Chapter 3 Conceptual framework for sustainable watershed management

The second research question is answered in this chapter. A conceptual framework is developed based on the lessons learned from Chapter 2 that helps to understand the different aspects and elements of sustainable watershed management and their interactions.

3.1 Introduction

Sustainable development was defined in the Brundtland report ‘Our Common Future’ WCED, (1987) as “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” Subsequently many authors have used the term sustainable development for specific development activities like sustainable agriculture, sustainable forestry, sustainable energy development, etc. A single development may be considered successful if it is weighed against its specific performance criteria. But, to achieve sustainability, all different aspects of development should be considered simultaneously. For this an integrated approach is essential. Through this framework an attempt is made to integrate different aspects of sustainability in the context of watershed management.

The United Nations Environment Programme (UNEP) observed that “the intensified and unsustainable demand for land, water, marine and coastal resources resulting from the expansion of agriculture and uncontrolled urbanization leads to increased degradation of natural ecosystems and erodes the life supporting systems that uphold human civilization. Caring for natural resources and promoting their sustainable use is an essential response of the world community to ensure its own survival and well-being” (UNEP, 1996). Euston and Gibson (1995), “interpret sustainability broadly to mean a condition in which natural systems and social systems survive and thrive together indefinitely. Sustainability represents a distinctly contemporary imperative, stemming from persistent, unfulfilled claims of solidarity and justice, a deepening understanding of the interrelatedness of life, and the stark realities of the destruction of nature. Today it becomes a basic human responsibility to ensure that both natural and human systems are sustained in a condition of health-for the sake of earth and people”

Many research organizations and individuals have defined sustainability with regard to development in agriculture, forestry, land management etc. The Consultative Group on International Agricultural Research (TAC/CGIAR, 1988, cited in: Prinz, 1998) states that sustainable agriculture is the successful management of resources of agriculture to satisfy changing human needs while maintaining or enhancing the quality

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1 Based on Vishnudas et al. (2005a, 2006b)
of the environment, conserving natural resources. According to Bruenig (1996), "sustainable management of forests should aim at forest structures which keep the rainforest ecosystems as robust, elastic, versatile, adaptable, resistant, resilient and tolerant as possible; canopy openings should be kept within the limits of natural gap formation; stand and soil damage must be minimized; felling cycles must be sufficiently long and tree marking so designed that a selection forest canopy structure and a self regulating stand table are maintained without, or with very little, silvicultural manipulation; production of timber should aim for high quality and versatility. The basic principle is to mimic nature as closely as possible to make profitable use of the natural ecosystem dynamics and adaptability, and reduce costs and risks" Hurni et al. (1996), cited in: Hurni (2000) defines sustainable land management as a system of technologies and or planning that aims to integrate ecological with socio-economic and political principles in the management of land for agricultural and other purposes to achieve intra and intergenerational equity.

For a watershed to be used sustainably, the sustainability of land, agriculture and forest should be considered together. Therefore we define sustainable watershed management as the management of a watershed system with sustainable technological options, which may ensure the sustainability of land, agriculture and forestry or its combinations to conserve natural resources, with adequate institutional and economic options.

3.2 Chain of sustainability

For a watershed to be used sustainably, four main elements need to be considered: natural resources, technology, institutions and economics. A suitable metaphor for these four elements is a chain of shackles, the chain being as strong as the weakest shackle (See Figure 3.1). The functions of each element in the chain are defined as follows:

![Figure 3.1. Chain of sustainability in watershed management](image)

For successful and sustainable watershed management, natural resources should be protected from degradation and maintained for good production. To utilize natural resources, technologies are required. These should be well adapted to local circumstances, and supported by an appropriate institutional setting. People should be able to maintain these themselves and the technologies should be cost effective. The rules defining access and exclusion to natural resources and the services they provide should be
transparent. The institutions governing the use of natural resources should be based in the watershed community. It should involve the relevant stakeholders, particularly the community, from problem identification to all levels of planning. And finally, technologies should be affordable. It should be conducive to increase income as well as to enhance land conservation. If a project does not yield tangible benefits to the people it is not going to become sustainable.

