Socioeconomic and Policy Research on Watershed Management in India

Synthesis of Past Experiences and Needs for Future Research

Joshi PK, Vasudha Pangare, Shiferaw B, Wani SP, Bouma J and Scott C. 2004. Socioeconomic and policy research on watershed management in India: Synthesis of past experiences and needs for future research. Global Theme on Agroecosystems Report no. 7. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 88 pp.

Introduction

Background

A large portion of the rainfed areas (65% of arable land) in India is characterized by low productivity, high risk and uncertainty, low level of technological change and vulnerability to degradation of natural resources. The region houses a sizable number of unemployed, poverty-stricken and undernourished population. This region is underdeveloped due to extreme seasonal fluctuations, weather and market uncertainties and highly unstable income. The majority (about 70%) of the population in the region is dependent on agriculture. Ironically, the rainfed areas were bypassed with respect to investment on infrastructure and technology intervention as compared to irrigated areas because investments were supposed to be less productive. Policy initiatives were inappropriate, lethargic and often unattended for this vulnerable region. Such a scenario has impeded the growth performance of the rainfed areas as compared to irrigated agriculture.

Water is critical for rainfed areas because of scarcity and also lack of proper management that accelerates shortages. Broadly, rainfed areas are confronted with two major technical and water-related problems:

1. Heavy and intense rainfall and surface runoff during the monsoons leading to soil erosion and siltation or pollution of water bodies downstream; and
2. Severe drought in the summer season leading to acute scarcity of water for postrainy season crops.

These two extreme eventualities need to be managed for enhancing agricultural productivity, augmenting income and preventing degradation of soil and water. The watershed program was initiated with the basic premise to overcome such anomalies in the country. It was viewed as the key program, which could meet the emerging and complex challenges of rainfed areas: deplorable poverty, huge unemployment and acute degradation of natural resources. The program was reckoned as a catalyst to bring the second-generation green revolution [International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) refers as 'grey to green revolution'] in the rainfed areas. The program was expected to benefit poor farmers dependent on marginal areas and bridge the gulf between irrigated and rainfed areas.

The watershed program is a land-based program, which is increasingly being focused on water, with its main objective being to enhance agricultural productivity through increased in situ moisture conservation and protective irrigation for socioeconomic development of rural people. An important concern in watershed development is the equitable distribution of the benefits and sharing of the costs of land and water resources development and the consequent biomass production.

Though the watershed program in India was initiated more than four decades ago, the activities were more vigorous and seriously conducted only during the 1990s, particularly after the worst drought of the century in 1987. The nature and scope of the watershed programs were modified over different plan periods and recently tuned to encourage people's participation. The Government of India through different ministries has invested more than US$2 billion during the last 50 years for watershed development under various programs until 1999–2000. In the past, several useful studies were conducted to assess the impact of watershed programs, and to examine people's participation (eg, Chopra et al. 1990, Farrington and Lobo 1997, Marothia 1997, Samra 1997, Deshpande and Thimmaiah 1999, Hanumantha Rao 2000, Kerr et al. 2000, Ratna Reddy 2000). These studies have mixed conclusions on the performance of watershed programs in achieving the expected economic

and environmental outcomes. These evaluation studies provided useful insights on the performance of numerous watersheds and examined conditions for the success of the watershed programs across different geographical regions of the country. This study draws from many such studies and attempts to synthesize major lessons and experiences through a fresh assessment of the existing literature complemented by in-depth case studies.

Purpose and objectives of the study

The purpose of the study is to review past experiences in watershed research and development in India with emphasis on policy and institutional constraints to sustainable watershed management in the rainfed drought-prone regions, synthesize lessons from diverse experiences, identify knowledge gaps, and develop recommendations for future research. The study will provide useful insight into the importance of economic, policy and institutional issues and constraints and suggest options for watershed management. The analysis will also serve as a basis for identifying needs for future research in this area.

The specific objectives are:

- Undertake a critical review of the existing literature on the socioeconomic and institutional aspects of integrated soil and water management research to identify major research gaps and synthesize key lessons from technology design and development experiences in the semi-arid tropics (SAT).
- Assess the different institutional approaches to watershed management (including ICRISAT's consortium approach in benchmark watersheds) and the role of different stakeholders for successful watershed management.
- Assess and identify factors behind the success (in terms of sustained adoption of technologies and community participation for collective action) or failure of the different watershed management approaches with emphasis on biophysical factors, technology characteristics, distribution of benefits to different members of the community, and socioeconomic (markets, prices, policies, regulations, institutions, etc) constraints at different levels.
- Investigate upstream and downstream tradeoffs and scaling up issues in water use and land use intensification resulting from different watershed management approaches with particular emphasis on various practices on the 'green' to 'blue' water continuum, ie, rainfed to full irrigation. By extension, to assess the implications for scaling up and for sustainable agricultural intensification through watershed management in semi-arid areas.
- Identify existing knowledge gaps and suggest priority areas for further research in relation to policy options and institutional arrangements (at various levels) to enhance private and collective investments in soil and water management resulting in resource use intensification.
- Assess whether suggested future research investments provide high international public goods benefits and how best the Consultative Group on International Agricultural Research (CGIAR) centers can contribute to address these issues and promote sustainable intensification of agriculture in the semi-arid areas.

Scope of the study

The study is based on review of literature and earlier empirical analysis in different watershed areas complemented by field study of six watershed development programs in India. These programs covered different agroecological regions and are managed and funded by different agencies: Mysore resettlement and development agency (MYRADA) in Karnataka, Rajiv Gandhi Watershed Mission

(RGWM) in Madhya Pradesh, Adarsh Gaon Yojana (AGY) in Maharashtra, Sukhomajri and Logarh watersheds in Haryana, Fakot watershed in Uttaranchal and Adarsha watershed in Kothapally in Andhra Pradesh. The paper is organized as follows. A review of theoretical policy and institutional issues and concepts relevant to watershed management is presented. In the next section, the current policy and institutional context for watershed management in India is presented. This is followed by a brief review of the watershed development programs in the country. The next section discusses the methods used for the case studies followed by six selected case studies. Major lessons from the case studies and the review of literature are also presented. The conclusions of the study are presented and in the last section areas for future research are outlined.

Policy and Institutional Issues and Concepts for Watershed Management

In recent years, watershed-related social science research has received considerable attention from scholars in India and elsewhere. The research areas covered a large number of issues important for sustainable watershed management. This section highlights the key concepts and policy and institutional issues in watershed management that would help discuss and interpret the findings of this study in perspective with the existing views and theories. The section highlights: (i) market failures and externalities in watershed development; (ii) incentive problems for collective action in management of common property resources; (iii) incentive problems for private investment in watershed management; and (iv) policy and institutional alternatives for watershed management.

Market failures and externalities in watershed management

Since water flows along the topo-sequence and watersheds are often inhabited by a number of small landholders (belonging to differing social, political and administrative units) with fragmented landholdings and differential resource use rights, optimal and sustainable management of water and soil resources requires appropriate policies and institutional arrangements that encourage and stimulate both private and collective efforts. Costs and benefits from watershed development efforts are determined by the stock of resource use rights and entitlements of individual holders and the ability to exclude others from benefiting from such investments. Excludability depends on biophysical conditions (eg, topography), property rights, and the prevailing legal and institutional framework, including customary laws.

Moreover, investments in water and soil management practices (including cropping systems, cereal-legume rotations, agroforestry, soil conservation, water harvesting, etc) by a single landholder in watersheds often generate valuable economic and ecological goods and services that influence the flow of benefits and costs both on-site (for the resource owner) and off-site (for other members of the community). The off-site unintended spillover effects of private resource use decisions that affect production (or consumption) activities of other farmers and are not mediated through the market mechanism are commonly referred to as externalities. Some of these externalities could be positive and others negative. The distribution of investment costs and benefits and the presence of unintended spillover effects (externalities) determine farmers' technology choices, land use patterns and investment strategies in the watershed. The type of public policies and institutional incentives needed to internalize the watershed externalities depend on the public good characteristics (related to excludability and rivalry) of the economic and ecological goods and services generated from watershed investments.

From an economic perspective, a rational farmer can only be expected to undertake resource-improving investments when the on-site (on-farm) discounted benefits that directly accrue to him/her from such investments are higher than discounted costs. When private resource-improving and conservation investments generate additional benefits (goods and ecological services) off-site, to the community (society) at large, the level of investment undertaken by the private farmer would be less than what would be socially desirable. This occurs because part of the benefits accrues to others, and the self-interested private investor lacks the economic incentive to spend resources beyond what is privately profitable. Capturing such positive spillover social benefits requires special policies (eg, cost sharing, subsidies, benefit transfer, etc) and institutional arrangements to support private farmers in their resource-improving investments. In other cases, the characteristics of the externality may be negative and other farmers in the watershed may have no way of mitigating such spillover effects. Lack of excludability of undesirable effects means that part of their decisions on resource use and production choices fall under the control of other farmers. In the case of watershed, topographic and landownership conditions may also imply that negative externalities flow in several directions (reciprocal externalities) in such a way that land use and water management decisions of each farmer affect the well being of the other. These kinds of mutual spillover effects also require interventions mediated through targeted policies and institutional incentives that encourage cooperation and collective action.

Incentive problems for common pool resource management

In the context of watershed management, common pool resources, ie, non-exclusive resources of which the rights of use are commonly held by users in a relatively well defined group (usually a community), include groundwater and surface water, wastelands and grazing lands, and forests. As market prices and effective government regulation is missing to ensure a sustainable management of these resources, households and communities somehow have to coordinate the supply and demand to avoid overexploitation.

Coordination of resource use at the community and watershed level is complicated because individual households have to forego some of the short-term individual benefits. Whether individual households are willing to do so will depend on many factors, among which institutional issues (ie, factors that facilitate coordination, like information, trust and informal rules and regulations), the perceived short- and long-term private costs and benefits of coordination, and social norms will play an important role.

If people do not cooperate in coordinated use of land and water resources in the watershed, the effects of watershed rehabilitation may not be sustained. In fact, many disappointing watershed development experiences can largely be attributed to communities failing to take over the management of their resource base in the long term. This makes social and institutional issues so crucial for the sustainability of watershed development that without a certain level of local coordination and collective decision-making, sustainable outcomes will be hard to maintain.

