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APPROACHES TO WATERSHED MANAGEMENT AND SUSTAINABILITY OF THE RENEWABLE NATURAL RESOURCES: AN INDIAN EXPERIENCE

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Abstract

Sustainability of renewable natural resources, in general, and common pool natural resources (e.g., land, Water and Forests) in particular has now become a major concern to natural resources policy makers, planners, scholars and managers in both developed and developing countries of the world. The term "Sustainability" implies the ability of a natural resources system to produce socially optimum level of output which is necessary to meet in perpetuity the needs and aspirations of the people dependent on the system, with no detrimental effects on the resources system itself and the physical environment, and with no imposition of significantly greater risks on future generations. In other words, sustainability implies not only conserving natural products which are maintaining ecological functions and supply of natural resources products essential to the livelihoods of local people. Although the CPRs include such diverse things as common pastures or grazing lands, community forests, community fish ponds, lakes, rivers, streams, ground water basins, air sheds, etc., they all face one common problem

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and that is: how to co-ordinate the whole community. The occurrence to "the tragedy of the commons" implies loss of sustainability, which translates to loss of welfare on part of those who depend on the CPRs in question for their livelihood. Both developed and developing countries of the world are best with "the tragedy of the commons" and are in search of practicable strategies to resolve the problem. In this paper, drawing upon India's experience, an attempt is made to show how the watershed management approach could attain sustainability of the renewable natural resources of land, water and forest in general and CPRs in particular.

Introduction

Sustainability of renewable natural resources, in general, and common pool natural resources (e.g., land, Water and Forests), in particular, has now become a major concern to natural resources policy makers, planners, scholars and managers in both developed and developing countries of the world. The term "Sustainability" implies the ability of a natural resources system to produce socially optimum level of output which is necessary to meet in perpetuity the needs and aspirations of the people dependent on the system, with no detrimental effects on the resources system itself and the physical environment, and with no imposition of significantly greater risks on future generations. In other words, sustainability implies not only conserving natural products which are maintaining ecological functions and supply of natural resources products essential to the livelihoods of local people. Common property resource such as a village pasture, an open access resource such as marine fishery and sometimes even a private property resource such as fallow cropland. Although the CPRs include such diverse things as common pastures or grazing lands, community forests, community fish ponds, lakes, rivers, streams, ground water basins, air sheds, etc., they all face one common problem and that is: how to co-ordinate the whole community. The occurrence to "the tragedy of the commons" implies loss of sustainability, which translates to loss of welfare on part of those who depend on the CPRs in question for their livelihood. Both developed and developing countries of the world are best with "the tragedy of the commons" and are in search of practicable strategies to resolve the problem.

In this paper, drawing upon India's experience, an attempt is made to show how the watershed management approach could attain sustainability of the renewable natural resources of land, water and forest in general and CPRs in particular.

Sustainablity as a Goal in CPR Management

Sustainability is being increasingly accepted globally as explicit in the development and management of renewable natural resources in general and CPRs in particular. Sustainability of socially optimum level of output as a goal is superior to the goal of maximum sustainable yields (MSY) which, until recently, had been the major goal of management of many renewable natural resources. This is so because, unlike sustainability, the MSY principle does not consider ecological and other intangible effects of resource exploitation nor does it take into account the changing human needs over time.

Sustainability should, however, be made a precept in natural resource management. Plato, for instance, accurately and graphically described direct and indirect effects of deforestation of the mountains of Attica on the region's soil and water resource and the economy of Athens.[1]

Conditions for Sustainability

Dasgupta[2] mathematically derives two conditions for attaining sustainability. The first condition states that the rate of harvest from a renewable natural resource should not exceed the rate of natural regeneration/replenishment at any point in time. In mathematical terms, this condition can be stated as: $Tt = H(St)$ where Yt denotes harvest rate of time, t, and H (St) is the rate of natural regeneration in time, t. This condition characterizes a stationary harvest policy. The second condition states that the present value of marginal net social benefit from harvest should be equal to the present value of marginal cost of increasing the current harvest. This condition is a perquisite for a stationary harvest policy to be optimal.

An optimal stationary policy which specifies an optimal level of stock, S*, and an optimal rate of harvest, Y*, has an underlying production function relating labour and capital inputs, natural resources stock, and technology to production of natural resources commodities. A typical natural resource commodity production function may be represented as follows:[3]

$$Y(t) = f[L(t), K(t), S(t), t]$$

Where Y (t) is the natural resource commodity or the harvest/output of the natural resource at time, t, L (t) and K (t) are the labour and capital inputs respectively used in production of Y, S (t) is natural resource stock and t indicates technology. The output of resource commodity could be increased by technological improvement or by augmenting the stock, or by intensifying labour and capital

inputs. An improvement in technology will shift the production function upward and thereby may change the optimal stationary policy, ceteris paribus. Thus, a unique optimal stationary policy associated with every unique resource commodity production function may be visualized. Based on this relationship the optimal levels of harvest and stock need not be stationary or constant over time; they could change in response to human needs and aspirations. In other words, Natural resource's systems could be manipulated and managed to produce socially optimum output over time on a sustainable basis.