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<th>Natural Resources</th>
<th>Technology</th>
<th>Institutions</th>
<th>Economics</th>
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<td>Reduce soil erosion</td>
<td>Suitable to locality</td>
<td>Governance</td>
<td>Cost-effectiveness</td>
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<td>Increase water availability</td>
<td>Simple to construct</td>
<td>Accountability</td>
<td>Low cost</td>
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<td>Increase productivity</td>
<td>Unskilled labour</td>
<td>Transparency</td>
<td>Construction</td>
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<td>Equity</td>
<td>Maintenance</td>
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<td>Local labour</td>
<td>Efficiency</td>
<td>Labour</td>
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<td>Indigenous technology</td>
<td>Rules and customs</td>
<td>High Output</td>
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<td>Access to information</td>
<td>Land Tenure</td>
<td>Income generation</td>
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- Access to Capital
- Ability to Pay
- Land ownership
- Eligibility to subsidies
- Labour Contribution
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Figure 3.2. Conceptual framework for sustainable watershed management
These four elements of the chain are studied in detail and the factors indicating the sustainability of each element are determined. The conceptual framework outlined here can be applied to watershed evaluation not only in Kerala but also elsewhere in the world with similar situations and will be explored and explained in the next sections (see Figure 3.2).

3.3 Sustainability of natural resources

Degradation of land threatens agricultural productivity and water availability in many developing countries. About 16% of agricultural land in developing countries and a higher proportion of crop and dry lands have degraded moderately or severely mainly through soil erosion, nutrient depletion and salinisation (Scherr, 2000). This degradation can be reversed through appropriate land and water management, which enhances infiltration, stabilizes slopes and increases soil moisture. Fuel, crops and fodder depend upon the availability of soil moisture. Drinking water availability depends upon how much water infiltrates to join groundwater storage, to raise the water table and increase base flow. All these constraints directly depend upon the precipitation, runoff and the conservation measures adopted to prevent soil erosion in the catchment.

Conventional soil and water conservation projects have often failed due to their over emphasis on building structures. The farmers often do not understand the purpose of the terraces and bunds; they may even expect incentives to maintain these structures. Beyond the project these structures may be left unattended and deteriorate. In order to attain sustainability, there should be change in the attitude towards watershed management from a purely technical approach of conservation to a participatory approach by involving people in all phases of project planning and implementation. By considering the traditional practices and experiences of the farmers, experts and scientists could co-develop appropriate technology jointly with the people. Instead of providing engineering structures, semi-permeable vegetative barriers using local materials and local labour can be used. These barriers will filter out sediments, reduce the velocity of runoff and also retain runoff water. This will be less costly compared with constructing engineering structures. Locally available organic manure to substitute expensive chemical fertilizers will reduce water contamination. Soil conservation measures that produce the most rapid return on investment are the most favoured. These include bunds that require relatively small initial investment, provide fodder or fuel, and conserve soil moisture (Kerr and Sanghi, 1992).

Again the farmer's level of access to resources plays a critical role in the acceptability or appropriateness of the various technologies (Johns, 2002). If land is a limiting factor to production then practices that reduce the land area are unlikely to be embraced. If labour is limited, then the gender division of labour and the timing of the various activities become critical to the adoption of technologies; and if capital is limiting...
then any conservation measure requiring specialized equipment is unlikely to be acceptable (Stocking, 1993, cited in: Johns, 2002).

Another important criterion is that different people use the upstream and downstream catchment for multiple purposes. Protection against soil erosion requires revegetation in the upstream and restricted entry for grazing and firewood collection in hilly areas. This will affect the livelihood of the upstream community especially the poor, the landless and women who relies on commons for survival. Croplands on sloping upper watershed areas may also be treated with soil conservation measures. But, the benefits may disproportionately reach the wealthiest landlords in the downstream catchment who own most of the irrigable land.

Factors indicating sustainability of natural resources

The main factors indicating sustainability of natural resources are explained below (refer to Figure 3.2).

*Soil erosion:* Soil erosion happens when particles of soil come loose and are carried away by water or wind. The erosion problem is very severe on certain types of soils, on steep slopes, where there is intense rainfall and where the vegetation is removed. Soil conservation means reducing soil erosion and maintaining soil fertility. It relies on increasing the amount of water seeping into the soil, reducing the velocity and amount of runoff, and keeping enough vegetation to protect the soil surface to bind the soil together (IIRR, 2000).

*Water availability:* Soil conservation is closely related to water conservation. Water conservation relies on trapping runoff water, allowing it to infiltrate into the soil in order to raise the water table and increase the soil moisture level. This can be achieved through conservation efforts like providing pits or dams, ensuring protective cover of vegetation on the soil surface or by providing contour ditches or bunds (IIRR, 2000).