Several scholars have elaborated the conditions under which people are expected to cooperate in a coordinated use of the resources and when they are not. Unequivocally, the most famous contribution is the 'Tragedy of the Commons' (source: Hardin 1965), which has for a long time set the stage. In 'Tragedy of the Commons', an individual herdsman decides about the number of cattle he leaves for grazing on a common pasture. As the private benefits of adding an extra cow are higher than the social loss of overgrazing, the pasture is overexploited and the resource is depleted. The example has often

been used to illustrate why common property arrangements would not work. With many people deciding about the use of a resource and nobody controlling the benefits of sustainable use, all users would just choose to maximize their own profit at the expense of the others. According to Ostrom (1990), "Whenever one person cannot be excluded from the benefits that others provide, each person is motivated not to contribute to the joint effort, but to free ride on the efforts of the others. If all participants choose to free ride, the collective benefit will not be produced."

Depending on the socioeconomic context and effectiveness of the institutional arrangements in place, groups of people or local communities might, however, succeed in effectively managing the common resources they control. Within these groups the problem of free riding or non-cooperation can often be dealt within a rather cost-effective way whereas for the state government the costs of monitoring enforcement and control of resource use in the watershed would be enormous. By giving local communities collective ownership, the incentive to regulate resource use increases as well; no longer are the expenses of over use paid by the absent owner (eg, the state); they are borne by the users themselves.

In his analysis, Hardin did not account for the possibility of effective collective ownership. In fact, his analysis addressed the problem of an open access resource 'free for all'. Whereas in an open access resource there are indeed little incentives for agents to cooperate, in common property resources social norms and informal rules and regulations of the communities can provide the incentives for controlling free-riding behavior.

Although a theoretical framework for the analysis of common pool resource management is lacking, the factors that determine local communities to be successful in addressing the problems with common pool resource management involved have been assessed in several empirical studies. Agrawal (2001) provides an overview of three major studies on common property resource management in India by Wade (1988), Ostrom (1990) and Baland and Platteau (1996). Agrawal distinguishes four categories of factors that play an important role:

1. Resource system characteristics
2. User group (UG) characteristics
3. Institutional arrangements
4. External environment

Resource characteristics affect the conditions for cooperation both through the extent to which user rights can effectively be assigned (predictability of the dynamics of resource use, boundaries of the resource and its size) and the scarcity of the resource and the degradation risks involved. Although Agrawal in his overview does not account for this last condition, resource scarcity (and the economic value of the resource) affects the incentive for cooperation through its impact on the perceived benefits of coordination. Research has shown this relation to be non-linear; for heavily degraded resources, users are expected not to cooperate as the expected benefits are low, whereas for ample resources cooperation derives little benefits as these are abundantly available (Chopra and Kadekodi 1999). Ecological risk and resource scarcity also affect management of resources (Wade 1988). The author explained much of the variation in village organizations by accounting for differences in resource scarcity and environmental risks.

The UG characteristics are expected to affect the conditions for cooperation through their effect on the costs of coordination and the social dynamics of resource use involved. Although the effect of inequality on the sustainability of common pool resource management are rather ambiguous (Baland

and Platteau 2001), with increasing group size, heterogeneity and differing interests, the costs of coordination tend to increase as well. Coordination costs are the so-called transaction costs that arise where people interact. Interaction will be rather costless when people know and trust each other, but as soon as they are not so familiar with each other's motives and background, investments have to be made to facilitate interaction. Shared norms and values, UG interdependence, a shared history of village cooperation and many other factors help in reducing the transaction costs of cooperation. If consequently the costs of cooperation are low, the likelihood that the community will succeed in managing its resources in a sustainable way increases too.

Institutional arrangements are basically the investments in coordination and resource allocation mechanisms that were earlier made. Institutions do not necessarily coordinate resources in a socially optimal way; however, as has been shown by Baland and Platteau (2001), institutions might serve distributional purposes more than welfare objective of improved resource allocation.

This can be explained by the fact that local institution building requires investments as well. Just as income inequality may trigger a more sustainable management of common resources if it induces the rich to invest in conservation of these resources, the costs of institution building and monitoring, enforcement, and control are often borne by the larger shareholders in the common resource base too. This might be positive for total welfare, as some form of resource use coordination will now arise, but more often the financiers will push their own interests at the forefront of these institutions. Institutional arrangements actually improve efficiency by reducing the costs of coordination. But this may vary depending on the local socioeconomic and political context; the existing institutions might as well reflect the vested interests of the more powerful resource users, without actually improving the sustainability of common pool resource use. Participation of the different stakeholders in decision-making, fairness in the distribution of resource costs and benefits, and accountability of the resource managers involved could give an indication of how effective existing institutions could be in coordinating and regulating the use of common pool resources.

Finally, the external environment plays an important role in influencing the incentives for sustainable resource use, both through its direct effect on the perceived costs and benefits of cooperation, and through the interactions with the broader institutional context. Changes in market structure, input-output prices, subsidies, population growth, and external aid are important factors that affect the sustainability of local resource use. These factors are also important for conservation or productivity enhancing investments in privately owned resources in watersheds and will be discussed in the following section.

Incentive problems for private investment in watershed management

The livelihood strategies and resource use patterns of rural households are determined by asset endowments and exogenous conditioning variables, like population pressure, technological options, rural infrastructure, public policies and access to markets and institutions (Reardon and Vosti 1995). The farm-level profitability of production and conservation technologies and available investment options differ across regions and countries based on socioeconomic, policy and biophysical conditions (Binswanger and Rosenzweig 1986, Pender et al. 1999, Shiferaw and Holden 2001). This implies that technology development and intervention strategies for sustainable intensification of agriculture should take into account differences in the biophysical and socioeconomic factors in different ecoregions. Important factors that influence farmer incentives to undertake private soil and water conservation investments are highlighted.

Markets and policy

The adoption of new conservation technologies and investments will depend on the relative returns and stability of incomes that new options provide compared to existing alternatives. Smallholder farmers are generally risk-averse (Binswanger 1980). Land degradation increases the risk of future crop failures and risk-averse households under perfect information can be expected to invest in practices that reduce degradation. The choice of technologies and investment strategies will therefore depend on profitability as well as risk (stability of income) considerations. To the extent that new technologies are perceived to be risky, food security and safety-first considerations can deter adoption of profitable options. Apart from risk, access to credit and ability to relax capital constraints also affect technology adoption and farmer investment behavior. Credit in many developing countries is made available for productive inputs like fertilizer and improved seeds, which are expected to bring returns in the short term. Conservation and resource-improving investments that often bring benefits in the medium to long term are poorly served in credit markets. The high cost of capital credit may also be higher than the rate of return on conservation investments, thereby discouraging farmers from adopting such alternatives.

In addition to profitability, stability of incomes in pest, disease and drought stress situations and availability and access to inputs needed in the production process are vital considerations for farmers. Besides profitability, the functioning of local markets determines the level of use of fertilizer, labor and other inputs needed in the production process. In semi-arid areas, the short growing period increases the pressure on available family labor during the planting season. Imperfections in credit and labor markets also prevent the ability to effectively alleviate these constraints.

Soil and water conservation methods, like terracing and leveling, often require enormous labor investments per unit of treated land. Least-cost and labor-saving water and soil management options that require locally available resources are preferred options. In the wake of increasing land scarcity, vegetative methods (eg, growing grasses and legumes) and agroforestry methods that do not compete much with available farmland and provide additional benefits in terms of increased production of food, fodder and fuel-wood, and reduce wind and water erosion are suitable options requiring more attention in natural resource management research and development efforts.

In some cases, public policies subsidize certain inputs (eg, fertilizer, water and power subsidies in India) or the public sector accounts for a significant share of the local and national supply (eg, water sector in many countries). Some of these subsidies may provide distorted signals to resource users and displace individual efforts for undertaking resource-conserving or -improving investments. For example, subsidies on fertilizer and irrigation water as in India may discourage farmers from adopting innovations that reduce soil erosion and conserve available water supplies.

Property rights and externalities

One other factor, which has received greater attention in the literature in recent times, is right of access and security of rights to resources (eg, Feder and David 1991, Place and Hazell 1993, Besley 1995). For obvious reasons, farmers lack the economic incentive to invest in resource improvements unless the existing resource rights ensure that they will reap the fruits of their investment. Security of rights does not, however, presuppose private ownership or private titles to the resource. What seem to matter most for private investment are the degree of security (in terms of ability to exclude others and enforce rights) and the duration of use a given property rights regime provides to the resource user. When the length of use rights is short or when the probability of retaining rights is low (eg, due

to risk of expropriation), the expected returns from resource-enhancing investments can be very low. This has the effect of shortening the planning horizon of the resource user.

As explained earlier, a related problem occurs when part of the benefits of private investments (positive externalities or spillover effects) accrue to the community or society at large. When the social or communal benefits are larger than private benefits, the optimal level of investment undertaken by a private individual will be less than what would be optimal for society at large. This requires public interventions through cost sharing and subsidies that would stimulate private investments to a socially desirable level. In other cases, costs and benefits of investments are unequally distributed or even accrue to different groups of people often geographically separated from each other. This kind of problem often occurs in watershed management where water and soil conservation investments on the higher reaches bring disproportionately higher benefits to farmers in the lower reaches of the watershed. This creates problems for collective action unless some innovative institutional arrangements can be designed to compensate the losers. If individual resource users in the watershed invest in conserving or improving the resource, the resulting privately optimal level of investment will fall short of what would be optimal at the watershed scale since such investments also bring spillover benefits to others located downstream.

Poverty and time preference

Poverty is one factor blamed for limiting the uptake of more profitable natural resource management technologies. When markets are imperfect, poverty may be associated with high rates of time preference, which may discourage investments with upfront costs but generate long-term benefits (Holden et al. 1998). High rates of time preference (subjective rate of discount) and insecurity of tenure (short-planning horizons) discourage technologies with high initial investment costs and relatively higher net benefits in the future.

In the absence of better alternatives that provide short-term economic incentives, public intervention would be required to encourage adoption of resource-conserving practices by compensating farmers for an amount equivalent to the technology gap (net short-term losses from choosing new options). Unless subsidized, farmers with a positive discount rate may not be interested in such technologies with high initial investment costs and delayed benefits.

Biophysical factors and technology options

Factors such as natural fertility of soils, topography, climate and length of growing period also influence the success of research investments and the type of technologies needed to sustain livelihoods and conserve the resource base (Binswanger and Rosenzweig 1986). For example, in semi-arid areas with infertile soils and erratic rainfall patterns, risk considerations imply emphasis on water management to reduce soil erosion and to increase crop yields. In semi-arid areas suffering from moisture stress and seasonal drought, technologies that provide moisture conservation gains are likely to provide insurance against drought risk and reflect easily on crop productivity, thereby providing incentives for farmers to adopt such practices. Technologies for harvesting rainwater and groundwater also provide opportunities for supplementary irrigation, which would increase the productivity of other purchased inputs (eg, fertilizer) and raise the income of the poor (Oweis et al. 1999).

