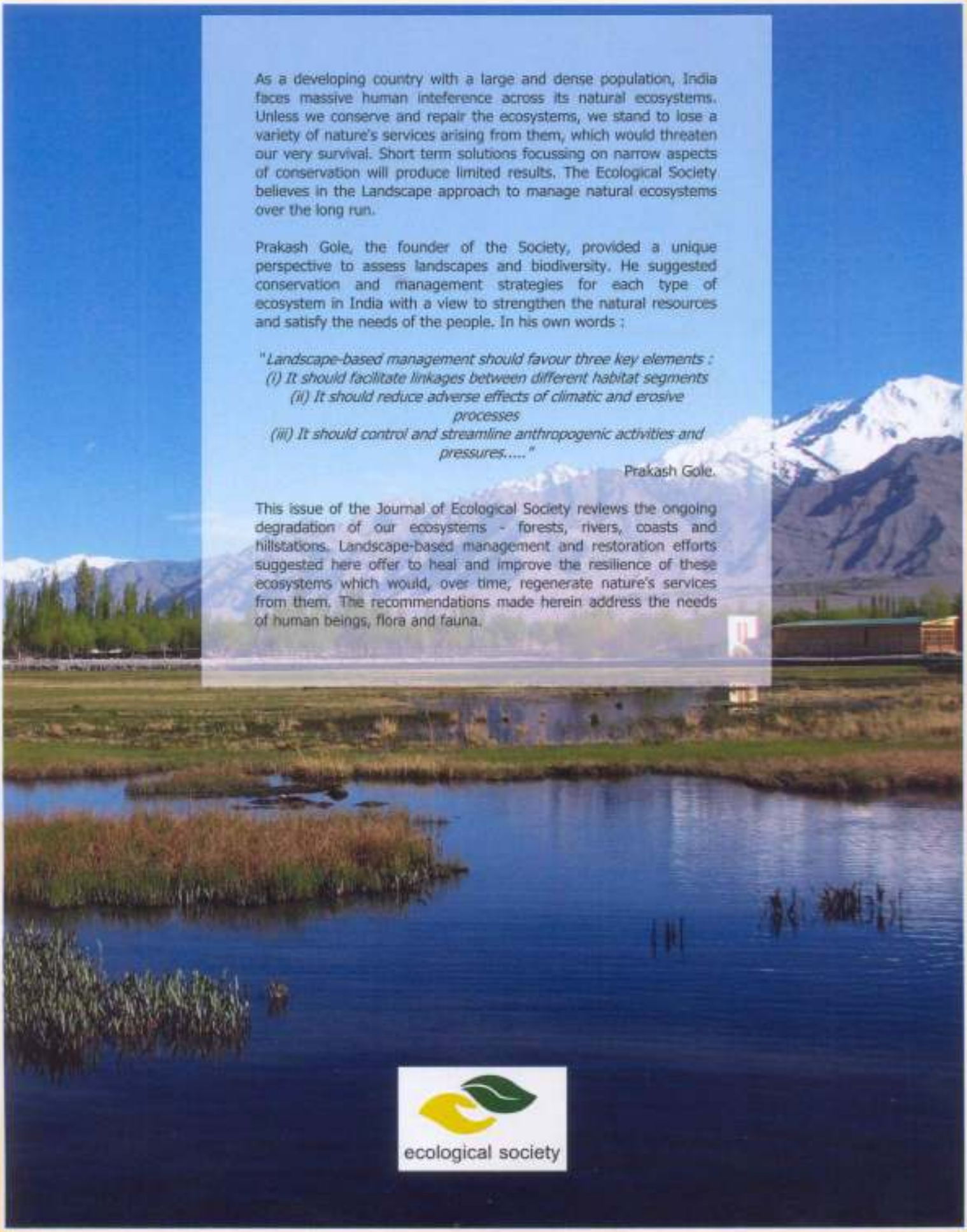
Admissions start from May



As a developing country with a large and dense population, India faces massive human inteference across its natural ecosystems. Unless we conserve and repair the ecosystems, we stand to lose a variety of nature's services arising from them, which would threaten our very survival. Short term solutions focussing on narrow aspects of conservation will produce limited results. The Ecological Society believes in the Landscape approach to manage natural ecosystems over the long run.

Prakash Gole, the founder of the Society, provided a unique perspective to assess landscapes and biodiversity. He suggested conservation and management strategies for each type of ecosystem in India with a view to strengthen the natural resources and satisfy the needs of the people. In his own words :

"Landscape-based management should favour three key elements :
(i) It should facilitate linkages between different habitat segments
(ii) It should reduce adverse effects of climatic and erosive processes
(iii) It should control and streamline anthropogenic activities and pressures....."

Prakash Gole.

This issue of the Journal of Ecological Society reviews the ongoing degradation of our ecosystems - forests, rivers, coasts and hillstations. Landscape-based management and restoration efforts suggested here offer to heal and improve the resilience of these ecosystems which would, over time, regenerate nature's services from them. The recommendations made herein address the needs of human beings, flora and fauna.

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