*Biomass productivity:* Management practices should be such that it should increase production: annual and perennial crops, pastures, trees etc. and in doing so will enhance biomass production while conserving soil and water. In the past little emphasis was given to this approach as a means to achieve conservation. In reality, improvements in a farmer’s crop, livestock and land husbandry practices will be more effective in conserving soil and water than the implementation of physical conservation works alone (Shaxson, 1988, cited in: Douglas, 1998).

3.4 Technological sustainability

To achieve sustainable development, sustainable technologies need to be developed, transferred and adopted (Guerin, 2001). Land degradation is a central challenge to sustainable development. At the global scale, key problems threatening natural resources and the sustainability of life support systems are: soil degradation, the availability of
water and the loss of biodiversity (WBGU, 1996, cited in: Humi, 2000). Natural resources can potentially be used in a sustainable way through appropriate technology. Following the sustainability paradigm, 'appropriate' would require that a technology should be ecologically protective, socially acceptable, economically productive, economically viable and reduce risk (Humi, 1997). Management of watersheds can be made possible by using a variety of technologies such as vegetation conservation like grass contours, alternative tillage techniques and physical structures like terraces, stone bunds etc. The World Bank has given more importance to vegetative measures in watershed management. This supports the global trend that favours choosing technologies that are low cost and more farmer friendly. Successful adaptation of this technology in the World Bank projects was achieved by involving farmers in the choice of technologies, a strategy that helps to implement technologies that are more compatible with existing land uses and surrounding environments and that meet farmers needs (World Bank, 2001).

Watershed management mainly involves management of soil and water, agriculture and forestry. But technical remedies for the management of these resources will only succeed if they can function within and address local socio-economic constraints (FAO, 1999). Farmers rarely adopt recommended technologies by the experts. Technologies intended to improve the productivity and sustainability of small scale farming systems should ideally be simple, low cost, productive, maintainable, low risk to climatic variations, flexible, conservation effective such as reducing runoff while improving soil moisture (FAO, 1999). Also, technologies, which are simpler, more accessible and are relatively more labour intensive rather than capital intensive, generate more employment and trigger more intense local involvement (Paranjape and Joy, 1998). Literature shows that farmers and the village community have developed their own technologies based on local knowledge and materials, which are cost effective, simple and easy to construct and maintain. Scientists have investigated the scientific basis of local technical innovations. This has led researchers to either validate the farmer’s practices or improve upon their technical content without losing their comparative advantage of cost effectiveness. Numerous projects in the tropics and subtropics have failed because the technology used turned out to be unsuitable for the specific conditions of the site where they were applied. This unsuitability can be in regard to the natural conditions, to a too high level of technology, or to a too high input and management level and may be incompatible with the local life-style (Prinz, 1998).

Factors for technological sustainability
In order to assess the sustainability of a technology, the following factors are considered to be important (refer to Figure 3.2).
Suitable to locality: Each watershed has its own unique physical characteristics. The choice of technology should be based on local parameters such as soil type, topography, climate, etc. (FAO, 1999).

Simple to construct: The technology should not be too complicated. As the maintenance of the structure has to be done by the local community themselves and as the technology has to be adopted by the farmers after the departure of a project team, its design and construction should be simple to understand and maintain by the farmers (FAO, 1999).

Unskilled labour: Technologies should be easy to construct in terms of time and money. If skilled labour is required, the cost of construction will be high and if the design is complicated then skilled labour will have to be involved (Paranjape and Joy, 1998)

Local labour: Empowering local labour by providing training for the new technology will decrease migration. The more demand for local labour, the more job opportunities and this will improve the livelihood in the watershed (Paranjape and Joy, 1998).

Labour availability: Investments in natural resources for construction of contour bunds or terraces or embankment protections can be particularly labour demanding and may be too expensive to undertake in communities with limited access to labour. For any technology to be adopted, it should be such that it can be carried out during the off-season. Then it does not compete directly with labour for agriculture, and hence the opportunity cost for labour may be lower (McCulloch et al., 1998).

