

Chapter-23

Managing Natural Resources with Economic, Ecological and Stewardship Functions

Natural resource management-Basic definition and concept

Some eleven thousand years back, agriculture took a birth in the lap of nature and at its beginning , it was a beautiful synergy between human techniques and rhythmic nature. This went on with rippling notes of traditional wisdom and bounties of nature. As an aftermath of Second World War and till then, unabated mechanization as well as chemicalisation have been transforming our agriculture into a huge source of pollution to the environment and nature. Right now, it takes a serious shape, detrimental, deleterious and destructive. Agriculture can't thrive and is of no meaning as well even if it is not being supported by the endowments of nature and cybernetics of nature. Natural resource management refers to the management of resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations (stewardship).

Classification of Natural Resources

The air we breathe and the light we get from the sun are available in unlimited quantity. But what are about coal, forest, and petroleum? The stock of these resources is limited. The quantity of these resources is depleting day by day.

Inexhaustible Resources

The resources which cannot be exhausted by human consumption and other uses are called inexhaustible resources. These include energy sources like solar radiation, wind power, water power (flowing streams) and tidal power, and substances like sand, clay, air, water in oceans, etc.

Exhaustible Resources

On the other hand, there are some resources, which are available in limited quantities and are going to be exhausted as a result of continuous use. These are called exhaustible resources. For example, the stock of coal in the earth is limited and one day there will be no more coal available for our use. Petroleum is another important exhaustible resource.

Renewable Resources

Some of the exhaustible resources are naturally regenerated after consumption and are known as renewable resources. e.g. The living beings (both animals and plants) reproduce and can thus, replace the dying or killed individuals. However, if the consumption of these resources exceeds the rate of regeneration they may also get totally exhausted. Some examples are fresh water, fertile soil, forest (yielding wood and other products), vegetation, wildlife, etc.

Non-renewable Resources

The resources, which cannot be replaced after the use, are known as non-renewable Resources. These include minerals (copper, iron etc.) fossil fuels (coal, oil etc.). Even the wildlife species (rare plants and animals) belong to this category.

Natural Resource management deals with managing the way in which people and natural landscapes interact. It brings together land

use planning, water management, biodiversity conservation, and the future sustainability of industries like agriculture, mining, tourism, fisheries and forestry. It recognizes that people and their livelihoods can rely on the health and productivity of our landscapes, and their actions as stewards of the land play a critical role in maintaining this health and productivity. Natural resource management specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources. Environmental management is also similar to natural resource management. In academic contexts, the sociology of natural resources is closely related to, but distinct from, natural resource management.

Natural resource management issues are inherently complex. They involve the ecological cycles, hydrological cycles, climate, animals, plants and geography, etc. All these are dynamic and inter-related. A change in one of them may have far reaching and/or long term impacts which may even be irreversible. In addition to the natural systems, natural resource management also has to manage various stakeholders and their interests, policies, politics, geographical boundaries, economic implications and the list goes on. It is very difficult to satisfy all aspects at the same time. This results in conflicting situations. After the United Nations Conference for the Environment and Development (UNCED) held in Rio de Janeiro in 1992, most nations subscribed to new principles for the integrated management of land, water, and forests. Although program names vary from nation to nation, all express similar aims.

The various approaches applied to natural resource management include:

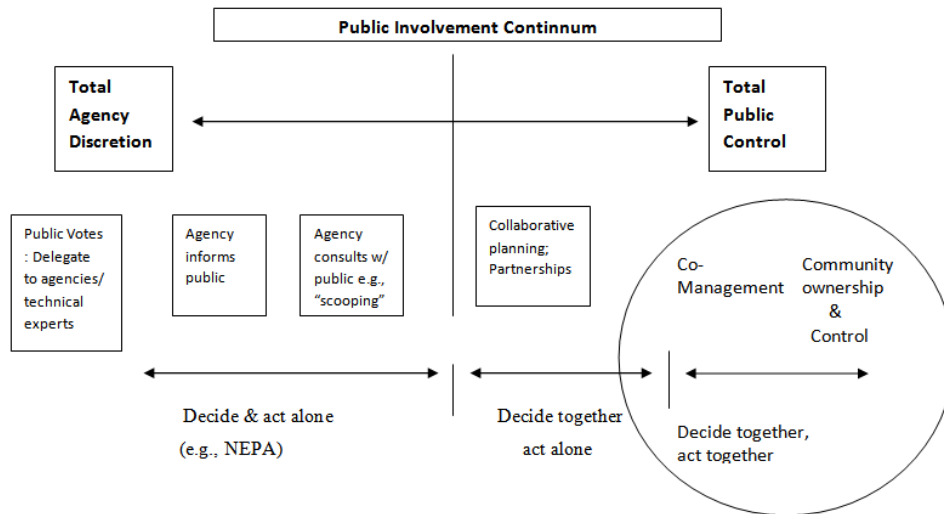
- Top-down (command and control)
- Community-based natural resource management
- Adaptive management

- Precautionary approach
- Integrated natural resource management

Community-based natural resource management

The community-based natural resource management (CBNRM) approach combines conservation objectives with the generation of economic benefits for rural communities. The three key assumptions being that: locals are better placed to conserve natural resources, people will conserve a resource only if benefits exceed the costs of conservation, and people will conserve a resource that is linked directly to their quality of life.^[5] When a local people's quality of life is enhanced, their efforts and commitment to ensure the future well-being of the resource are also enhanced. Regional and community based natural resource management is also based on the principle of subsidiarity. The United Nations advocates CBNRM in the Convention on Biodiversity and the Convention to Combat Desertification. Unless clearly defined, decentralized NRM can result an ambiguous socio-legal environment with local communities racing to exploit natural resources while they can e.g. forest communities in central Kalimantan (Indonesia) A problem of CBNRM is the difficulty of reconciling and harmonizing the objectives of socioeconomic development, biodiversity protection and sustainable resource utilisation. The concept and conflicting interests of CBNRM, show how the motives behind the participation are differentiated as either people-centered (active or participatory results that are truly empowering) or planner-centered (nominal and results in passive recipients). Understanding power relations is crucial to the success of community based NRM. Locals may be reluctant to challenge government recommendations for fear of losing promised benefits. CBNRM is based particularly on advocacy by nongovernmental organizations working with local groups and

communities, on the one hand, and national and transnational organizations, on the other, to build and extend new versions of environmental and social advocacy that link social justice and environmental management agendas with both direct and indirect benefits observed including a share of revenues, employment, diversification of livelihoods and increased pride and identity. CBNRM has raised new challenges, as concepts of community, territory, conservation, and indigenous are worked into politically varied plans and programs in disparate sites. Warner and Jones address strategies for effectively managing conflict in CBNRM.