In higher rainfall areas, soil and water conservation mainly helps to mitigate soil erosion and reduce overland flow and improve safe drainage of excess water. The heterogeneity of the biophysical system in both dry and wet areas requires careful consideration of local conditions in development of

watershed management technologies. Farmer incentives to adopt and adapt soil and water management technologies as component parts of watershed management programs will therefore depend on availability of profitable technological options in a given biophysical and socioeconomic setting.

Policy and institutional alternatives for watershed management

Addressing the challenges of sustainable natural resource management through watershed-based planning and implementation requires innovative policy and institutional alternatives that will help internalize the externalities and deal with the unique coordination and incentive problems of policy and market failures for private and collective action. There are no universally accepted policy and institutional arrangements to address these problems; the set of policy and institutional options should be fine-tuned to fit the local biophysical and socioeconomic conditions of the area. The relevant policy issues should include creation of enabling conditions including availability of profitable conservation and production technologies, markets for local produce and required inputs, and a system of property rights that would encourage private and community investments. Special policies may also be developed to foster the uptake of some socially desirable technologies that may not be otherwise adopted by individual farmers to a required level. This may include mechanisms for price support to local produce, cost-sharing arrangements with farmers and the communities for specific watershed investments, targeted subsidies for specific locations (eg, low-income rainfed regions) or communities (eg, minority groups), and creation of basic infrastructure to facilitate the emergence of competitive markets. Targeted subsidies could also be interlinked with other socially desirable programs in such a way that beneficiaries would be required to comply with other established principles and norms. An example may be linking fertilizer subsidies with active participation in community watershed management programs.

The institutional arrangements required for sustainable watershed management are equally varied and diverse. The basic elements should include arrangements for delivery of credit service, information, enforceable rules and regulations to regulate the use of common property resources, legislation for empowering local communities and mechanisms for local capacity building. Local-level institutions (and enabling policies) that enhance collective action, conflict resolution and equitable distributions of benefits from watershed development to the various segments of the community (including the minorities, the landless and women) are also required. An important policy and institutional issue is the linkage of property rights to land and groundwater use in watersheds. When the water rights are linked with land rights, private investment in water use may lead to depletion of groundwater resources. This is a classic common property externality where the action of any one economic agent increases the social costs of resource use for the entire community and the individual user lacks the incentive to limit his/her level of use. Collective ownership of groundwater may be a suitable approach in this case. Under such arrangements, indigenous institutions and community norms could be evolved to allocate trade rights to groundwater that landless farmers and laborers could also benefit.

Strong local-level institutions can increase the viability and sustainability of watershed management programs by empowering the community to manage and maintain the assets created under the project. Strengthening and empowering local institutions, however, needs to be done through a continuous process of capacity building, which includes not only technical training but also human resource development for upgrading communication skills, building confidence and leadership, decision-making and conflict resolution.

Current Policies and Institutional Arrangement for Watershed Management

Watershed development in India is reckoned as the engine of growth and sustainable development in the rainfed and drought-prone areas. Hence, the watershed development program in general receives good policy support at the national and state levels. Several programs were launched to target watershed development with a focus to improve food security, alleviate poverty and sustain the quality of the natural resource base. This section covers some important policies and programs launched by the Central Government that affect the success of the watershed programs. The most important policies and guidelines including the National Agricultural Policy, Water Policy, Land Policy, Forest Policy and the Watershed Development Guidelines are highlighted.

Agricultural development policy

The new agricultural policy, released recently, is an all encompassing national guideline for addressing wide-ranging problems of the agricultural sector. Over the next two decades, it aims to propel a growth rate in excess of 4% per annum – a growth that is efficient, equitable, demand-driven and sustainable. The policy lays out a comprehensive national strategy for attaining these lofty goals and targets. The watershed management approach has been identified as a major intervention strategy for integrated and holistic development of the rainfed areas. The policy emphasized strengthening the watershed development programs. It states that "... the Government accords abiding importance to improving the quality of the country's land and soil resources. Reclamation of degraded and fallow lands as well as problem soils will be given high priority to optimize their productive use. Special emphasis will be laid on conserving soils and enriching their fertility. Management of land resources on watershed basis will receive special attention. Areas of shifting cultivation will also receive particular attention for their sustainable development. Integrated and holistic development of rainfed areas will be promoted by conservation of rainwater by vegetative measures on watershed basis and augmentation of biomass production through agro- and farm-forestry with the involvement of the watershed community. All spatial components of a watershed, ie, arable land, non-arable land and drainage lines will be treated as one geo-hydrological entity. Management of grazing lands will receive greater attention for augmenting availability of animal feed and fodder. A long-term perspective plan for sustainable rainfed agriculture through watershed approach will be vigorously pursued for development of two thirds of India's cropped area which is dependent on rains" (Government of India 2000b).

The National Agricultural Policy clearly provides strong support to the watershed development programs. It reflects the observed commitment of the Government to take up watershed development programs more aggressively, including provision of the necessary financial and institutional support for its implementation. Its implications were reflected in the annual budget (2003–04) of the Central Government, which stressed on promoting watershed development, conserving natural resources and bringing second green revolution in India. The policy defined at the national level is very conducive and favorable to watershed development. Its implementation may, however, depend on the capacity at the state and local levels.

Water policy

The Central Government plays a crucial role in defining and establishing the overall framework and guidelines for state-level operation and implementation of various programs to improve water

allocation and its efficient use and management. The National Water Policy, first adopted in September 1987, has been revised and issued again in 2002 to address the newly emerging issues of water availability, quality and inter-sectoral distribution. The policy recognizes that "water is a scarce and precious national resource to be planned, developed, conserved and managed". It identifies water management as one of the most crucial elements in the development planning of the country. In relation to watershed management, the policy states, "… watershed management through extensive soil conservation, catchments-area treatment, preservation of forests and increasing the forest cover and the construction of check-dams should be promoted. Efforts shall be to conserve water in the catchments" (Government of India 2002). Further, on drought-prone area development, the policy states, "… it should be made less vulnerable to drought-associated problems through soil-moisture conservation measures, water harvesting practices, minimization of evaporation losses, development of the groundwater potential. Pastures, forestry or other modes of development which are relatively less water demanding should be encouraged. In planning water resource development projects, the needs of drought-prone areas should be given priority." The policy identifies the water allocation priorities (in decreasing order) as drinking water, irrigation, hydropower, ecology, industry, navigation and other uses. To meet these criteria, water resource development and management is to be planned as multiple-use projects considering the hydrological (eg, watershed, sub-basin, basin) sectoral and environmental aspects for sustainable and conjunctive use of surface and groundwater resources.

The recently released document 'Vision for Integrated Water Resources Development and Management' by the Ministry of Water Resources, Government of India stressed the need for rainwater harvesting, preventing soil erosion providing sustainable irrigation and mitigating the problem of drinking water. The action plan set to accomplish rainwater harvesting is to support non-government efforts in rainwater harvesting both financially and technically (Government of India 2003). Similar thrust has been given by various state governments in their respective 'Vision 2020' documents implying that watershed programs would receive high priority for conserving rainwater, preventing soil erosion and overcoming vulnerability of the poor in the rainfed areas. These policies clearly demonstrate the commitment of national and state governments for the development of rainfed areas through watershed management. The missing elements in these policies are related to the lack of clarity on the rights to surface water and groundwater and incomplete recognition of the rights of communities to manage water resources through collective action.

The priority given to the drought-prone areas in planning water resource development projects in the policy is consistent with the emphasis given to watershed development in the country. The policy does not accord much significance to watershed development for conserving rainwater, recharging groundwater, afforestation and pasture management. It also does not stress on community participation in management of soil and water resources. In the absence of strong community participation the success of such programs is uncertain. The policy also fails to address the individual and community rights on surface and groundwater. The de facto situation is that the individual who owns a given piece of land has the right to appropriate surface water and groundwater. In the watershed framework, the community conserves the rainwater and recharges the groundwater using check-dams and other recharge facilities. However, in the absence of appropriate regulatory mechanisms and institutional arrangements for distribution of benefits across households including the landless, the private landowners capture the irrigation benefits from increased availability of groundwater. The water policy fails to address this important issue for watershed management. The national water policy seems to relegate such powers to the states, which are expected to formulate and implement state water policies backed with operational action plans within two years (ie, before

2005). As in the case of other national policies, translating the national water policy into action at local and state levels will be crucial for attaining the goals of watershed management. Lack of proper institutional structures and mechanisms, enabling legislation and supporting economic incentives will also affect the implementation of the policies at the local levels.

Land policy

Land reforms, land ceilings and restrictions to sell agricultural land were the important policy decisions taken at the national level. The purpose of land reform was to abolish tenancy, give land rights to the tiller and consolidate the fragmented lands. The aim was to protect the interest of the farming community and landless laborers. The smallholder farmers dominate Indian agriculture; their number is increasing due to restrictions on sale of agricultural land and shortage of non-farm employment opportunities. The average size of landholding at the national level is too small (1.1 ha) and is often fragmented into small parcels. About 80% of the operational holdings are <2 ha. Their number consistently grew from 70% in 1970–71 to about 80% in 2000–01 (Table 1). The smallholder group (<2 ha) of the farming community commands approximately 39% of the total operational area. There are estimates that in next ten years this group would command about half of the total operational area (Jha 2001). These smallholder farmers are economically unviable and unsustainable. The majority of the small and marginal farmers cultivate for their food security. About 85% of the land in their possession is under food grains to meet their own consumption needs. The marketable surplus is very small, which restricts them from tapping new income augmenting opportunities and from commercialization of agriculture. The purpose of land reform policy was to consolidate the fragmented landholdings and distribute the donated and unutilized lands to landless laborers and small and marginal farmers. Initially the policy was successful in consolidating fragmented lands but the law of inheritance further fragmented the landholdings.

The other land-related policy was the agricultural land ceiling act. The agricultural land ceiling act was passed to protect the interest of small and marginal farmers. The purpose was to discourage large farmers, who because of their economic and social power, accumulate land and exploit the small and marginal farmers, and thus bring social justice and equity in land distribution. The national land ceiling guidelines of 1972 suggested an upper farm size limit ranging between 4.05 and 7.28 ha in irrigated and dryland areas, respectively. The states were, however, empowered to develop and implement their own land ceilings suitable for local conditions in irrigated and dryland areas. Accordingly, the states have defined the land ceiling depending upon the perceived productivity of land, ie, irrigated

Table 1. Share of operational landholdings by size groups in India.