Material availability: Soil conservation is least expensive if the resources required are available in abundance. Conservation programmes should take advantage of local materials for construction (Kerr and Sanghi, 1992). Government programmes in India show that some projects insisted on earthen bund construction even though soil was scarce, simply because they proved optimal under research station conditions. If the material is to be brought from outside, then the transportation cost will be high, which the poor may not be able to afford. Therefore choice of material should take into consideration the proximity at which the material is available while designing the technology.

Indigenous technology: Technological options should take into consideration farmer's indigenous practices. It will be the local farmers who understand the nature of the land, and the real problems they are facing. Earlier top-down, highly technocratic approaches to watershed management paid little attention to local technical and managerial knowledge, which is the root cause of failure of such projects (Kerr, 2002). Reij et al. (1996) cited in: Boyd et al. (2000), reports that local approaches to natural resource management are well suited to complex and dynamic environments.

Access to information: Farmers must know about the availability of new technologies and this knowledge must extend to knowledge about the returns from adoption, which in a risky world requires judgments about alternative possible outcomes of yields and profits. Full information about profitability and risk is rarely available for new technologies,
simply because they are new (McCulloch et al., 1998). Therefore programmes should be planned and implemented in full participation with farmers in order to identify in advance what the farmers will accept and what they will not. Arrangements should be made with farmers to carry out the work on their own land to ensure that they are satisfied with it and to save money (Kerr and Sanghi, 1992).

3.5 Institutional sustainability

The watershed has been recognized as a unit for integrated resource management, where management is not merely limited to land, water and biomass, but also concerned with integration for self-reliance and holistic development of the rural poor. In an operational context, this would mean integrating: different uses and management of resources, different departments with sectoral interest through an inter-disciplinary approach, and towards alleviation of poverty (Mollinga, 2000). All collective efforts are mediated through institutions, and without institutional change we will not move purposefully towards sustainability (Dovers, 2001).

An 'institution' is an underlying, durable pattern of rules and behaviour and 'organizations' is a more changeable manifestation of that (Dovers, 2001). North (1990) defines institutions as 'the rule of the game in society' and organizations may be thought of as 'the players or groups of individuals bound together by some common purpose to achieve objectives' Dovers (2001), drawing partly on Henningham, defines institution as 'a persistent, reasonably predictable arrangement, law, process, custom or organization structuring aspects of the political, social, cultural or economic transactions and relationships in a society. Institutions allow organized and collective efforts towards common concerns and the achievement of social goals. Although by definition persistent, institutions constantly evolve' Thus the failure of any development to attain sustainability may also be due to the inappropriate institutional arrangements. Hence in order to analyze institutional failure or success in a project it is necessary to understand the existing pattern of institutions adopted by that project.

The role of strong institutions at grass root level is crucial for successful watershed management. In the context of watershed management, two kinds of institutions need to link and interact frequently with each other: one involving the internal stakeholders and the other involving the external stakeholders (Farrington et al., 1999). The first is at the community level in the form of self-help groups, user groups or watershed community. These groups are to be empowered and need to be federated at the watershed level for providing a forum for collective action. The second set of institutions encompasses the external agencies such as government, non-government organizations, local administration and researchers. These institutions need to work together for synergy and give top priority to capacity building and financial sustainability of grass root level institutions.
Actors
Each institution involved in the watershed management is closely examined independently to resolve their role in watershed management. The main actors and the important factors are analyzed and discussed below.

For the management to be effective, government has to take decisions in terms of setting up the foundation in which various local organizations and stakeholders can negotiate solutions to local development and resource management issues. Government is the supreme authority to issue guidelines on the use, management and conservation of natural resources; implementation of the rules formulated and resolution of disputes that arise during the interpretation and application of rules. Government can facilitate development activities through capacity building, and provision of technical and financial support. People may be aware of the alternative conservation measures, but due to poor living standards and lack of off-farm employment, efforts to improve sustainable practices seem to be difficult without support from government (Fagerström et al., 2003b). Though there is a shift from the centralized and state driven management regimes towards decentralized and community based management strategies in the watershed management, the process presents a number of challenges to the institutions. These challenges include proper representation of stakeholders, lack of adequate financial resources, lack of planning and political interferences. Decentralizing water management may shift problem areas from central to local level without providing the necessary financial and material resources (Kujinga, 2002).

Government encompasses various departments both at central and state level. Integrated watershed management presupposes integration of relevant departments such as agriculture, forestry, fisheries and animal husbandry. Hence government should be capable to provide adequate guidelines, financial and institutional support to affected people to undertake responsibilities of complex, conflict-ridden problems in resource conservation practices.