Source: Extension strategy on Natural Resource Management, M.M. Adhikary, S.K. Acharya, D.Basu.

Adaptive management

The primary methodological approach adopted by catchment management authorities (CMAs) for regional natural resource management in Australia is adaptive management. This approach includes recognition that adaption occurs through a process of ‘plan-do-review-act’. It also recognizes seven key components that should be considered for quality natural resource management practice:

- Determination of scale
- Collection and use of knowledge
- Information management
- Monitoring and evaluation
- Risk management
- Community engagement
- Opportunities for collaboration

Integrated natural resource management

Integrated natural resource management (INRM) is a process of managing natural resources in a systematic way, which includes multiple aspects of natural resource use (biophysical, socio-political, and economic) meet production goals of producers and other direct users (e.g., food security, profitability, risk aversion) as well as goals of the wider community (e.g., poverty alleviation, welfare of future generations, environmental conservation). It focuses on sustainability and at the same time tries to incorporate all possible stakeholders from the planning level itself, reducing possible future conflicts. The conceptual basis of INRM has evolved in recent years through the convergence of research in diverse areas such as sustainable land use, participatory planning, integrated watershed management, and adaptive management. INRM is being used extensively and been successful in regional and community based natural management.

Framework and Modeling

There are various frameworks and computer models developed to assist natural resource management.

Geographic Information Systems (GIS)

GIS is a powerful analytical tool as it is capable of overlaying datasets to identify links. A bush regeneration scheme can be

informed by the overlay of rainfall, cleared land and erosion. In Australia, Metadata Directories such as NDAR provide data on Australian natural resources such as vegetation, fisheries, soils and water. These are limited by the potential for subjective input and data manipulation.

Natural Resources Management Audit Frameworks

The NSW Government in Australia has published an audit framework for natural resource management, to assist the establishment of a performance audit role in the governance of regional natural resource management. This audit framework builds from other established audit methodologies, including performance audit, environmental audit and internal audit. Audits undertaken using this framework have provided confidence to stakeholders, identified areas for improvement and described policy expectations for the general public. The Australian Government has established a framework for auditing greenhouse emissions and energy reporting, which closely follows Australian Standards for Assurance Engagements. The Australian Government is also currently preparing an audit framework for auditing water management, focussing on the implementation of the Murray Darling Basin Plan.

Natural Resources Scenario: Challenges and Prospects

Natural resources (land, water, biodiversity and genetic resources, biomass resources, forests, livestock and fisheries) – the very foundation of human survival, progress and prosperity, have been degrading fast, and the unprecedented pace of their erosion is one of the root causes of the agrarian crisis that the country is facing. The demographic and socio-economic pressures notwithstanding, the unmindful agricultural intensification, over use of marginal lands, imbalanced use of fertilizers, organic matter depletion and deteriorating

soil health, extensive diversion of prime agricultural lands to non-agricultural uses, misuse and inefficient use of irrigation water, depleting aquifers, salinisation of fertile lands and water logging, deforestation, biodiversity loss and genetic erosion, and climate change are the main underlying causes. Interlinked as producers and service providers, the resources must be judiciously conserved, developed and harnessed.

Of the country's total 142 m ha cultivated land, 57 m ha, 40 per cent of the total, is irrigated and the remaining 85 m ha is rainfed. Of the total geographical area of 329 m ha, about 146 m ha is classified as degraded, although varying estimates have been provided by different agencies. As generally agreed, the resources have been degrading fast, costing 11 to 26 per cent of the GDP during the 1980s and 1990s. Land distribution is highly skewed, more than 80 per cent of the farmers are small, marginal and sub-marginal and together own about 40 per cent of the total cultivated land, and increasing proportions of the holdings are becoming uneconomical.

Water availability at the National level is reaching close to 1700 cubic meter (cu m) per capita – the threshold line, and if things do not improve, it will drop to water scarcity line by 2025. India annually receives about 350 million hectare meter (m h m) rain water, but almost half of it finds its way back to the sea, whereas the per capita water storage in India is only 210 cu m against 1110 cu m in China and 3145 cu m in Brazil.

Rampant loss of biodiversity and agricultural genetic resources has greatly enhanced genetic vulnerability of our agricultural systems besides losing invaluable gene pools, such as Tharparker in Western Rajasthan. The two recent National initiatives in this field, namely, National Biodiversity Board and Plant Variety Protection and Farmer's Rights Authority are supposed to address this issue, but there is little

coordination between the two. Participatory breeding, integrated germplasm and indigenous knowledge conservation and benefit sharing, particularly involving women and tribals, should be promoted through transparent modes of accessing the National Gene Fund and increasing gene and IPR literacy. Establishment of living heritage of livestock germplasm (mostly at State Farms), village gene banks, offshore quarantine centres for germplasm screening against serious diseases and pests and maintenance and trade of pedigreed animals and elite medicinal and aromatic plant landraces by farm science graduates should be strongly supported.