Two approaches have been used to attain sustainability on the commons: the agro-ecological characterization approach and the watershed management approach. Both are quite similar in many respects.

The Agro Ecological Characterisation Approach

Inter-disciplinary in ecology, climatology, geography, ecophysiology, soil sciences, plant science, animal science, environment economics and other resource related disciplines is needed to generate new information and technologies necessary for sustainability. At present there is no universally accepted conceptual framework to integrate these different disciplines so that they could interact effectively and contribute to the goal of sustainability. Agro-ecological characterization provides a potentially practicable framework for effective integration of various disciplines.[4] Early global and regional attempts at agro-ecological zoning have shown that this approach can be valuable to agricultural planners. In essence, proper agro-ecological characterization depends upon the collection, organization and analysis of climate, soil and land topography data and their influences on the distribution of spices, plant growth, and agricultural yield. Despite significant advances made in the methodology of agro-ecological zoning, the application of this approach to effective management of natural resources is beset with a number of problems such as controversy over tools and techniques, lack of a unified approach across different disciplines, data inadequacies, and lack of trained staff.[3] In India, this approach is being adopted on a pilot project basis into 15 agro-climatic zones and 74 sub-zones and agro-climatic zonal planning has been accepted as an instrument of ensuring comprehensive and integrated approach to natural resource management.

The Watershed Approach

This approach is conceptually very similar to the agro-ecological characterization approach. The only difference between the watershed approach and the agro-

ecological approach is that in the former, watershed is used as a unit for planning and management whereas in the latter an agro-ecological zone serves this purpose. In a watershed may be defined as a natural drainage area of a river, a tank, or a lake. In watershed approach, a watershed is used as a unit for planning and management of land, water, forests, and other resources of the watershed. The approach is holistic, multi-disciplinary and is a practicable approximation of the systems approach. It enables the planners and managers to consider simultaneously various physical, biological, socio-cultural, economic and institutional factors operating within a watershed and its surrounding environment and formulate a comprehensive and integrated watershed development plan to achieve specific private and social objectives. In the watershed approach, natural and human resources are all inter-dependent and interact with one another. A mono-disciplinary approach focusing on only one of the resources in isolation of the others is inadequate. Similarly, restoration and development of only privately owned land resources in an area cannot resolve the problem of degradation of the entire land resources in an area; CPRs of land which in a typical Indian dry land watershed account for nearly 30 per cent of the geographical area should also be restored and developed.[5] This means that nothing short of a systems approach can realize the full potential synergistic benefits from the use of watershed's resources. The watershed approach is also justified on the ground that it internalizes various externalities[6] involved in the use of land water resources in a watershed and thereby narrows the hiatus between individual and social interest. The externalities can be internalized either by requiring the beneficiaries to compensate those whose activities produced the (positive) externalities or by disturbing the cost of watershed development among all farmers situated in the watershed in proportion to the size of their land holding.

A typical watershed development project consists of the following activities:

- Assessing watershed dwellers' felt needs, priorities, resources and constraints through a benchmark survey.
- Survey, measurement and mapping of the natural resources of the watershed, and assessment of their status and productivity.
- Planning for restoration/development, conservation and optimum utilization of the watershed resources using the latest available technologies and in accordance with the watershed dwellers' needs and preferences.
- Provision of basic supporting infrastructure and creation of necessary institutions.
- Planning for human resource development (through education, training and motivation), and utilization.

India's Experience and Lessons

In India, the watershed approach was first adopted on a significant scale in 1974 when the Government of India (GOI) enforced its implementation under a centrally-sponsored "Scheme of Soil Conservation in the Catchment's of River Valley Projects". These projects are now being implemented by the State governments through their Agriculture Department and technical back up is provided by the All India coordinated Research Project for Dry land Agriculture (AICRPDA), the Central Research Institute for Dry land Agriculture (CRIDA), and the Central Soil and Water Conservation Research and Training Institute. Another Centrally sponsored scheme of integrated watershed Management in the catchments of Flood-Prone Rivers was started during the sixth plan period. In July 1986, the Union Ministry of Agriculture and Rural Development launched the National Watershed Development Programme (NWDP) for rain-fed agriculture as a centrally sponsored scheme.

The Sukhomajri Experience

The Sukhomajri project is a well-known model of micro-watershed development in India and has been well documented. The Sukhomajri experience indicates that exhortations for participation and co-operation do not work, especially if they are aimed at people who live on the margin of subsistence.[7] The poor cannot stop grazing their animals in highly degraded and over-grazed common properly lands for the sake of land conservation when their lives depend on the animals. Only with increased productivity of crops and increased milk yields resulting from supplemental irrigation made possible by the reservoirs constructed under the project, and assurance of equal share of the reservoir water were the villages ready to invest in soil and water conservation measures and to participate in the programme whole-heartedly.[8] A major criticism of the project is that it is highly resource-intensive; a lot of technical, managerial, and financial resources have been spent on the project. Resources of that magnitude and quality are not available in India for replication of the model and hence it is no surprise that the model has not been made available in India for replication of the model and hence it is no surprise that the model has not been replicated elsewhere in India including its home state, Haryana.