Institutional sustainability may not be achieved without the involvement of politicians. The practices of local government and also of the government officers in the local bodies are influenced by politics. Considering the political context of most but not all the developing countries, elected representatives govern the local government; they often win elections through threat and money. Political representation may be characterized by class, gender and caste. Generally the richer members from the upper caste of a community dominate local politics and local organizations, which results in benefits going to certain sectors of the community. Hence the poor and weaker sections may often be left unattended. Their marginal representation may or may not be considered in watershed projects. Also administrative boundaries and hydrological watershed boundaries often do not coincide. A watershed may consist of two or more administrative boundaries, and planning for watershed management has to be carried out
based on the hydrological boundaries. The practical challenges of mobilizing local social and political support across political boundaries pose a major limitation for watershed planning. Decision-making and allocation of funds for the various project activities depends on the political influence of the ruling party and their influence in the local bodies. Therefore political leaders are to be involved in these projects so that they should support (or do not hinder) new alliances and linkages. Also boundaries are central to the watershed management as they specify the area over which jurisdictions shall apply as well as the roles of stakeholders. Hence Schumacher’s (1973) hypothesis can be applied to place jurisdiction at local or community level. As the community is small, the activities will be more transparent to their constituencies and thus it becomes politically more acceptable. Also as the focal areas are small, they fall within a single local government area where members know each other as neighbours (Tiffin and Gichuki, 2000, cited in: Lal, 2000).

According to the World Bank, FAO and many governments, environmental deterioration can be reversed with people’s participation either directly or through the involvement of people in participation with the state governments, transforming the common experience of conflict into co-operation. In the former top-down approach of planning, the community was considered as a hindrance to development programmes rather than a key player. Recent thinking has revived the role of the community in bringing about decentralization, conservation and participation. Participation implies that stakeholders work together to set criteria for sustainable management, identify priority constraints, evaluate possible alternative technologies, formulate policies and monitor and evaluate impacts. All stakeholders must get an opportunity to participate, otherwise more powerful stakeholders are likely to control watershed resources and undertake use practices without regards for their impact on less powerful individuals. Thus the community has to play a dominant role in order to attain sustainability. We have seen from the literature in Chapter 2 that the local communities are closer to the real problems and therefore are aware of factors that experts often do not consider and their objectives are more realistic for economic development. Hence people’s participation is essential for the planning of sustainable watershed management.

The literature on the role of non-governmental organizations (NGOs) in watershed management provides conflicting ideas upon their involvement. Though NGOs have demonstrated the ability to strengthen people’s requirement and to provide a supportive role for creating local level organizations, many of them tend to work more as independent implementers than as catalysts for bridging the gap between local people and the state. The challenge of reaching a large number of poor people in resource poor regions has forced governments to involve NGOs, who are better suited for the task of mobilizing people’s participation (Farrington et al., 1999). The involvement of NGOs in
watershed projects depends on the capacity of the people to organize themselves for collective action.

Researchers are important actors, who can impart knowledge and information, provide assistance in decision-making, may help to prioritize fund allocations in project management and developing innovative technologies for appropriate land and water management. Also integration of user's knowledge and perception with researcher's knowledge is important for identifying resource-conserving technologies. In many places in the world, user participation has been shown successful in the planning of sustainable land management. User participation at all stages of the research provides useful feedback to researchers. It may improve the relevance and appropriateness of the technologies and contributes to actual and potential impact of research (Johnson et al., 2003). Empowering participation (decisions made jointly between researchers and users) should strengthen human capital of participants. Providing training to the people and interaction between people and researchers will strengthen experimentation, problem solving skills and ability to initiate and sustain innovation. Involving people in research often increases project costs in the short run, but it is likely to be cost effective in the long run as the introduced technologies and policies are more appropriate.

Factors for institutional sustainability

In order to build up strong institutions for watershed management, it requires effective involvement of all people. The following indicators represent the important factors for institutional sustainability in the grass root organizations (refer to Figure 3.2).

Accountability: Accountability is the central component of good governance. Accountability is a highly abstract concept, sometimes interpreted in formalistic and legalistic terms, and sometimes used in a more concrete way to refer to the social, economic and political mechanisms through which some agents become responsive to other agents (Moore, 1995, cited in: Bauman, 1998). Therefore all organizations involved in watershed developments should be accountable to the people and also accountable to the government, who can stop funds and disband committees if procedures are not followed as specified. Accountability and authority should be linked and who is accountable to whom should be well defined.