Forests, the green cover, are the natural resource infrastructure for agriculture/primary production and rural economic growth. India, harbouring 16 major forest types – tropical, temperate, alpine etc., is one of the 17 mega diversity centres and two biodiversity hot spots of the world. Per capita forest area in the country (0.064 ha) is one-tenth of that of the world's average, and 41 per cent of the country's forest cover is degraded. Despite the high importance of forests as source of food, fuel, fodder and fibre, and of linking conservation with community based forestry, allocation to the forestry subsector has rather been meager, less than 1 per cent of the Plan size. Moreover, most of the budget has to come from the State Governments which seldom meet their commitments and the forests continue to suffer. The share of the Central Government should be increased to at least 50 per cent of the total requirement, and the Tribal Bill, 2005 should be fully implemented and linked with the NREGA.

Livestock accounts for about 27 per cent of the Agricultural GDP and is positively egalitarian in its distribution and in ownership by women, and is a major pillar of income, food and employment security. Possessing the world's largest livestock population, India ranks first in

milk production, fifth in egg production and seventh in meat production. Total livestock output has been growing at a much faster rate of 3.6 per cent per annum against only 1.1 per cent registered for the crops sub-sector during the past decade. The targeted overall agricultural annual growth rate of 4.1 per cent during the XI Plan is stipulated to be achieved through a growth rate of about 8 per cent in the livestock subsector. In order to double the current growth rate to achieve the XI Plan target, constraints to increased livestock production and productivity (which is one-third of that of the world average) must be properly identified and addressed. Institutional supports and policy actions such as livestock insurance, market and price support, Livestock Feed and Fodder Corporation, Fodder Banks, Small Holder's Poultry Estates, etc. are needed towards achieving the rapid and inclusive growth.

Fisheries (53 per cent of the production from aquaculture) contribute significantly to food, nutrition, economic and employment securities, and fortunately are one of the fastest growing agricultural sub-sectors during the last three decades. Currently, fisheries contribute 4.6 per cent of the agricultural GDP, provide employment security to about 11 million people and annually earn foreign exchange worth Rs. 7,300 crore – about one-fifth of the value of the National agricultural export. The overall growth rate of fish production could be doubled to about 8 per cent towards achieving the overall agricultural growth rate of 4.1 per cent during the XI Plan. The following constraints should, however, be addressed to harness the potential: siltation and pollution of water bodies, poor management of production-processing-distribution chain, poor quality control of fish seed and feed, under-exploitation of available species such as cold water fishes like trout and Mahseer and air-breathing fishes like Mangur. Weak infrastructure for landing and marketing and inadequate

access to water bodies/tanks, multi-user conflicts and inappropriate leasing policies are other important constraint

Strategy and Intervention For Natural Resource Management(NRM)

Natural resources can be managed from different angles and aspects viz. ecology, economy, resilience, conservation, community participation and social value generation. These all encompass the approaches of mutually synchronized social and ecological interventions. While generating ecological services, the community interest and contribution need to be incorporated in the process of resource socialization, access and entitlement. For example, forest resource management across the world has included both FPC (Forest protection committee) and EDC (Eco development committee) to strategically involve both the peripheral and core forest dwellers.

The NRM is basically based on two structural approaches: i) Systemic and, ii) Systematic. While Systematic approach takes care of the ecosystem from its entirety, the systemic travels into its core system function, although two approaches are equally interdependent and interactive.

In the recommendation of XIth five year plan of planning commission there are some strategies regarding natural resource management. NRM, particularly through the watershed approach, needs major adjustments and shifts in the strategies and approaches. The programme should be divided into three components:

- Comprehensive integrated development of multiple natural resources on watershed basis;
- Situation specific and need-based development of individual resources (out side the watersheds); and

- Integrated crop-livestock-fish-biomass farming system based management of natural resources, especially in rain fed areas (inside and outside the watershed programmes).

A differentiated and need-based approach with substantial investment in natural resource management both in irrigated and rainfed areas in watershed as well as beyond watershed programmes is called for. The following programmatic interventions are suggested separately for each component:

Comprehensive management of natural resources

The major steps are:

- Delineation, codification and prioritization of sub-watersheds for the preparation of perspective plan at the State level.
- Separation of capacity building phase from main implementation phase.
- Consideration of sub-watershed as a geo-hydrological unit at Programme Implementing Agency level and revenue village as a management unit at Watershed Committee level.
- Gram Panchayat to play governance role while stakeholders groups (UG / SHG etc.) should carry out execution of their own works and be accountable to Gram Sabha. Panchayatas should help to create durable assets in watersheds by linking the programme with NREGS.
- Preparation of State specific process guidelines to build upon their strengths and experiences.
- Integration of small size forest areas under watershed programmes through CFM in place of JFM as being successfully practiced in Andhra Pradesh.

- Enhancement in project duration from 5 to 10 years for adoption of comprehensive approach. Organisation of CBOs into sustainable bodies as a pre-project activity through complementary funding.

Location specific management of natural resources

The following need-based treatments, outside of watersheds, are priority actions:

- Reclamation of problem soils (saline, alkaline, acidic etc.); greater attention is called for acidic soils as the acidification is spreading fast.
- Comprehensive development of degraded lands assigned to resource poor families under land distribution programmes.
- Development of common land with revenue department through adequate investment.
- Revival of small size indigenous water harvesting structures.
- Investment on community borewells to retain ground water as a common property resource.

Farming systems based management of natural resources

- Development of farming systems through new paradigm consisting of (i) sustainable management of natural resources through social regulations, (ii) diversification of farming systems, (iii) major emphasis on improving soil health and use of inputs based on internal raw materials, (iv) emphasis on protective irrigation, (v) extension system managed by CBOs, (vi) financial support through revolving funds and (vii) adequate facilitation through experienced resource organizations.
- Convergence of different production related programmes, namely, agriculture, horticulture, livestock, fisheries etc as per the new paradigm.

- Labour incentives for preparation of organic inputs from internal raw materials (to cut down the costs as being done for chemical inputs from external raw materials).