Size group	1970–71	1980–81	1990–91	2000–01
Number of operational holdings (%)				
Small (<2 ha)	70	74	78	81
Medium (2–4 ha)	15	14	13	12
Large (>4 ha)	15	12	9	7
Area of operational holdings (%)				
Small (<2 ha)	21	26	32	39
Medium (2–4 ha)	19	21	23	25
Large (>4 ha)	61	53	44	36

Source: Jha (2001).

(one crop or two crops) and dryland (Table 2). There are very few states, which have land ceilings exceeding 10 ha in irrigated land with one crop. In dryland areas, the limits were kept at higher levels. This is an indirect compensation for the lower relative productivity of land and the much higher risk and uncertainty in dryland agriculture.

Another important policy decision was to restrict the sale of agricultural land. Due to urbanization and industrialization, the agricultural lands are targeted. In the absence of such policy, the investments made for land improvement under the watershed programs in areas where the non-agricultural demand for land is high may be in vain.

Small and fragmented landholdings are one of the major obstacles to enhance private investment in watershed programs. The small and fragmented holdings make it difficult for the farming community to make investments on land improvements and discourage planting high-value crops, which need intensive care and protection. Land consolidation encourages investment on land improvements due to economies of scale and reduces cost of protection. The watershed development programs provide opportunities to small and marginal farmers for collective action that allows a consistent treatment of adjoining pieces of land and reduces costs due to economies of scale. Future land policies need to discourage further decline in landholdings and their fragmentation.

Forest policy

The severe drought of 1987 has prompted policy makers and foresters to seriously reexamine the forest status and policy issues that affect forest management in the country. It was reckoned that the fast depletion of forest resources was one of the major causes of drought that led to the serious water crises and degradation of natural resources throughout the country. It was decided that at the national level at least one-third of the total land area of the country should be under forest or tree cover. In the hilly and mountainous regions, two-third of the land area was required to be under forest cover to

Table 2. Ceiling on landholdings in India.

State	Irrigated land (ha)		Dryland (ha)
	With two crops	With one crop	
Andhra Pradesh	4.05–7.28	6.07–10.93	14.16–21.85
Assam	6.74	6.74	6.74
Bihar	6.07–7.29	10.12	12.14–18.21
Gujarat	4.05–7.29	6.07–10.93	8.09–21.85
Haryana	7.25	10–90	21.80
Himachal Pradesh	4.05	6.07	12.14–28.33
Jammu and Kashmir	3.60–5.06	–	5.95–9.20
Karnataka	4.05–8.10	10.12–12.14	21.85
Kerala	4.86–6.07	4.86–6.07	4.86–6.07
Madhya Pradesh	7.28	10.93	21.85
Maharashtra	7.28	10.93	21.85
Orissa	4.05	6.07	12.14–18.21
Punjab	7.00	11.00	20.50
Rajasthan	7.28	10.93	21.85–70.82
Tamil Nadu	4.86	12.14	24.28
Uttar Pradesh	7.30	10.95	18.25
West Bengal	5.00	5.00	7.00

Source: Government of India (2001b).

prevent soil erosion and to ensure the stability of the fragile ecosystems. The 1988 Forest Policy was formulated to address these targets by focusing on conservation that includes preservation, maintenance, sustainable utilization, restoration and enhancement of forests and natural environment (Government of India 1988). The Forest Policy has great significance for watershed management. It is aligned with the watershed management objectives that emphasize conservation and management of natural resources. The key objectives of the Forest Policy that are relevant to the watershed programs include: (i) maintenance of environment stability through preservation and, where necessary, restoration of ecological balance that has been adversely disturbed by serious depletion of the forests; (ii) prevent soil erosion and denudation in the catchment areas of rivers, lakes and reservoirs in the interest of soil and water conservation for mitigating floods and drought and for reducing siltation of reservoirs; (iii) control further problem of sand dunes in the desert areas of Rajasthan and along the coastal tracts; (iv) expand the forest/tree cover in the country through massive afforestation and social forestry programs; (v) meet the growing demand of fuel-wood, fodder, minor forest produce and small timber of the rural population; and (vi) make the afforestation programs a people's movement with the involvement of women. Today these could be viewed as integral components of watershed development programs.

To implement the National Forest Policy, the strategy was to develop a need-based and time bound program of afforestation and tree planting, with more focus on fuel-wood and fodder development, on all degraded and denuded lands in the country, whether forest or non-forest land, is a national imperative. It was subsequently decided that village and community lands should be given priority for afforestation and fodder development programs. Undoubtedly, such programs would control soil erosion and runoff, prevent desertification and improve the micro-ecosystem. To encourage the participation of village community, it was decided that the revenue generated from such programs should belong to the panchayats, and such revenues should be shared with the local communities to provide an incentive to protect the forest resources. Since one of the reasons behind depletion of forest resources is the free grazing system, the policy mentioned that grazing in forest areas should be regulated with the involvement of the community. Adequate grazing fees should be levied to discourage people in forest areas from maintaining large herds of non-essential livestock. To initiate such activities, the policy stressed that the government would provide technical assistance and other necessary inputs.

Since land laws are governed by the state governments, the policy document mentioned that these land laws need to be modified to facilitate and motivate people and institutions to undertake tree-farming and grow fodder plants, grasses and legumes on their own land. It emphasized that degraded lands should be made available for this purpose either on lease or based on the land grant rules. Appropriate regulations should govern the felling of trees on private holding.

The National Forest Policy, however, does not mention watershed development as a strategy for enhancing land cover or rehabilitate degraded ecosystems, but its objectives and strategies are by and large consistent with those of the watershed development programs. It is to be noted that one of the intervention points of watershed development is to rehabilitate, conserve and manage degraded lands, and augment production of fuel and fodder through community participation. This goal is commonly shared with the fastest policy of the country. More integration of the forest policy with the watershed management approach is expected to enhance the synergy and complementarity of the two approaches. One important mechanism for implementing the National Forest Policy in the dryland areas is through the watershed development programs.

Watershed development guidelines

Several government departments and state governments took up watershed development programs. Until 1997, watershed development projects have been taken up under different programs launched by the Government of India. Notably, the Drought Prone Area Programme (DPAP), and the Desert Development Programme (DDP) adopted the watershed approach in 1987. The Integrated Watershed Development Projects initiated by the National Wasteland Development Board in 1989 also aimed at developing wastelands based on the concept of integrated watershed development. Since their inception, these programs were taken up by the Ministry of Rural Development. The other major program based on the watershed concept is the National Watershed Development Programme in Rainfed Areas (NWDPRA) under the Ministry of Agriculture. All these programs had their own guidelines, norms, funding patterns and technical components based on their respective and specific aims (Government of India 1994). In 1994, the Ministry of Rural Development issued a new comprehensive guideline for all its projects.

The 1994 guidelines of the Ministry of Rural Development

It was realized that while the focus of these programs may have differed, the common objective of these programs has been land and water resource management for sustainable production. Therefore, common guidelines for all the programs under the Ministry of Rural Development were developed in 1994 and implemented since 1995. These guidelines were used by the centrally sponsored schemes for watershed development under the Ministry of Rural Development and the Ministry of Agriculture. Based on the common principles the Ministry of Agriculture developed a new guideline in 1997 for implementation of NWDPRA.

The 1994 guidelines provide special emphasis to improve the economic and social conditions of the resource-poor and the disadvantaged sections of the watershed community:

- More equitable distribution of the benefits of land and water resources development and the consequent biomass production, and greater access to income generation opportunities and focus on farm resource development.
- Participating villages should be selected based on the community's willingness to provide voluntary contribution and take over management of the assets created through the project when the project activities cease.
- At least 5% of the cost of investment should come from the village community or panchayat or users, who are likely to derive the benefits of such investments.
- At least 10% of the cost of investment on individual works on private property must come from the beneficiary users (5% for schedule castes, schedule tribes and people below poverty line).

In each selected village, a watershed of approximately 500 ha was to be identified and selected by the Watershed Development Team (WDT) in consultation with the panchayat/village community. The area can be increased or decreased subject to the condition that the project implementing agency (PIA) handles a total area of 5000 to 6200 ha. If a small part of the watershed is outside the village boundary, it may be taken up for development with the consent of the neighboring village/panchayat. Other criteria of selecting the watershed area are:

- The area has acute shortage of drinking water.
- Large population of schedule castes and schedule tribes depend on it.
- Preponderance of wastelands and common lands.

- Actual wages are significantly lower than minimum wages.
- The area is contiguous to another watershed, which has already been developed.

Depending upon the ecosystem and major problems faced by different districts/blocks, each watershed development project was eligible for funds as specified in Table 3. The amount was to be divided amongst the different project components subject to the pre-decided ceiling. The funds are released in installments; 25% of the project outlay is released in the first year, 40% in the second year, 25% in the third year and the remaining 10% in the fourth year. Every year the funds are released in two installments. After the first installment, the disbursement is dependent on 50% utilization of the funds released earlier. During the first year, 15% of the funds is released to the PIA at 3% for administrative costs, 3% for training, 4% for community organization and 5% for development works. The activity-wise disbursement of the watershed budget is given in Table 4.

The guidelines also specify different training activities for the WDT. The training program for one month of four modules of one week each is most important. The four modules are:

1. Watershed treatment technologies and alternate land uses with emphasis on low-cost structure, vegetative barriers, farmers' innovations and production technologies.
2. Participatory rural appraisal methods and community organization techniques, group behavior and convergence of services.
3. Project management tools and techniques.
4. Administrative and accounting procedures, measurement and recording procedures, inspection and audit, computerization and report writing, etc.

Common guidelines

The 1994 guidelines of the Ministry of Rural Development were in operation for 5 years. This period has seen many successes as well as some failures in watershed development. Hence greater flexibility of the guidelines was essential to enhance the robustness of the response to the regionally differentiated demands that characterize rural India. Since different ministries were involved in the watershed development, it was decided to develop common guidelines. The 1994 guidelines were

Table 3. Funding pattern for watershed development projects, 1994 guidelines.

Ecoregion	Funding pattern (Rs ha^{-1})
Hot sandy arid	5000
Hot arid	4500
Cold arid	5000
Semi-arid	4000
Dry sub-humid	3000
Dry sub-humid (Hill region)	4000
All other areas	4000

Table 4. Distribution of watershed development funds by activity, 1994 guidelines.

Activity	Ceiling (%)
Watershed treatment, development works, development activities	80
Watershed community organization	5
Training	5
Administrative overheads	10

instrumental for developing the common guidelines. The Ministries of Agriculture and Rural Development jointly developed the 'Common Approach/Principles for Watershed Development' in 2000 (Government of India 2000a). The two ministries and Ministry of Forest and Environment then adopted these guidelines as common principles for implementation of watershed development projects.