Transparency: All financial transactions should be transparent. This will ensure that funds are utilized effectively and loans and subsidies reach the intended beneficiaries. Also it will help in eliminating corruption especially among politicians, government officials, NGOs and other external and internal agents involved in the project. It also means that all the decisions are taken as per rules and all information are freely available and accessible to the people who are affected by these decisions. Hence information should be understandable to the community (UNESCAP, 2002).
Equity: Equity is linked to fairness. In watershed management, the entire watershed is considered as a hydrological unit. Each individual in the watershed irrespective of rich and poor, class and gender is expected to know how the system works, since environmental service as well as the mutual linkages and dependencies that exist from people living in upstream to downstream. Therefore 'equity' should be considered as a well-defined working rule (Seckler, 1986). Development interventions should confront inequalities between different social and ethnic groups to reduce the chance of inter-group conflict. Failure to take into consideration different gender perspectives can lead to further marginalization of women and does not contribute to sustainable rural development (FAO, 1999).

Efficiency: Efficiency in governance is directly linked to the effectiveness of resource management. The process and institutions will have to consider the needs and interests of society, which help in producing good results with the best use of resources (UNESCAP, 2002).

Participation: Participation of all who are involved in watershed development is the key element of good governance. This can be achieved through the involvement of external or internal stakeholders either directly or officially or through representatives. The stakeholders include all those who affect or are affected by the policies, decisions and actions of the system. They can be individuals, communities, social groups or institutions of any size, aggregation or level in society. The term thus includes policy makers, planners, and administrators in the government and other organizations, as well as commercial and subsistence user groups (Grimble et al., 1995). Participation of people should be ensured in all level of planning from the problem identification to the implementation level. It should be well organized and informed. If the people are socially and economically vulnerable, their needs and priorities should be emphasized and their involvement in decision-making is not a must (UNESCAP, 2002).

Rules and customs: Social relevance and effectiveness of a project depends on how the rules are enforced. Rules are to be enforced impartially. And this shall be achieved through independent judiciary and uncorrupted officials. Informal rules may be endogenously enforced within the community; they are upheld by mutual agreement among the social actors involved or by relations of power and authority between them (Leach et al., 1999). Informal rules are important particularly in the case of common property resource management.

Land tenure, property rights and collective action: Security of tenure is widely recognized as an important prerequisite to sustainable land management (Jones, 2002). Secure tenure in land will encourage people to invest in land, which leads to increase productivity, and increase in efficiency. This may be facilitated through negotiation of tenancy or rent contracts with emphasis on land management to provide enough long-term security to encourage soil and water conservation. Property rights in watershed
management play an important role in governing resource management and may impact on the welfare of the people who depends on these resources. Since people living upstream fail to invest in land and do not consider the downstream impacts, for sustainable solutions to emerge, people should be sufficiently motivated to use resource-conserving practices in their own farms. This in turn needs investments in participatory processes that bring people together to deliberate on common problems, and form new groups or associations capable of developing practices of common benefits (Pretty and Ward, 2001).

**Empowerment:** Empowerment of women’s group may increase the efficiency in resource management. Working collectively, women are often better able to gain rights where they can benefit most. When an additional income is gained through women, they are likely to spend income on household food and inputs into child health and nutrition (Meinzen-Dick et al., 1997).

**Boundary of watershed:** In the context of watershed management, the administrative boundary and the hydrological boundary of the watershed often do not coincide. Watershed projects when decentralized are attributed to the lower administrative jurisdiction without considering geographical or hydrological parameters of the watershed. This is not conducive to integrated watershed management. In addition, people living beyond the watershed boundary in the same administrative jurisdiction when exempted from project benefits may raise socio-political problems (Dovers, 2001).