Conservation Approach

As the human population is continuously growing the consumption of natural resources is also increasing. With the increasing industrialisation and urbanisation of the modern human society, the use of all the resources is rising. If they are not properly used and well managed, a serious scarcity will result. Therefore we need to conserve the natural resources. This will also upset the ecological balance. Conservation is the proper management of a natural resource to prevent its exploitation, destruction or degradation. Conservation is the sum total of activities, which can derive benefits from natural resources but at the same time prevent excessive use leading to destruction or degradation.

Need for Conservation of Natural Resources

We know that nature provides us all our basic needs but we tend to overexploit it. If we go on exploiting the nature, there will be no more resources available in future. There is an urgent need to conserve the nature. Some of the needs are :

- To maintain ecological balance for supporting life.
- To preserve different kinds of species (biodiversity).
- To make the resources available for present and future generation.
- To ensure the survival of human race.

Conservation of Natural Resources and Traditions of India :

Our country is a asset house at wild genetic resources. Wild species and relatives of crop plants contain valuable genes that are of immense genetic value in crop improvement programmes. The

important wild related species and types in various crop groups, prevailing under different phytogeographic zones at the country needs particular attention in the agro-biodiversity management system for a sustainable use to help maintain food, nutritional and agricultural economic security. The need for conservation of natural resources was felt by our predecessors and in India, there was a tradition of respecting and preserving the nature and natural resources. Natural resources were conserved in the form of sacred groves/forests, sacred pools and lakes, sacred species etc. In our country the conservation of natural forests is known from the time of Lord Ashoka. Sacred forests are forest patches of different dimensions dedicated by the tribal to their deities and ancestral spirits. Cutting down trees, hunting and other human interferences were strictly prohibited in these forests. This practice is wide spread particularly in peninsular, central and eastern India and has resulted in the protection of a large number of plants and animals and. Similarly, several water bodies, e.g., Khecheopalri lake in Sikkim was declared sacred by people, thus, protecting aquatic flora and fauna. Worshipping certain plants like banyan, peepal, tulsi etc. has not only preserved them but also encouraged us for their plantation. History recalls numerous instances where people have laid down their lives in protecting the trees. Recent Chipko movement in India is one of the best examples. This movement was started by the women in Gopeshwar village in Garhwal in the Himalayas. They stopped the felling of trees by hugging them when the lumbermen arrived to cut them. This saved about 12000 square kilometers of the sensitive water catchment area. Similar movements also occurred in some other parts of the country. Since most of the World's Biodiversity is not in protected areas but on lands used by people, conserving species and ecosystem depends on our understanding of social systems and their interactions with

ecological system. Involving people in conservation requires paying attention to livelihoods and creating a local stake for conservation. It also requires maintaining cultural connections to the land and at times restoring and cultivating new connections. Different strategies have been implemented across the globe to achieve conservation and maintain biodiversity. One strategy is to establish protected areas that strictly exclude human use and provide for the preservation of wilderness. In other cases such as Biosphere reserves, human use areas are established adjacent to core protected areas, with restricted use areas as an intervening buffer zone. In the face of rapid change in land use and extinction of species, there is considerable debate about which strategies are best for achieving conservation objectives. Climate change complicates this debate, because areas considered to be sensitive habitat today may shift geographically in the future.

Addressing Conservation Issues:

Traditional Management of Biodiversity:

Many traditional societies have used ecosystem services without destroying the ecosystems of which they have been part for thousands of years. Otherwise, there would have been no resources left for us to conserve today. A landscape produces a variety of goods and services for livelihood needs, and some human actions maintain ecological processes and biodiversity. In practice, people actively disturb and manage their landscape through the triggering of successional processes. Disturbance helps maintain spatial and temporal diversity at both landscape and site levels. The specific mechanisms by which biodiversity are conserved in these multifunctional landscapes vary with the ecological and cultural settings (F.Stuart Chapin et al 2009)

Threatened Species and Community-Based Conservation

The social ecological systems of the developing world have faced the threats to some of the endangered species. Elephants of east Africa, turtles of Costa Rica, blue sheep of the Himalayas, pandas in China, and other threatened species are commonly found where human population face severe poverty; there are limited option for economic development, and in some cases ecosystem services have been dramatically reduced in quality (WRI, 2005).

The paradigm of community –based wildlife management assumes that high levels of community involvement in resource management and explicit incentives for conservation encourage stewardship behavior and protect threatened species from possible extinction. During the past 20 years the World Bank has shifted away from supporting top-down arrangements for economic development and adopted this new approach. The related shift in funding for community-based programs is striking. In 1996, US dollar 125 million was loaned by the World Bank for participatory environment projects ; by 2003 , the total of loans had grown to 7 billion dollar(Mansuri and Rao 2004).

Resource Co-management

Small, resource based communities of our social system are now a days embedded within a broader socio-ecological context. All the local communities have at least some level of interaction with regional and national governments, NGOs and neighboring resource users. Effective linkages across scales of management that foster the evolution of local-level conservation strategies are therefore critical to sustainability (Dietz et al. 2003). Communities which share use of commons with other communities and there are potential issues of resource scarcity, there is a need to establish vertical (across the level of organization) and horizontal (across the same level) linkages of resource governance

among resource user communities, state agencies, and others. This kind of linkages is termed as co-management which is defined as the sharing of power and responsibility in decision-making between state governments and communities in the functions of resource management. When Co-management is implemented with a focus on learning-by-doing, these arrangements are referred to as adaptive co-management. Both formal and informal co-management has proven critical in the development of strategies that support livelihoods and conservation initiatives, contributing to social learning and social-ecological resilience at local and regional scales.