The Ministry of Agriculture brought out the new guidelines based on the 'Common Approach' in 2000 as 'WARASA - Jan Sahbhagita', Guidelines for National Watershed Development Project for Rainfed Areas (Government of India 2000c). A similar document of revised guidelines (Guidelines for Watershed Development) based on the common principles was also issued by the Ministry of Rural Development (Government of India 2001a). The new guidelines give more flexibility that was needed at village/watershed level. These guidelines, inter alia, envisage the convergence of different programs of the Ministry of Rural Development, Ministry of Agriculture and other Ministries and Departments. Following the 73rd and 74th Amendments to the Constitution of India in early 1990s, the Panchayati Raj Institutions (PRIs) have been mandated with enlarged role in the implementation of developmental programs at the grassroots level, and accordingly their role has been more clearly brought out. The 1994 guidelines were made more flexible, and workable with more participation of the community. The new guidelines provide more emphasis on local capacity building through various training activities and empowering community organization.

The new guidelines also specify detailed criteria for selection of watershed villages including:

- Participatory rural appraisal exercise
- Preparation of strategic plan for watershed development
- Demand-driven approach
- Withdrawal strategy by PIA/WDT
- Mechanism for allocation of watershed budget: Approximately US$43000 and US$64000 are allocated to a watershed of 500 ha with less than 8% and more than 8% slope, respectively for a period of 4 years. A broad allocation of funds based on the 2000 common approach is for major components (Table 5).

Another most important feature of the new guidelines is the development criteria for success of the watershed. Among others, the exit protocol for the PIAs is developed. One can easily rate the watershed based on the criteria developed under the guidelines.

Table 5. Distribution of project fund for different activities, 2000 guidelines.

Components	Allocation of funds (%)
Management	
Administrative cost	10.0
Community organization	7.5
Training program	5.0
Sub-total	22.5
Development	
Natural resource management	50.0
Farm production system for land owning families	20.0
Livelihood support system for landless families	7.5
Sub-total	77.5
Total	100.0

Institutional arrangements for watershed development

The watershed development guidelines and approaches which evolved since the early 1990s have clearly articulated the need for different institutional arrangements from the community to district and state levels. A number of institutions have therefore been conceived and established at different levels (Fig. 1). Besides creating new institutions, existing institutional arrangements are also used for facilitating participation of the people. The PRIs (eg, the rural local bodies), women's groups, youth groups and cooperative societies that already existed before project implementation are also used as platforms for discussion of needs related to the watershed development program. The PRIs should play an important role in the implementation of watershed development, as the recently adopted 73rd constitutional amendment act strengthened their position to plan and manage rural development activities (including watershed management, agriculture, forestry, fuel and fodder and the maintenance of community assets). The following institutions are generally found at the district and village level in both government as well as non-government approaches to watershed management in the country. These institutions are created based on the provisions of the Common Approach and Principles for Watershed Management jointly conceived and developed by the Ministries of Agriculture and Rural Development.

Self-help groups

Self-help groups (SHGs) usually are homogeneous groups consisting largely of landless individuals with common or similar sources of income such as animal husbandry, goat rearing, poultry and agricultural labor. These are more often women's groups having 15–30 members in each group. The primary activity of these groups is thrift and credit. Under the Watershed Guidelines, a revolving fund of Rs 50000 (for a period of four years) is allocated to each watershed project for supporting the SHG members to scale up their activities or to invest in productive assets for increasing incomes.

User groups

User groups largely consist of landowning individuals who will benefit directly from land and water treatment or management interventions such as different types of bunds, farm ponds, farm bunds, etc. These groups may also consist of individuals who will benefit from different interventions on common lands such as fodder development, plantation or protection of trees and vegetation required for livelihoods (eg, leaf plate making and rope making). The UGs are usually formed around specific interventions. Land owners who will benefit from a particular bund form a UG; this group is involved in the construction and maintenance of the bund. The UGs provide a base upon which to build collective action in the management of natural resources in the watershed.

Watershed Association

The Watershed Association (WA) represents all the households residing within the unit identified for intervention and who depend directly or indirectly on the watershed area. The unit of intervention may be a village or a micro-watershed. The WA is established from the SHGs and UGs formed within the watershed area. The Gram Sabha and the panchayat also form part of a WA if the village is the unit of intervention or if the watershed boundary coincides with the village boundary. The WA under the Watershed Guidelines is registered under the Societies Registration Act to make it a legal entity to receive funds from the government.

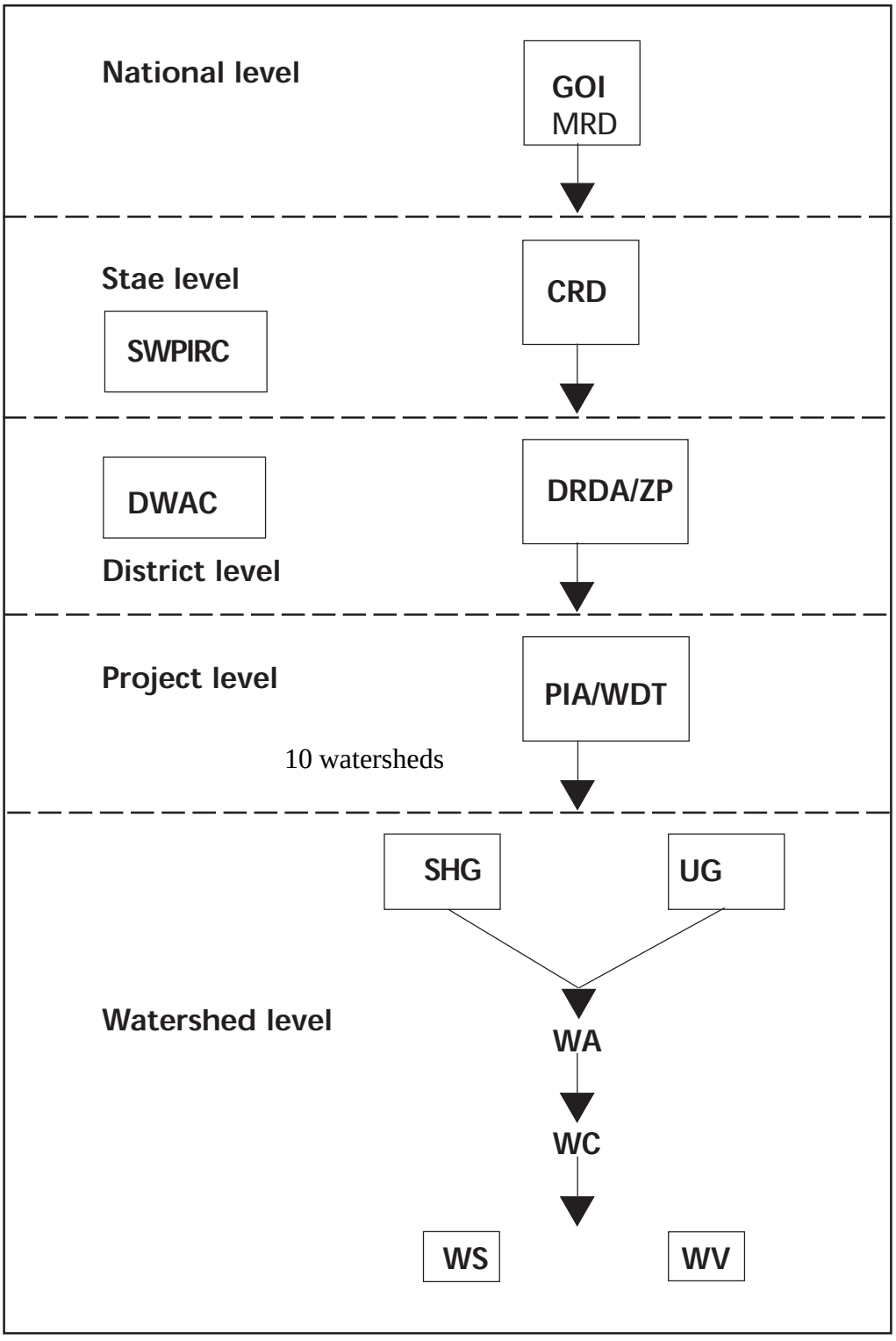

Figure 1. Institutional arrangements for watershed management in India.

(Note: GOI = Government of India; MRD = Ministry of Rural Development; SWPIRC = State Watershed Programme Implementation and Review Committee; CRD = Commissionerate of Rural Development; DWAC = District Watershed Advisory Committee; DRDA = District Rural Development Agency; ZP = Zilla Parishad; PIA = Project Implementation Agency; WDT = Watershed Development Team; SHG = Self-help group; UG = Users' group; WA = Watershed Association; WC = Watershed Committee; WS = Watershed Secretary; WV = Watershed Volunteers.)

The WA, run by an elected president, appoints the Watershed Committee and has the following functions:

- Evolve/improve the watershed development plan
- Monitor and review its progress
- Approve the statement of accounts
- Resolve differences or disputes within or among groups
- Lay down procedures for the operation and maintenance of assets
- Operate the Watershed Development Fund (WDF) account after the project period

Watershed Committee

The Watershed Committee usually consists of 10–12 members who are nominated by the WA. The composition of the Committee consists of 4–5 members from UGs, 3–4 members from SHGs, 2–3 members from the Gram Panchayat, a member from the WDT, at least one woman representative and one representative from the minority community in the village or watershed. The Watershed Committee is responsible for the implementation of the project. The Committee manages the project funds, and is responsible for coordination and liaising with the Gram Panchayat (elected village assembly), PIA, WDT, District Rural Development Agency, Zilla Parishad and other agencies.

Watershed Development Team

The WDT, appointed by the PIA, consists of four technically qualified persons like civil engineers, social scientists and community organizers at watershed level. The four members of the WDT are employed for the period of the project (4 years) through funds made available for watershed development. Under the guidance of the PIA, the WDT works with the communities and facilitates the formation of UGs and SHGs. It works with the WA in planning and implementing the watershed program. The WDT is also responsible for capacity building. The team initiates the processes, facilitates stakeholder participation and provides technical support for development and management of watershed activities.

Project implementing agency

The District Rural Development Agency or the district level council (Zilla Parishad) has overall responsibility for program implementation in the district. They appoint the PIA, which appoints the WDT. The PIA (and hence the WDT) is selected for a cluster of 2–10 watersheds.

Watershed Development Programs and Approaches

Several watershed development programs were launched in India. This section provides an overview on evolution of watershed development programs in the country.