### 3.6 Economical sustainability

Any new technique or any new measure proposed for soil and water conservation has to be economically viable; otherwise people will not accept it. Even if a new measure fulfils the requirements of all other facets of sustainability, but is not economically viable, it is doomed to fail (Prinz, 1998). If people do not have the confidence that they will benefit from investments in technologies, they are less likely to adopt the technologies (McCulloch et al., 1998). Any land management initiative should aim at enabling watershed settlers to adopt practices conducive to increase income as well as to enhance land conservation. Even though people adopt traditional conservation methods, they do accept innovative technologies that improve productivity (Paudel and Thapa, 2004). Even if the technology is economically viable, the economic return from the conservation measures should cover all the farmers input to be sufficiently attractive to be maintained by the farmer. Therefore it is desirable to measure economic viability not only in terms of crop yield but also in terms of function, such as resource conservation and risk minimization (Prinz, 1998).

While designing different structures for soil and water conservation, we need to know the conditions under which households choose to invest in building or maintaining soil and water conservation practices. This can be analyzed through the livelihood
strategies adopted by the poor, together with policies and structure, which influence these strategies (Boyd et al., 2000). Literature shows that there is a relationship between household’s access to assets and soil and water conservation. According to Anderson and Thampapillai (1990), the level of income, labour availability, access to low cost credit, and secure land tenure are some of the factors influencing the household’s attitude towards conservation. The adoption of soil and water conservation represents a decision by households to intensify their agricultural production – to improve output per unit area through capital investment or an increase in labour inputs. It is essential to recognize that soil and water conservation measures impose opportunity costs through their demands on labour, often at times of peak demand (Hailu and Runge - Metzger, 1993, cited in: Boyd et al., 2000). It is often assumed that investing in soil and water conservation is automatically beneficial without looking in detail at the costs and benefits, and particularly the on-farm versus off-farm costs of soil degradation. Investments in soil and water conservation tend to generate returns in the long term, but do not necessarily result in higher yields or income in the short term (Boyd et al., 2000).

Generally poor people do not have enough income to support and sustain their daily needs. People usually perform soil and water conservation work themselves rather than hire labourers. They will hire labour only if the returns are higher than the wages and if they have cash available to pay the wages. People with off-farm income and those who have jobs outside the watershed may not take sufficient care of their land and may not find it profitable to hire others to do the work for them (Kerr and Sanghi, 1992). This will adversely affect the overall development programme towards attaining sustainability. Provision for subsidies should be available for undertaking soil and water conservation works. Subsidies that are offered should be based on a detailed assessment of the local cost of labour and remittances as a result of work undertaken. They are justified by the public benefit of well-maintained watersheds and reduced erosion. If subsidies are used they should be paid directly to the households on completion and verification of agreed work (Smith, 1998).

Development organizations should view income generation and farmer participation as powerful tools for the management of watersheds. Most farmers need cash income for their households. They often purchase staple foods to complement their own production, work as day labourers or migrate to meet their cash needs. Many farmers meet the goal of food security only through additional income generation. Therefore organizations managing watersheds should select practices that are low-cost, productivity-enhancing, value-adding to the farm income, risk-reducing in the short term and which require little labour or management investments in order to ensure their widespread adoption among neighbouring farmers. The local component of the capital costs, like cost of local materials and local labour, are in effect incomes to the local people, since money goes back to the people as wages and as price for the local materials
bought from them. Hence economic sustainability determines the efficiency of the management system and it relates to the cost effectiveness and affordability of the various activities in the project (refer to Figure 3.2).

Factors for economical sustainability

The following factors determine the economic sustainability of watershed projects. 

Cost Effectiveness: Farmers are incapable of adopting soil conservation technologies that require large capital investments. Construction costs and maintenance, materials and labour should be optimum for the adoption of an innovative technology. The technological choice is highly depended on the overall cost of construction. Mostly soil conservation measures require large initial investments and maintenance works. Small farmers hesitate to adopt new technologies partly due to their suspicion about the benefits of technologies and partly due to other socio-economic constraints (Paudel and Thapa, 2004). Therefore the technology options should be such that net return should be higher than the investment in conservation measures. Using local labour and local materials, job opportunities are created in the watershed. Also increased output from crops and fodder are likely to increase their livelihood. Cost effectiveness may be achieved if the conservation measures are based on understanding of farmer's perception about soil erosion and the condition under which they adopt and maintain conservation measures (Kerr and Sanghi, 1992).