Single-species Management of Wild Resources

The focus of Single-species management of wild resources often is on ecological controls rather than institutions that link conservation to community livelihoods. People living in a broad range of rural to semi-urban environments pick berries, harvest mushrooms, catch fish and hunt wildlife as culturally and nutritionally significant activities that link their livelihoods to local ecosystem. These kinds of activities are usually responsive to formal and informal institutions that foster the conservation of these resources. The harvest of resources is often regulated through formal institutions because human overharvest can significantly reduce future availability. Formal management of this kind put emphasis on the maximum sustained production of particular species that are compatible with available habitat, natural mortality, and harvest rate. Management of human harvest is challenging because of both biological and social uncertainties and social pressures to manage populations in ways that deviate substantially from those that occur naturally. Management is equally challenging when target populations become extremely dense. This kind of scenario occurs when people eliminate a potential predator of a specific species and

does not act as predators themselves. As a result of this that specific species becomes abundant which leads to many wildlife diseases and also vector of some humane diseases. The resulting disease risks have the unacceptable consequence of disconnecting people from nature by reducing human use of natural areas.

The main reason of recent declines in biodiversity is due to human actions, but on the other way they may be also important pathways to potentially sustainable solutions. The conservation and maintenance of biodiversity at various levels are clearly social-ecological, rather than strictly biological, issues. Establishment of protected areas is an important measure but it alone cannot be sufficient to meet the challenges of biodiversity conservation. We have to work with people, encouraging stewardship ethics and cultural connections to land, to protect biodiversity everywhere as creation of artificial “islands” to conserve biodiversity through protected areas will not serve the purpose. Conservation that builds livelihoods for local people in ways that are compatible with conservation objectives seems crucial. Unless local people can meet their basic livelihood needs, they may have little choice but to conflict with conservation objectives. So the solutions often involve working with local communities in such a way that they can use some of the resources under a conservation scheme, creating a local stake in biodiversity protection.

India’s efforts for Biodiversity Conservation

Dr. M.S.Swaminathan (1983) suggested the following categories for preservation

- Cultivated varieties in current use.
- Obsolete cultivars.
- Primitive cultivars or land races.

- Wild species and weedy species closely related to cultivated varieties.
- Wild species of potential value to man.
- Special genetic stock developed by man.
- The fair and equitable sharing of benefits arising from the utilization of genetic resources.

Stewardship Approach

Stewardship is an ethic that embodies the responsible planning and management of resources. The concepts of stewardship can be applied to the environment and nature, economics, health, property, information, theology, etc. Stewardship was originally made up of the tasks of a domestic steward, from *stiġ* (*house, hall*) and *weard*, (*ward, guard, guardian, keeper*). Stewardship in the beginning referred to the household servant's duties for bringing food and drink to the castle's dining hall. Stewardship responsibilities were eventually expanded to include everything the domestic, service and management needs of the entire household. Commercial stewardship tends to the domestic and service requirements of passengers on ships, trains, airplanes or guests in restaurants. This concept of stewardship continues to be referenced within these specific categories. Stewardship is now generally recognized as the acceptance or assignment of responsibility to shepherd and safeguard the valuables of others.

Use of the term stewardship in the context of management and use of natural resources has increased markedly during recent years. Terms like "environmental stewardship," "countryside stewardship," and "forest stewardship" have become common and stewardship appears to be starting to displace the term management. Usage, particularly in the US, has extended into legislation and incentives, such as the US Forest Stewardship Act and Stewardship Contracts (Wright and

Rideout, 1990). The term has also been adopted by organizations promoting sustainable management, like the Marine Stewardship Council and the Forest Stewardship Council. It is used in the context of both private and public land, though the emphasis tends to be on the former.

Stewardship is usually used to describe forms of “responsible” management where concerns such as sustainability and environmental quality being promoted (e.g., Brown and Mitchell, 1996). However, in much of the land use and conservation literature the term is used loosely, with little attempt at definition. This is presumably because people consider the term to be well enough understood so as not to require defining. However, it is far from clear what the term stewardship actually describes, and how it differs from established terms such as management, or sustainable management. In particular, it is not apparent what the element of responsibility means; to whom or what is a “steward” responsible (when a traditional manager, by implication, is not), and how this responsibility is manifested in practice. The word itself is derived from sty-ward, someone that looks after farm animals, and has links with the term warden (as in nature reserves).

F. Stuart Chapin, III, Gary P. Kofinas, Carl Folke, 2009, formulated that Ecosystem stewardship recognizes that society’s use of resources must be compatible with the capacity of ecosystems to provide services, which, in turn, is constrained by the life-support system of the planet. They made contrasts between steady-state resource management, ecosystem management, and resilience-based ecosystem stewardship. They emphasized resilience, a concept that embraces change as a basic feature of the way the world works and develops, and therefore is especially appropriate at times when changes are a prominent feature of the system. They addressed ecosystems that provide suite of

ecosystem services rather than a single resource such as fish or trees. They focused on stewardship, which recognizes managers as an integral component of the system that they manage. Stewardship also implies a sense of responsibility for the state of the system of which we are a part.

Steady-state resource management	Ecosystem management	Resilience-based ecosystem stewardship
Reference state: historic condition	Historic condition	Trajectory of change
Manage for a single resource or species	Manage for multiple ecosystem services	Manage for fundamental social-ecological properties
Single equilibrium state whose properties can be sustained	Multiple potential states	Multiple potential
Reduce variability	Accept historical range of variability	Foster variability and diversity
Prevent natural disturbances	Accept natural disturbances	Foster disturbances that sustain social-ecological properties
People use ecosystems	People are part of the social-ecological system	People have responsibility to sustain future options
Managers define the primary use of the managed system	Multiple stakeholders work with managers to define goals	Multiple stakeholders work with managers to define goals
Maximize sustained yield and economic efficiency	Manage for multiple uses despite reduced efficiency	Maximize flexibility of future options
Management structure protects current management goals	Management goals respond to changing human values	Management responds to and shapes human values

Livelihood and Natural resource management

Well-being, or quality of life is more than human health and wealth . In the context of ecosystem stewardship and sustainability, well-being also includes happiness, a sense of fate control, and community capacity. Livelihoods of individuals and households include their capabilities, tangibles assets, and means of living (Chamber and Conway 1991). Well-being and livelihoods are therefore key elements

that set the stage for sustainability, resilience and adaptability of people to change.