The Ralegan Siddhi Experience

Like the Sukhomajri project, the Ralegan Siddhi project is another well-known and well-documented model of micro-watershed development in India.[7] The

Ralegan Siddhi experience indicates that the rural people, under the guidance and leadership of good, enlightened, and honest persons, could achieve a lot through their own efforts and resource. Given proper leadership, it should be possible to replicate this model in other Indian Villages. Padma Shri Anna Hazare is now working to institutionalize the model by training rural youths who have volunteered to follow in his footsteps.

The Pidow Project Experience

The Karnataka's District Watershed Development Programme (DWDP) is also well known in India for its innovative, three-tier organizational structure, statewide coverage, and laudable achievements. The PIDDOW project experience shows that a non-governmental organization could do a good job of enlisting people's participation in soil and water conservation programme perhaps better than a government agency.[9] As a first in the process of enlisting their participation, the project staff organized the people into small homogeneous groups/associations around income generating activities and motivated and trained the people to design, construct, repair and maintain various soil and water conservation structure on their own private land as well as on the common properly lands.

The Operational Research Projects (ORP) Experience

As mentioned earlier, 47 ORPs in integrated watershed development were launched in India during the Sixth Plan period. On the basis of these findings, they concluded that the watershed approach is the key for maximizing crop production on a sustained basis without any detrimental effects on the environment, that the ideal size of a watershed unit for efficient planning and management of resources is 400-500 ha, and that the involvement of farmers, technicians, developments agencies, and administrations is essential in all stages of watershed development and management.

To sum up, the major elements of the watershed approach that help attain sustainability are as follows:

- Restoration of degraded land resources through appropriate soil conservation and land reclamation measures.
- Harvesting, storage, conservation, and optimal utilization of rainwater.
- Use of land according to its physical suitability. This typically means that: (a) steep slopes and fragile land in upper researchers of watersheds, which are

mostly CPRs, are used for growing trees, grasses and other permanent vegetation to produce enough biomass for the needs of the watershed community with respect to fuel wood, fodder, organic manure, etc., (b) relatively flat lands are used for production of foods crops, and (c) cash crops, and the lands in lower reaches of watersheds are used for storage of rain-water for supplemental/protective irrigation during the dry season.

- Preparation of resource budgets, nutrient budgets and balancing of the budgets by recycling of renewable resources like biomass, solar energy, water, atmospheric nitrogen and other plant nutrients. This will ensure fulfillment of one of the conditions for sustainability, i.e., inputs and outputs must be balanced.
- Control of pests and diseases by biological methods.
- Processing of timber, minor forest produce and other biomass to add value to them and to generate employment opportunities for watershed dwellers.
- Manpower planning and development of human resources through education, training, motivation and provision of information about new technologies and government policies, and programmes.
- Determining optimal carrying capacity of watersheds in terms of human and animal population at the existing and prospective levels of technology and adjusting the existing population accordingly. This needs to be integrated vertically and horizontally with planning in other watersheds.
- Organising watershed community along economic activities and motivating them to mobilize their resources, to manage their CPRs collectively, and establish institutions for equitable distribution of benefits from the CPRs and maintenance of the developed CPRs in good productive condition.

Conclusions and Implications

India now has the technical know-how, more important, the means to halt the processes that lead to degradation of natural CPRs. All that appears to be lacking is the political will to apply the available technical knowledge, a national policy and an appropriate institutional structure to plan, co-ordinate, implement, monitor, and evaluate watershed development programmes on a national scale.

Given the interdependencies among various natural and human resources and hence the existence of externalities in their use and management, the watershed approach which is a close approximation of the systems approach, is the most

appropriate approach for planning and management of natural CPRs. Sub-watersheds measuring 400-500 ha each could be used as units for planning and management but smaller administrative and/or socio-economic units should be used for implementation and monitoring purpose. The components of balanced resource budgeting, crop nutrients budgeting, and biomass-recycling constituting the watershed approach largely ensure that the conditions for sustainability are fulfilled. Integrated development and use of privately-owned arable lands and CPRs of non-arable lands in a watershed can generate enough biomass for meeting the basic needs of local people and nutrients requirements of crops on a sustainable basis.

There is a need for a cross- sectoral and interdisciplinary study to sustainability. In essence, it requires that all major actors and players in the development process, namely, policy-makers, hydrologists, soil scientists, agronomists, horticulturists, foresters, environmentalists, resource economists, sociologists and so on jointly devise watershed development and management strategies that are not only technically and economically viable but also socially and politically acceptable.

The involvement of the people in planning and implementation is essential for success of watershed development projects. To enlist people's participation, good local leadership, flexibility in project design and operational procedures, equity in the distribution of project benefits and cost sharing, support of a non-governmental and non-political organization and proper education and training of people are all essential. Furthermore, people would not generally participate in a project unless the expected private benefits from participation are markedly higher than the expected costs of participation.

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