Early efforts to improve land and water management in upland areas provided inadequate incentives and resulted in low adoption and poor maintenance so that improved practices disappeared when the project ended. Land tenure problems, inappropriate technology and inadequate participation explain some of these problems, but the real problem is that there are insufficient incentives for the upstream people to permanently change their land use pattern. As mentioned in Chapter 2, the success of a project is highly depending on the valuable environmental services from people living upstream or downstream. Hence environmental service should be considered as an important tool for the sustainability of the watershed. Since there is no market for environmental services, land users do not receive compensation for such services or consider them when making a land–use decision (World Bank, 2001). The upstream people should be paid by downstream people for the protection of the watershed either through negotiation or through economic linkages (Swallow et al., 2001).

Affordability: Affordability is defined by access to capital and ability to pay. Ability to pay depends, among others, upon ownership of land and eligibility to subsidies. Watershed development is considered a focal point for rural development in many developing countries with the aim of increasing agricultural production and reducing poverty on hill slopes in rural areas (Perez and Tschinkel, 2003). A wide variety of donors and development agencies promote watershed development, including the central
government, several state governments and the World Bank and several bilateral assistance programs. Subsidies are given for conservation measures to adopt conservation technologies with respect to the land holding size, ownership of land and repayment capacity of the users. But a large percentage of users in the upstream area are landless and depend on the uncultivated lands to support themselves. Net benefits are skewed towards the wealthiest landowners downstream, while the poorest people have to bear the cost of conservation. Although bilateral agencies establish major watershed initiatives through government and non-governmental organizations, these organizations may prioritize watersheds with fewer landless people, the subsidies may get diverted from the intended beneficiaries. If a watershed approach is adopted in a project where the administrative boundaries do not coincide with the watershed boundary, those living upstream are likely to get greatest amount of subsidies. Then people living within the administrative boundary but outside the watershed boundary may raise opposition. If fixed land improvement grants were provided irrespective of land holding size to each household or individuals, poorer farmers would benefit more than the better off. The management of common property may be implemented through landless labourers by providing them with some rights over these resources. The disadvantage of offering subsidies to households is that people may produce forged documents claiming more than one household in each family to claim more subsidies (Smith, 1998). Another disadvantage is that if the entire cost is borne by the government or other external agency, the sense of ownership on the part of the community will be weak. It is therefore important to insist on the community sharing, in cash or in kind, a substantial part of the costs of the development (Vaidyanathan, 2001). No perfectly equitable system of subsidies is possible though a fixed grant per household may be the most equitable option. Project norms should be flexible to experiment with different subsidy options. Any subsidy that is offered should be based on the detailed assessment of the conservation works executed.

Agricultural input and output prices, taxes, wages, and interest rates influence the income of farm households and their investment strategies for land and water conservation. The poor anticipate and compare returns with respect to the returns from other livelihood options (Scherr, 2000). Reardon and Vosti’s (1995) concept of ‘conservation investment poverty’ highlights poor people’s limited capacity to mobilize cash, labour, machinery or other resources even for highly profitable and effective investments. In small farms, the poor may be able to invest incrementally without access to financial credit or hired labour by raising cash through off-farm employment. Through collective action and local credit groups, or through sharecropping and community labour, they could undertake resource-improving investments (Scherr, 2000).

Even though impacts are perceptible, it is difficult to assess the economic value of the numerous potential benefits that do not enter the market. These include ecorestoration, management of groundwater, lower risk of soil erosion and flood
protection and maintaining or enhancing biodiversity. Hence the challenge is to introduce an innovative technology which fits into a farming system, which is cost effective and affordable to people.

3.7 Conclusion

Sustainability means maintaining environmental assets or at least not depleting them. The rapid depletion of these essential resources coupled with the degradation of land and atmospheric quality indicate that man has not only exceeded its current social carrying capacity, but is actually reducing future potential and biophysical carrying capacities by extinguishing essential natural capital stock (Rwelamira, 1999). To attain sustainable natural resource use, an integrated approach is essential. Sustainable watershed management may combine sustainable resource use with rural development and poverty alleviation. To achieve sustainable management of watershed and the conservation of natural resources as well as poverty alleviation, there is a need to identify appropriate technologies for watershed management that are affordable and cost effective. Sustainable watershed management needs to be supported by adequate institutional arrangements and must be economically viable. The success or failure of sustainable watershed management depends on what can be symbolized as a chain consisting of four shackles: conservation of natural resources, affordable and effective technology, appropriate institutions and economic feasibility. The chain is as strong as the weakest shackle. If one of them is inadequate, the project fails. The framework developed in this chapter can be used to evaluate watershed projects and may pinpoint at the factors that constrain their sustainability.