Several conceptual frameworks have been put forward to enhance the understanding of the people-environment relationship. However, one that has received much attention in recent times is the concept of 'sustainable livelihood'. A key thrust of the concept is that it allows the consideration of various factors and processes which either constrain or enhance poor people's ability to make a living in an economically, and socially sustainable manner (Krantz, 2001). The sustainable livelihood approach (SLA) is an analytical framework, which seeks to improve our understanding of how people use the resources at their disposal to construct a livelihood (Swift & Hamilton, 2001). Given its usefulness for policy and planning, it has attracted wide usage and a range of working definitions (Chambers & Conway, 1992). To Scoones (1998), sustainable livelihood is: A livelihood that comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base (Scoones, 1998:5). The sustainable livelihood framework has five main basic elements: (i) context, (ii) livelihood resources, (iii) institutional processes, (iv) livelihood strategies, and (v) livelihood outcomes. The framework holds, for example, that: in a particular context, households draw upon particular sets of assets (capital/resources), which they use to construct livelihood strategies.

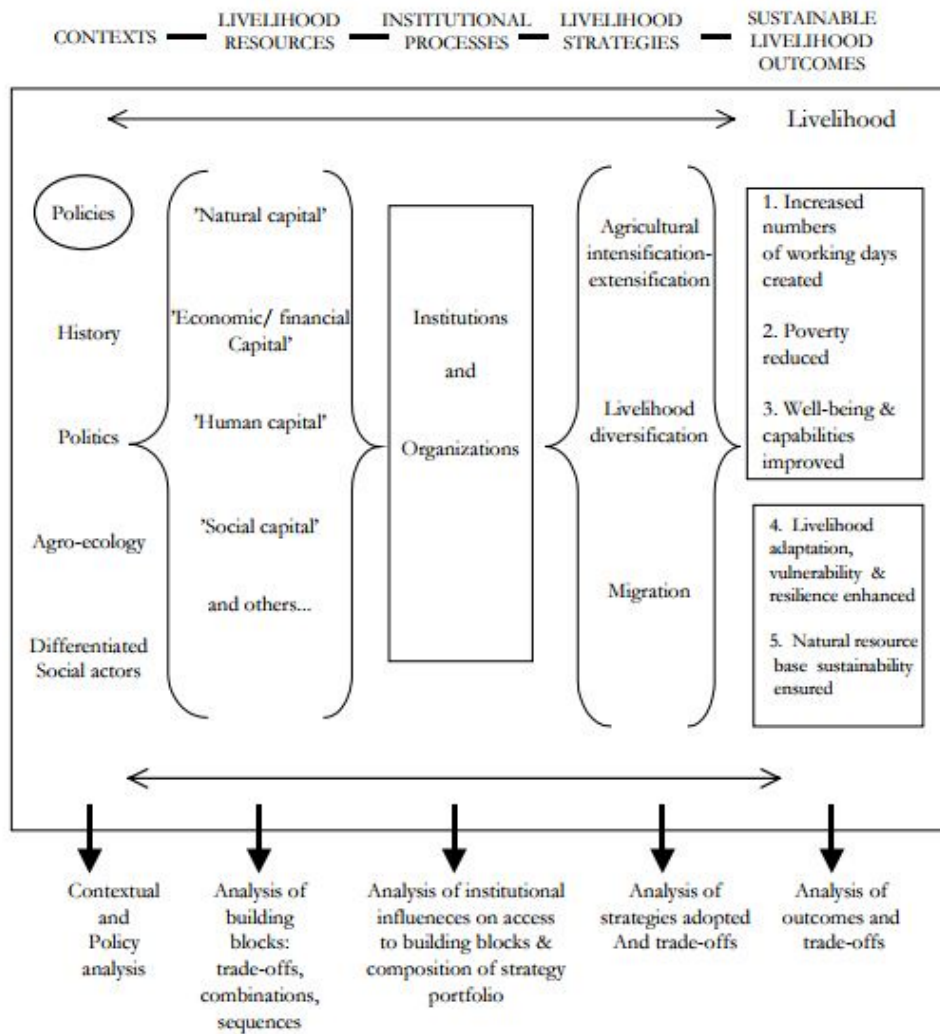


Fig. The sustainable livelihood Approach (Source: Scoones 1998: 4)

Despite rapid urbanization and increased livelihood diversification, more than 60 per cent of India’s population still depends on agriculture for livelihoods. The nexus between poverty and environmental conservation remains strong. Land degradation is a key issue affecting resource productivity. It is estimated that about one third of the soil in India has been affected by erosion. This has a direct impact on agricultural

productivity and hence food production, especially for resource poor farmers living off marginal land-holdings. The area declining under forest cover has now been arrested, but the volume and density of forests have been reduced causing scarcity of valuable forest produce, important for the livelihoods of poor in many regions (TERI, 1998). Degradation of natural resources has a direct negative bearing on livelihoods of poor people. However, experience from India shows that improvements in resource productivity per se cannot be equated with poverty reduction. As an example, several years of watershed development programmes has illustrated that the poor have often been excluded from accessing gains in productivity as well as related decision-making processes.

Stable livelihoods are one of the strongest determinants of safety and security . Lack of food security, in particular, is a critical component of well being . The family with insufficient income to buy food and no suitable land to grow crops are more vulnerable to environmental hazards that influence food supply than are people with greater access to these assets. Although the early literature on risk and vulnerabilities focused primarily on exposure to environmental hazards, there is increasing recognition that livelihood security is generally a stronger determinant of vulnerabilities and risks such as famine than are climatic events such as floods and droughts (Sen 1981, Adger 2006)

Participatory Management of Resources and Monitoring:

Participatory monitoring (also known as collaborative monitoring, community-based monitoring, locally based monitoring or volunteer monitoring) is the regular collection of measurements or other kinds of data (monitoring), usually of natural resources and biodiversity, undertaken by local people, who live in the area being monitored, who rely on local natural resources, and consequently have great local

knowledge of those resources. The people involved usually live in communities with considerable social cohesion where they regularly work together on shared projects.