History of watershed management

The concept and history of watershed management in India started way back in 1880 with the Famine Commission, and then with the Royal Commission of Agriculture in 1928. Both Commissions laid the foundation for organized research in a watershed framework. A small-scale watershed development program to conserve soil and prevent land degradation was started during the early twentieth century at Lingajat Peetadhipathi, near Bijapur in Karnataka. The activities included bunding in the then Bombay Province for rural employment during drought relief operations. Thus Bombay Land Improvement Act, 1943, provided a model for other states. Realizing the importance of the watershed programs for land reclamation, the multi-disciplinary Soil Conservation Department was set up at Hazaribagh under the

Damodar Valley Corporation. The government supported program started in mid-1950s, when the focus on watershed programs was sharpened with the establishment of the Soil Conservation Research, Demonstration and Training Centre at eight locations, namely Dehradun, Chandigarh, Agra, Valsad, Kota, Hyderabad, Bellary and Ootacamund. The Central Soil and Water Conservation Research and Training Institute (CSWCRTI) was established by linking all the eight centers in 1956. It started watershed activities in 42 locations mainly on a small scale to understand the technical processes of soil degradation and options that contribute to soil conservation.

The first large-scale government supported watershed program was launched in 1962–63 to check siltation in the multipurpose reservoirs as "Soil Conservation Works in the Catchments of River Valley Projects". This was followed by another mega-project, DPAP, in 1972–73. The main purpose of this project was mitigating the impact of drought in vulnerable areas. On similar lines, the DDP was added for development of desert areas and for drought management in the fragile, marginal and rainfed areas. These schemes were implemented in 45 catchments spread over 20 states in about 96.1 million ha.

Meanwhile, the CSWCRTI started demonstration of its technologies in actual village conditions at four locations from 1974 onwards (Samra 1997). The purpose was to validate the soil and water conservation technologies, and demonstrate the benefits of watershed programs to the farmers. These technologies changed the focus of watershed programs from mere soil conservation to soil and water conservation. Earlier programs focused largely on soil conservation. The success of the demonstration programs was responsible for launching a scheme of propagation of water harvesting and conservation technologies in rainfed areas in 19 identified locations in the country by the Department of Agriculture and Cooperation, Ministry of Agriculture. This in turn led CSWCRTI and the Central Research Institute for Dryland Agriculture (CRIDA) to take up jointly with the state departments additional 47 Operational Research Projects (ORPs) to validate soil and water conservation technologies under different agro-ecoregions and demonstrate the benefits of watershed activities to the farming community in the rainfed and hill areas. Recognizing the importance of watershed programs, the Ministry of Rural Development also adopted the approach in 22 locations in the rainfed areas in 1984. These 41 watersheds (19 of the Department of Agriculture and 22 of the Ministry of Rural Development) were commonly known as the 'model watersheds', where the Indian Council of Agricultural Research (ICAR) institutes and state agricultural universities (SAUs) were also involved to provide research and technology support. During the 1980s, several projects assisted by bilateral donors and international funding agencies, like the World Bank, were also launched. Besides, a number of non-governmental organizations (NGOs) also started working for the Integrated Watershed Development Programme in different parts of the country.

The programs launched under the ORP of CSWCRTI and CRIDA and 41 model watersheds were focused in the framework of the Integrated Watershed Development Programme. This program was a system combining erosion and runoff, and controlling land management (ie, through vegetative cover, bunds, check-dams and small percolation tanks) with irrigation wells for lifting groundwater on a sustainable basis so that the amount of water withdrawn is less than or equal to the annual recharge of groundwater. This system was an extension of the idea of water harvesting by which runoff water is collected in small ponds directly through gravity irrigation (Rajagopalan 1991). The integrated programme was organizationally multi-disciplinary and multi-agency and functionally participatory with active involvement of farmers of the watershed. Generally, a watershed covered about 2000–3000 ha. A watershed of around 1000 ha was characterized as micro- or mini-watershed. The key to the success of the Integrated Watershed Development Programme was participatory planning and implementation by government agencies and NGOs. The impact was documented in terms of

increased crop productivity, increased employment, better crops and cropping systems, which ensures higher and regular cash flow, additional area under sustained irrigation and cropping and reduced production risks.

In 1986–87, the NWDPRA was launched for optimizing the production of important rainfed crops like pulses, oilseeds, coarse cereals, cotton, etc. The program was launched in 99 selected watersheds to enhance crop productivity in arable rainfed areas. The severe drought of 1987 forced the Government of India to give more thrust to the rainfed areas. Also, the relevance and effectiveness of earlier watershed programs was questionable. The question was whether the watershed program should continue or not. To resolve this issue, a committee was constituted to: (i) examine the watershed-based programs for rainfed areas; (ii) advise if the program should continue or not; and (iii) if the programs continue, advise how the on-going programs should be modified for the effectiveness of watershed development. The recommendations of the committee led to the launching of the NWDPRA. All the earlier programs of the Ministry of Agriculture culminated in the development of the NWDPRA during the VII Plan to cover both arable and non-arable areas and to give more thrust for project and area-based approach for watershed development. During the VIII Plan, an area of 4.23 million ha in about 2554 watersheds covering 350 districts located in 25 states and 2 union territories was treated and developed with an expenditure of Rs 9679 million. In the IX Plan, an outlay was raised to Rs 10200 million to treat 2.25 million ha, which is slightly more than half of the area treated in the VIII Plan. The available information suggested that during the first three years of the IX Plan (1997 to 2000), 3003 watersheds covering an area of 1.7 million ha have been treated at a cost of Rs 5665 million, indicating substantial rise in unit area cost to treat watersheds compared to the VIII Plan. The Ministry of Rural Development also launched a new initiative known as Watershed Areas for Rainfed Agricultural Systems Approach (WARASA) by providing participation of NGOs as implementing agencies. It was decided to adopt a common approach for planning and implementation of various programs. This led to the formulation of the Watershed Development Guidelines of October 1994 by the Ministry of Rural Areas and Employment. The power of decision-making was devolved to district and village levels and financial allocations were made to local-level organizations. Provisions were made for partnerships between government, NGOs and people's organizations. Cost of watershed development under various schemes is given in Table 6.

The Ministry of Environment and Forest also implemented a program on watershed basis for sustainable ecosystem development in rainfed and degraded areas of the country since 1989–90. The program was launched as the Integrated Afforestation and Eco-development Projects Scheme (IAEPS) to promote afforestation and development of degraded forests by adopting an integrated watershed approach to development of land and other natural resources through micro-planning process. Under this scheme, approximately 0.3 million ha land was regenerated through afforestation with an expenditure of Rs 2031 million up to the end of the VIII Plan. During the IX Plan, an area of 0.227 million ha land was targeted for regeneration with a budgetary provision of Rs 2470 million.

Table 6. Cost (Rs ha^{-1}) of watershed development under various schemes in India.

Ministry	Up to VIII Plan	1997–2000
Department of Agriculture and Cooperation	2678.28	7540.75
Department of Land Resources	2978.15	3424.81
Ministry of Environment and Forest	6816.10	11507.30
Average of all programs	2880.38	5640.87

To integrate all watershed programs in 100 priority districts, the WDF was established in 1990–91 at the National Bank for Agriculture and Rural Development (NABARD). A total of Rs 2000 million, which includes Rs 1000 million by NABARD and a matching fund by the Ministry of Agriculture, was made available under the fund. The WDF was set up on the lines of the Rural Infrastructure Development Fund (RIDF) to help the state governments to augment their watershed development programs over and above the support they receive through budgetary resources (Sharma 2001). The main purpose of the fund was to create the framework conditions to replicate and consolidate the isolated successful initiatives under the different watershed development programs. There is a provision to give loan from the fund to state governments at an annual interest of 9.5% for watershed development.

Alternative approaches and experiences

As described above the watershed programs in the country have a long history. Over the years, the programs were tuned to overcome one or other issues. The experiences under the different programs also vary accordingly (Deshpande and Ratna Reddy 1991). Broadly, the watershed programs in the country are categorized into six different programs, which differ in terms of techniques, administration, planning and system composition. These are:

1. Operational Research Project (ORP) taken up by ICAR at different locations in the country.
2. World Bank financed projects – The Bank financed four watershed projects in Manoli (Maharashtra), Kabbalnala (Karnataka), Maheswaram (Andhra Pradesh) and Parua Nala (Madhya Pradesh). These were taken up with active participation of SAUs. These projects were managed by scientists and demonstrated encouraging results.
3. State government projects - The state governments of Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra took up such programs on a larger scale.
4. National Watershed Development Programme activated by the Central Government and implemented by state governments with some need-based modifications.
5. NGO projects – Projects undertaken by NGOs (humanitarian or philanthropic), which have relatively less scientific inputs and manpower but more participation from the local communities in the region concerned.
6. NGOs-government projects – These are collaborative programs taken up by the NGOs and government. An interesting example is the Indo-German Watershed Development Programme (IGWDP) in Maharashtra funded by the German government. Another example is AGY.

Hence, different ministries and agencies are involved in watershed R&D programs. These mainly include the Ministry of Agriculture, the Ministry of Rural Development, the Ministry of Environment and Forests, ICAR, NGOs and international agencies. The watershed programs of the Ministry of Rural Development included: (i) DPAP; (ii) DDP; (iii) Integrated Wasteland Development project; (iv) Watershed Projects under Externally Aided Schemes; (v) Support to NGOs; and (vi) Wastelands Development Task Force.

The watershed programs undertaken by the Ministry of Agriculture include:

- Soil and Water Conservation in the Catchments of River Valley Projects
- Integrated Watershed Management in the Catchments of Flood Prone Rivers
- Watershed Development Projects in Shifting Cultivation Areas
- NWDPRA

The Ministry of Environment and Forests implemented the IAEPS. The programs of ICAR were under the ORP largely to validate and demonstrate the improved technologies in a watershed framework. The same is true for ICRISAT, which has been developing and evaluating various watershed management technologies and approaches in the semi-arid and rainfed parts of the country. This is often implemented in collaboration with various national and state R&D programs. A number of NGOs have also been actively involved in watershed development activities, supported either by the Government or international agencies.

Impacts of watershed management projects

The watershed programs in the country are undertaken with multiple objectives ranging from rehabilitation of degraded areas to conservation of the resource base and improvement of the productivity of agriculture. Mitigating adverse impacts of droughts and resource degradation will contribute to reducing production risk and protecting livelihoods. Conservation of the resource base will contribute to sustainable productivity growth in agriculture, while the latter will improve the incomes of the poor and contribute to poverty reduction. In recent years, the watershed programs have increasingly focused on poverty. There has been a shift from assessing the impact of watershed management on the regeneration of the natural resource base, health of the environment and agricultural productivity to enhance the overall impacts on poverty and livelihood security. Enhancing people's livelihoods, reduction of poverty and sustainability are increasingly recognized as being the main objectives of watershed programs.