Participatory monitoring has emerged as an alternative or addition to professional scientist-executed monitoring. Scientist-executed monitoring is often costly and hard to sustain, especially in those regions of the world where financial resources are limited. Moreover, scientist-executed monitoring can be logistically and technically difficult and is often perceived to be irrelevant by resource managers and the local communities. Involving local people and their communities in monitoring is often part of the process of sharing the management of land and resources with the local communities. It is connected to the devolution of rights and power to the locals. Aside from potentially providing high-quality information, participatory monitoring can raise local awareness and build the community and local government expertise that is needed for addressing the management of natural resources.

The term ‘participatory monitoring’ embraces a broad range of approaches, from self-monitoring of harvests by local resource users themselves, to censuses by local rangers, and inventories by amateur naturalists. The term includes techniques labeled as ‘self-monitoring’, ‘ranger-based monitoring’, ‘event-monitoring’, ‘participatory assessment, monitoring and evaluation of biodiversity’, ‘community-based observing and ‘community-based monitoring and information systems’.

Many of these approaches are directly linked to resource management, but the entities being monitored vary widely, from individual animals and plants, through habitats, to ecosystem goods and services. However, all of the approaches have in common that the monitoring is carried out by individuals who live in the monitored places and rely on local natural resources, and that local people or local government staff are directly involved in formulation of research questions, data collection, and (in most instances) data analysis, and implementation of management solutions based on research findings.

Participatory monitoring is included in the term 'participatory monitoring and management' which has been defined as "approaches used by local and Indigenous communities, informed by traditional and local knowledge, and, increasingly, by contemporary science, to assess the status of resources and threats on their land and advance sustainable economic opportunities based on the use of natural resources". term 'participatory monitoring and management' is particularly used in tropical, Arctic and developing regions, where communities are most often the custodians of valuable biodiversity and extensive natural ecosystems.

It has been suggested that participatory monitoring is unlikely to provide quantitative data on large-scale changes in habitat area, or on populations of cryptic species that are hard to identify or census reliably. It has also been suggested that participatory monitoring is not suitable for monitoring resources that are so valuable they attract powerful outsiders. Likewise, in areas where changes, threats, or interventions operate in complex fashions, where rural people do not depend on the use of natural resources and there are no real benefits flowing to the local people from doing monitoring work (or the costs to local people of involvement exceed the benefits), or where there is a poor relationship between the authorities and the local people, participatory monitoring is probably less likely to yield useful data and management solutions than conventional scientific approaches.

With only 2.4% of the world's land area, India is home to 16% of the world human population and contributes immensely to global biodiversity with about 8% of total number of species¹. India is recognized as a mega biodiverse country and has four identified bio-hotspots, viz. the Himalaya hotspot, the North East of India, the rainforests of the Western Ghats and the Andaman & Nicobar Island chain. According to the livestock census of 2003, the country has

about 485 million livestock population and 489 million poultry population, being the first in cattle and buffalo population, second in respect of goat and third in respect of sheep population in the world. India has 57% of the world's buffalo and 16% of the world's cattle population. This means there is not only human population but also livestock population pressure on the shrinking natural resources. Though India is bestowed with 4% of the world's freshwater resources, the distribution is highly skewed across regions. The Ganga–Brahmaputra–Meghna basin with 33% of the land mass has 60% of total water flows, while the western coastline with 3% of the area has another 11%. This leaves just 29% of water resources in the remaining 64% of the area (peninsular India), thus keeping most of peninsular India water-starved compared to other parts of the country.

Approaches

Thematically, participatory monitoring has considerable potential in several areas, including:

1. For connecting knowledge systems: in efforts to bring Indigenous and local knowledge systems into the science–policy interface such as the Intergovernmental Platform for Biodiversity and Ecosystem Services.
2. For monitoring rapidly changing environments: to inform resource management in rapidly changing environments such as the Arctic, where Indigenous and local communities have detailed knowledge of key components of their environment, such as sea-ice, snow, weather patterns, caribou and other natural resources.
3. In Payment for Ecosystem Services (PES) programs: to connect environmental performance with payment schemes such as REDD+.

4. For reinforcing international agreements: in efforts to link international environmental agreements to decision-making in the 'real world'.

Typology

A typology of monitoring schemes has been proposed, determined on the basis of relative contributions of local stakeholders and professional researchers,^[87] and supported by findings from statistical analysis of published schemes. The typology identified 5 categories of monitoring schemes that between them span the full spectrum of natural resource monitoring protocols:

Category A. Autonomous Local Monitoring. In this category the whole monitoring process—from design, to data collection, to analysis, and finally to use of data for management decisions—is carried out autonomously by local stakeholders. There is no direct involvement of external agencies. **Category B.** Collaborative Monitoring with Local Data Interpretation. In these schemes, the original initiative was taken by scientists but local stakeholders collect, process and interpret the data, although external scientists may provide advice and training. The original data collected by local people remain in the area being monitored, which helps create local ownership of the scheme and its results, but copies of the data may be sent to professional researchers for in-depth or larger-scale analysis.

Category C. Collaborative Monitoring with External Data Interpretation. The third most distinct group is monitoring scheme category C. These schemes were designed by scientists who also analyze the data, but the local stakeholders collect the data, take decisions on the basis of the findings and carry out the management interventions emanating from the monitoring scheme.

Category D. Externally Driven Monitoring with Local Data Collectors. This category of monitoring scheme involves local stakeholders only in

data collection. The design, analysis, and interpretation of the monitoring results are undertaken by professional researchers—generally far from the site. Monitoring schemes of category D are mostly long-running ‘citizen science’ projects from Europe and North America.

Category E. Externally Driven, Professionally Executed Monitoring. Monitoring schemes of category E do not involve local stakeholders. Design of the scheme, analysis of the results, and management decisions derived from these analyses are all undertaken by professional scientists funded by external agencies.

The Use of Technology for Participatory Monitoring

Traditional methods of data collection for participatory monitoring use paper and pen. This has advantages in terms of low cost of materials and training, simplicity, and reduced potential for technical hitches. However, all data must be transcribed for analysis, which takes time and can be subject to transcription errors. Increasingly, participatory monitoring initiatives incorporate technology, from GPS recorders to geo-reference the data collected on paper, to drones to survey remote areas, phones to send simple reports via SMS, or smart phones to collect and store data. Various apps exist to create and manage data collection forms on smart phones. Some initiatives find that the use of smart phones for data collection has advantages over paper-based systems. The advantages include that very little equipment need be carried on a survey, a large amount and variety of data can be stored (geographical locations, photos and audio, as well as data entered onto monitoring forms) and data can be shared rapidly for analysis without transcription errors. The use of smart phones can incentivize young people to get involved in monitoring, sparking an interest in conservation. Some apps are especially designed to be usable by illiterate monitors. If local people risk threats or violence by

monitoring illegal activities, the true purpose of the phones can be denied, and the monitoring data locked away. However, phones are expensive; are vulnerable to damage and technical issues; necessitate additional training - not least due to rapid technological change; phone charging can be a challenge (especially under thick forest canopies); and uploading data for analysis is difficult in areas without network connections.

Social Audit

Social auditing is a process that enables an organization to assess and demonstrates its social, economic and environmental benefits and limitations. It ensures transparency and accountability in the system of governance to promote people's participation. It is not a fault finding tool but a system to understand, measure and assess the implementation of the schemes and plans to improve the effectiveness of the local governance. It has been used as a process to empower people to question the system, processes and authorities in order to assert their right. The main reason to implement social audit is to link the huge gap between what people need and what government thinks they need and what actually been done. Thus social audit is the process of understanding, measuring and reporting and most importantly improving the efficiency and effectiveness of the local governance. Social Audit on the part of natural resource department is very much relevant today and has to be compiled for. During the course of social audit, the following points need to be considered:

- Framing the environmental policy.
- Special drive for increasing sensitivity towards environmental accountability.
- Identification of environmental accountability in key result areas.
- Deciding the environmental objective-strategic and operational.

- Identifying the responsibility for different objectives with manager.
- Development of measures for strategic and operational objective.
- Allocation of resources-long terms budget, capital budget and revenue budget.
- Monitoring and review of performance of Key result areas including environmental responsibility at a stated interval.
- Recommendation of penal measures for violating the norms set.
- Awareness programme need to be taken up.

Issues and challenges of Stewardship function in India:

a) Issues in integrating ecological and economical interest , albeit, these two systems are “apparently contradictory”

Teeming populace and mounting pressures on natural resources comprising of land, water and biodiversity of our country have made it very challenging to integrate the issues of ecological and economic survival. We all are now living in the era of post green revolution. This era have witnessed over exploitation of resources, excessive application of chemical input, massive suicide on the part of farmers, increased food grain production, decreased soil fertility, increased pest and disease infestation , extinction of different gene base, introduction of genetically modified crop etc and still more to witness.

But all these approaches brought out a contradiction on the economic and ecological issues. For example if we see the increased food grain production. In our country the staple food is rice. To increase the production the main emphasis was on the increasing the production of rice for which depletion of ground water and land degradation was very high which concerns the ecological interest as well. So, here comes the need of stewardship, through which our land steward can well manage the issues of economy and ecology together. Instead of growing 3 season rice they can grow 2 season

rice, and one season they can go for any oilseed like Sesame. In such way food security, economic security and also ecological security all issues may be ensured.

b) Inadequate perception on the need and role of stewardship for a sustainable development :

Several awareness programme, training programme are being conducted for the farmers to popularize the concept of sustainable agriculture in our country. But most of the farmers of our country are still being ignorant of this concept or some find it very difficult to follow this concept. Agriculture enterprise being dependent on nature, it is a very risky venture either. In such condition to grasp the concept of sustainable development is very difficult on the part of farmer. Stewardship can be a way out for such kind of situation. This focuses on not only the sustainability of production but also sustainable livelihood. The farmers should be made very clear about the idea of stewardship. There should be a paradigm shift from steady resource management which focuses on the management of single resources to resilience based diverse ecosystem management which aims at management of fundamental socio-ecological properties.

c) In the absence of dedicated income generation out of conventional agriculture, no farmers perhaps can be mobilized for NRM vis-a -vis Stewardship; given there is no apparent and ephemeral return from conservational approaches.

Small and marginal farmers constitute the lion share among the farm family of our country. They sustain their livelihood on the marginal return they receive from the field annually. As per the conventional conservation approach if they are asked to go for typical organic farming or zero tillage or to keep the land fallow for season to conserve the soil it will have a direct negative effect on their real

income. A farmer who is not assured of the food security how he /she can for natural resource management in that particular conventional way. So, there is a need to draw a line between the over exploitative agriculture and conventional conservation approaches. The line which will lead the farmer to become a good steward of his/her land.

d) Government does not have any comprehensive policy for NRM in agriculture.

Stewardship in the western countries mainly followed in a privatized agriculture mode. Farmers are being paid off if they follow the principles of stewardship. But in developing country like India it is not possible on the part of government to the farmer to become a steward of their land. But resource management especially at agricultural sector is also very much necessary. So Government can implement some policy which will address the issues of natural resource management on the part of the farmer:

- Imposing fine if groundwater depletion crosses the threshold level.
- Freeing the farmer from the coercive taxation system.
- More ICT initiative so that each and every single farmer can connect themselves with the global market.
- More emphasis on social audit so that gap between implemented policy and implemented policy can be traced out.

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