Despite the long history of the watershed development programs, there are no systematic and large-scale impact assessment studies on the performance of watershed programs. Individual scholars, NGOs, and international agencies undertook some studies largely on a project basis. Others are conclusions derived from qualitative assessments and impressions. There is lack of proper indicators and evaluation methods to assess the tangible and non-tangible economic, social and sustainability impacts of the programs. The Mid-Term Appraisal of the IX Plan of the Planning Commission articulated satisfactory and unsatisfactory performance of watershed program on different dimensions (Government of India 2001c). On a satisfactory note, it stated, "… beneficial impacts such as increase in cropping intensity, change in cropping patterns, increase in crop productivity and increase in underground recharge as a result of conservation measures, reduction in soil and run-off losses with lesser siltation effect and reduction in sedimentation at watershed level. These projects have also generated employment and increased family incomes through diversified farming system such as livestock development, dryland horticulture and household production activities." On the other side, the Mid-Term Appraisal stated, "… the increase in agricultural production did not last for more than two years. Structures were abandoned because of lack of maintenance and there was no mechanism for looking after common lands. Projects have failed to generate sustainability because of failure of Government agencies to involve people."

The results of other studies were also similar. For example, Deshpande and Ratna Reddy (1991) concluded that: (i) location-specificity was an extremely important aspect of watershed planning since a population-resource interaction generates varied situations under heterogeneous environments, which were difficult to simulate a priori; (ii) watershed treatments alter the structure of income, stabilize income flows by avoiding overt fluctuations and have positive impact on income distribution; and (iii) people's participation and scientific input were two most important components of watershed planning that enhance impacts. Similarly, Palanisami et al. (2002) reported that watershed programs did not perform well in terms of controlling reservoir siltation, mitigating

the impact of drought and improving/stabilizing the production of crops (like pulses and oilseeds) generally grown in rainfed areas. The production of many rainfed crops fluctuates depending on the pattern and quantity of rainfall. Also, reservoirs are silting at alarming rates and droughts are causing hardships over large areas.

Similar findings were noted by Kerr et al. (2000) on the impact of watershed development programs in the rainfed areas. Contrary to rhetoric, the authors observed that few participatory watershed projects were successful and the impact of the program was limited. Also, participatory watersheds performed better than the more technocratic, top-down counterparts, and the programs with a combination of people's participation and sound technical input performed best. Similar observation was made by the Mid-Term Appraisal of the IX Plan, which stated that "projects have failed to generate sustainability because of failure of government agencies to involve the people. For watershed projects to be sustainable community management systems are needed and they can succeed only with farmers contribution and their commitment of time and resources" (Government of India 2001c). Based on a qualitative assessment of the impacts of the DPAP, Hanumantha Rao (2000) notes an overall positive and significant impact of the program.

Results from a meta analysis comprising 310 watersheds revealed that the mean benefit-cost ratio of watershed programs in the country was quite modest at 2.14 (Joshi et al. 2000). The average internal rate of return was 22%, which is comparable with many rural developmental programs. The watershed programs generated employment opportunities, augmented irrigated area and cropping intensity and conserved soil and water resources. The study added that performance of watershed programs was best in regions with a rainfall ranging between 700 and 1000 mm, jointly implemented by state and central governments, targeted in low and medium income regions, and had effective people's participation.

Farrington et al. (1999) also provided an overview of the recorded impact of watershed development programs in the country. Results indicate that successful projects have in fact reduced rainwater runoff and recharged groundwater and surface water aquifers, improved drinking water supply, increased the irrigated area, changed cropping patterns, crop intensity and agricultural productivity, increased availability of fuel and fodder, improved soil fertility and changed the composition of livestock. The impact of these projects on poverty alleviation and the long-term sustainability of project results were, however, less clear. Although some projects did seem to have paid attention to the needs of the landless and poor, their impact on poverty reduction was not assessed.

Policy and institutional constraints to scaling up and enhancing impact

Some of the impact assessment studies on watershed programs indicate positive and significant effects for soil and water conservation and sustainable productivity growth in the rainfed regions. The studies also note that lack of appropriate institutional support is impeding in tapping potential benefits of the watershed programs. The isolated and piecemeal approach to watershed development has not also been consistent with large-scale technology exchange and dissemination. People's participation was accorded high esteem for the success and sustainability of watershed development. Experience has demonstrated that people's participation was recognized as important as the technical components of the watershed programs. The WARASA guidelines of NWDPRA for the VIII Plan period have for the first time emphasized that watershed interventions should be ultimately people's programs and governments and NGOs should work together in the implementation process. Contrary to such a categorical emphasis, most of the watershed

interventions to date remained to be government programs and people's participation leaves much to be desired. Some authors have observed that micro-watershed rehabilitation in semi-arid India could make significant contributions to reversing environmental degradation (largely through improved recharge of groundwater) and permit a quantum shift in sustainable agricultural productivity in the lower slopes of watersheds. The program had also attracted substantial government and donor support. Yet approaches to watershed planning and implementation, which were both participatory and easily replicable, have remained elusive (Farrington and Lobo 1997). The authors further observed that cases of participatory watersheds especially those managed by NGOs were becoming abundant. Yet they were isolated and small. By contrast, many government-sponsored approaches were expanded rapidly, but often lacked the local ownership and group coherence necessary for sustainable management of the common pool components of watersheds. If micro-watershed programs are to be participatory and rapidly replicable, it is important to identify enabling conditions for scaling up and out. The authors identified the following pre-conditions for scaling out the successful approaches: (i) the close engagement of stakeholders and marshalling of political support at international, national, state and subsequently district and local levels and the creation of confluences of interest within and between levels; (ii) the creation of a local watershed planning methodology, which is technically defensible to funding agencies yet is participatory and accessible to community-based organization; (iii) the provision of appropriate capacity building and technical support to community organizations; and (iv) the creation of mechanisms which channel funds to local organizations with as few intermediate stages as possible.

In a cross-country study, Rosegrant et al. (2002) concluded that "… water harvesting has the potential in some regions to improve rainfed crop yields, and can provide farmers with improved water availability and increased soil fertility in some local and regional ecosystems, as well as environmental benefits through reduced soil erosion. However, despite localized successes, broader farmer acceptance of water harvesting techniques has been limited, due to high costs of implementation and higher short-term risk due to the necessity of additional inputs, cash, and labor. Water harvesting initiatives frequently suffer from lack of hydrological data and insufficient attention during the planning stages to important social and economic considerations, and the absence of a long-term government strategy for ensuring sustainability of interventions." The authors noted that greater involvement of farmers for planning and maintenance, and provision of appropriate educational and extension support helped in expanding the contribution of water harvesting methods.

Although several reasons can be identified for lack of significant impact of watershed programs (eg, complexity of the evaluation, delayed ecological effects and non-tangible project effects), attention is being focused on how the effectiveness of watershed projects might be improved. The evaluations all point in the same direction; participatory, demand-oriented projects that were responsive to community needs have been most successful. The problem is that these are also the projects that were most site-specific and difficult to replicate; not accidentally the most successful projects were led by NGOs. Besides, the sustainability of these projects is yet to be assessed, as even the projects that were implemented first cannot yet prove community resource management to work.

In many cases the benefits from watershed development may not also be equitably distributed to benefit the poorest of the poor. In some cases, the poor actually became worse off, because the measures for soil and water conservation restricted their access to common resources (Kerr et al. 2000). Failing to account for the needs of the poor not only makes watershed development less

effective in reaching one of its main goals, but also affects the sustainability of the overall outcomes. If the poor are unable to maintain or enhance their livelihood through access to existing or new benefit streams, the tendency will increase for common property resource management arrangements to break down.

What is it that made the participatory NGO approach so successful and how can this approach be scaled up? In their study, Kerr et al. (2000) distinguish two features that make NGO programs differ from government projects: scale of operations and staffing time. While government projects have huge budgets and work in hundreds of villages, NGOs mostly work in a handful of villages. They devote more staff time per village and they often work on a variety of activities in addition to watershed management. Although NGO projects are on average 20–40% more expensive, they are still more cost-effective than the cheaper, but not so effective, top-down approaches. Also, while government employees concerned with watershed management are almost exclusively trained in agricultural sciences and engineering, NGO staff members include more non-technical staff trained in community organization. NGOs typically devote a lot of time to project preparation; in fact, many NGOs first get involved in other village development activities before venturing off in watershed development.

Similar factors were found to explain the success of several World Bank projects. Demand orientation and responsiveness to community needs was key to the success of the better performing watershed projects with community participation in the planning and design of the project from the very start. Efficient, committed and accountable project management proved important as well, especially with regard to the project's ability to deal with the recurring institutional constraints. Then, successful projects made sure that the technologies chosen responded to the farmers' needs (felt by farmers themselves), and that locally available resources were used for project implementation. Finally, the sequencing of activities seemed important, suggesting the need for focusing activities first on generating short-term results. This way, farmers became interested to invest in measures to generate long-term benefits as well (Boersema 2001).

Both studies point to the importance of project preparation, demand orientation and institution building as key factors to determine project success. In all these, community participation and equity are central to the sustainability of the investments. Passive participation in itself will not guarantee the outcomes to be sustainable. In fact, Boersema (2001) argues that in many projects high subsidies and other inducements have distorted the true nature of the demand. While impressive rates of (passive) participation might be achieved on the short term, the uncertainty of benefits on the long-term and lack of mechanisms to ensure long-term cooperation might lead to unsustainable results once the project ends. In many instances, this follows from a mistaken assumption that what might be socially optimal in terms of overall environmental improvements will also be optimal from an individual point of view. We will explore some of these policy and institutional factors that enhance or hinder the impacts of watershed management programs through an in-depth assessment of the selected case studies from the different R&D experiences in the country.

Case Studies and Methods

One of the objectives of the study was to assess a few watersheds and draw lessons for future research and development in watershed management. To meet these objectives, this section covers two important aspects: (1) criteria for selection of case studies; and (2) classification of basic characteristics of case studies.

Criteria for selection of case studies

The basic criteria for selection of the case studies are based on the functioning, processes and approach of the different watershed programs in the country. The main purpose of the case studies was to examine the commonalities among watersheds located in different agro-ecoregions, developed through various approaches to watershed management by different agencies, and identify factors that contribute to the success or failure of different watershed development interventions. The focus was to understand if there were some common forces, processes and factors, which lead to their short-term success and long-term sustainability. The six watershed programs from six different states were selected considering biophysical factors, socioeconomic conditions, organizational affiliation (NGO, State Government, Central Government, international institution) and institutional approaches in managing the programs. The selected watersheds fall in a range of agro-ecoregions managed by the government, ICAR, NGOs and a consortium of institutions consisting of various agencies and led by ICRISAT. The basic features of the selected watersheds using these selection criteria are presented in Table 7.

Selected watershed management approaches

Using the above selection criteria, the following six watershed management approaches were identified for the study:

1. Adarsh Gaon Yojana (AGY): Watershed program initiated by the Maharashtra Government, funded by the State Government and implemented jointly by the government departments and NGOs.
2. Rajiv Gandhi Watershed Mission (RGWM): Watershed management program funded by the Central Government and driven by a state-level mission approach, and implemented by the State Government and NGOs.
3. Mysore resettlement and development agency (MYRADA): Watershed management program initiated and implemented by an NGO with government and non-government funding.
4. Sukhomajri Model: Watershed management program implemented by ICAR, State Government, and local-level institutions, with funding from Ford Foundation.
5. ICAR Model: Watershed management program implemented and funded by ICAR and partly shared by the Ford Foundation and stakeholders.
6. Consortium Model: Watershed management approach developed by ICRISAT and implemented by a consortium of organizations including research institutes, NGOs, government departments, and farmers and implemented with funding from DPAP (now District Water Management Agency (DWMA)), Andhra Pradesh and Asian Development Bank (ADB).

Once the case studies were identified, a discussion guide containing a checklist of issues was prepared for gathering the required information in the selected watersheds (see Appendix). The information used in the analysis is acquired through informal consultations and discussions with key managers, project leaders and key informants using this semi-structured format and review of the official documents of the projects. This was further enhanced through informal discussions with farmers and different interest groups within the community to assess the perceptions and attitudes of the expected beneficiaries, the role of the local people in the projects, the type of local institutions created, the level of capacity building achieved, and perceivable impacts of the programs in the selected villages. The information collected in this way includes the socioeconomic and biophysical background of the location, the approach and process followed in the watershed program, perceivable impacts and benefits to the community, the sustainability of these benefits, and other emerging issues and constraints.

Table 7. Indicators for selecting watershed case studies[1].

Watershed project	State	Agro-ecoregion	Sub-ecoregion (ESR) and Zone no.	Rainfall (mm)	Soils in the ESR (FAO classification)	Soil fertility	Major cropping system	Market access	Funding source	Implementation and management
MYRADA	Karnataka	Hot arid	Hot arid (3)	500–600	Vertisol, Nitosol	Medium	*Ragi* based	High	NGO, Govt.	NGO, Community
RGWM	Madhya Pradesh	Semi-arid	Hot moist semi-arid (5.2)	750–1000	Regosol, Vertisol	Medium	Wheat based	Medium	Central Govt.	State Govt., NGO, Community
AGY	Maharashtra	Hot semi-arid	Hot dry semi-arid (6.1) (Ahmednagar) Hot dry sub-humid (6.4) (Pune)	580	Regosol, Vertisol	Low	Sorghum based	Medium	State Govt.	State Govt., NGO, Community
Sukhomajri	Haryana	Warm sub-humid (to humid with inclusion of per-humid)	Warm moist to dry sub-humid transitional (14.2)	950	Cambisol, Planosol	Medium	Maize based	High	Ford Foundation	ICAR, State Govt., Community
ICAR model	Uttaranchal	Warm sub-humid (to humid with inclusion of per-humid)	Warm moist to dry sub-humid transitional (14.2)	1900	Luvisol, Nitosol, Cambisol	Medium	*Ragi* based	High	ICAR/ Ford Foundation	ICAR, Community
Consortium model	Andhra Pradesh	Hot semi-arid	Hot moist semi-arid (7.2)	800	Vertisol	Medium	Sorghum based	High	Central Govt., ICRISAT	ICRISAT, NARS, NGO, Community

1. RGWM = Rajiv Gandhi Watershed Mission; AGY = Adarsh Gaon Yojana (Model Village Project); ICAR = Indian Council of Agricultural Research; ICRISAT = International Crops Research Institute for the Semi-Arid Tropics; NARS = National agricultural research system; NGO = Non-governmental organization.

Analysis of Selected Case Studies

Adarsh Gaon Yojana (AGY)

Background

The State Government of Maharashtra launched the AGY (Adarsh Gaon Yojana meaning Model Village Program) in 1992[1]. The aim of the program was to create one model village in each taluk of the state, using Ralegan Siddhi[2] as a model, with an emphasis on the development and regeneration of land and water resources. The five principles of Ralegan Siddhi were *nasbandi* (restriction of family size), *nashabandi* (ban on alcohol), *charaibandi* (ban on free grazing), *kurhadbandi* (ban on tree felling), and *shramdan* (donation of voluntary labor for community welfare). These have evolved out of the philosophy of conservation and sustainable development. Ralegan Siddhi has demonstrated the importance of these principles and their contribution to sustainable development. The AGY, therefore, required villagers to take an oath that they would follow these five principles and implement the integrated watershed management program in their village. The philosophy of AGY encouraged villages to become self-sufficient and self-reliant.

Approach to watershed management

Villages that were selected for funding under the AGY program had the following characteristics: (i) located in a drought-prone area; (ii) scarcity of water was the key problem; (iii) irrigated area was less than 30%; and (iv) population was less than 4000. Villages had to apply for participation in the program. The first step in the application process was the collective decision taken by the Gram Sabha of the village to accept and abide by the principles and fulfill the criteria laid down by the AGY. Once the villagers had made this resolution, they sought the support and approval of the Gram Panchayat and identified an NGO to monitor and assist them in implementation of the program. After the NGO had been identified, the villages approached the State Level Committee for participating in the AGY. Some villages formed their own NGO and hired technical and social staff for implementing the program. The funds sanctioned under the AGY were made available to the villages for two main types of activities: (1) watershed development as the core activity; and (2) other non-core development activities.

The watershed development activities were undertaken by the NGO in each village while other development activities by the respective government departments. The AGY basically aimed to bring about all round development of the village by combining the finances and resources of the government with the skills of the NGOs and the motivation for participation of the villagers. The villagers were expected to drive the project in their village with the help of the NGO and the government departments. People's participation was the key to the success of the program.

The administrative structure for the implementation of the AGY consisted of several Committees appointed at various administrative levels such as the state, district, taluka and village. The Chairman of the State Level Committee was appointed by the Chief Minister and was given the authority to set up and manage the entire administrative structure for the program. Several government departments were actively involved in the program. The government officials at each administrative level in these

1. Information about background and approach to watershed management has been sourced from "Adarsh Gaon Yojana: Government participation in a peoples programme" by Hazare et al.
2. Under the leadership of Mr A Hazare, farmer leader and social activist, Ralegan Siddhi village was transformed from a poverty-stricken village to a prosperous one through the implementation of a watershed management program. Under the program, emphasis was laid on conservation of land and water resources, sound management practices and social change to enable greater participation from the community.

departments were members of the AGY Committee at each corresponding administrative level of the program. The government departments associated with the AGY were: soil and water conservation, rural development, agriculture, horticulture, health, social forestry, education, women and child welfare, Groundwater Survey and Development Agency, Khadi and Village Industries and Maharashtra Energy Development Agency.

The responsibility for financial planning and management and disbursement of funds was with the State Level Committee of the AGY. The State Government had agreed to dedicate funds for the program. The funds were routed through the Department of Soil and Water Conservation and Watershed Development. The funds were maintained in this department and disbursed with the sanction and order of the State Level Committee of the AGY. The budget had been worked out initially for a period of five years, based on the detailed project proposals prepared for the villages participating in the program. The funds were to be transferred to the bank accounts at the village level directly from the divisional level, after the State Level Committee had sanctioned them.

AGY hoped to demonstrate how the convergence of various government programs at the village level could bring about social and economic change along with regeneration of land and water resources. The strategy necessitated a high degree of cooperation between various departments that usually do not interact with each other. This degree of cooperation was difficult to achieve even for the AGY. The AGY depended upon funds dedicated by the state government. Due to lack of continued political interest and support, this assured funding did not come through on a regular basis almost since the beginning of the program. Also, the administrative procedures, which had been structured in a way so as to make the process transparent, in fact became too bureaucratic and troublesome for the villages to get through.

Currently, there are 222 villages under the program at various stages of completion. About 50 villages have shown good progress in terms of achieving the objectives of the program[3]. Two villages were identified for the field study; Hiwre Bazar, which is recognized as one of the best villages under the AGY and Ambadvet, where the AGY program has met with limited success.

Hiwre Bazar village

Background. Hiwre Bazar, a village of 210 households, is situated in Ahmednagar district and is 17 km from Ahmednagar town. The watershed development project under the AGY began in this village on 15 August 1994. The total watershed area in the village is 977 ha, divided into three micro-watersheds of 612 ha, 123 ha and 242 ha. The average rainfall in the village is 300–330 mm. The soil depth is 50–60 cm in the watershed. The watershed project is implemented by a locally formed NGO known as Yashwant Krishi Gram and Panlot Vikas Sanstha (YKGPVS) (Yashwant Agricultural Village and Watershed Development Organization).

The Watershed Committee consists of the Sarpanch[4] of the village, two farmers each from large, small and marginal categories, one landless individual, and one villager from the backward caste. This Committee is responsible for planning and implementing the project. The Committee guides the villagers in the construction of the structures with the help of technical assistants. One member from the Committee visits the construction site to monitor the work when the work is in progress. The decisions about building new structures or repairing old structures are taken in the Gram Sabha (village meeting, which is attended by all adult members of the community).

3. Information provided by the Deputy Director of the AGY.
4. Elected head of the Village Council under the Panchayat Raj or decentralized governance system.

The Forest Department owns some of the land along the ridge of the watershed. In order to manage this area of the watershed, the Forest Department has formed a Committee consisting of the Sarpanch of the village, six farmers representing different socioeconomic sections of the community, one landless individual and one villager belonging to the backward caste. The Watershed Committee and the Committee formed by the Forest Department work together to manage the resources in the watershed. During the period 1993–94, about 40000 continuous contour trenches were dug through *shramdan* or voluntary labor and about 0.6 million trees were planted in the land belonging to the Forest Department. Supported by the practice of *charaibandi* (ban on tree grazing) and *kurhadbandi* (ban on tree felling), this area over the years has developed good forest cover. About 300 t of grass fodder was harvested during the first year itself.

Under the AGY watershed development project, several new structures were constructed and old ones built earlier by the Agriculture Department were repaired and maintained by the villagers on both private as well as common lands. These structures include check-dams to arrest soil erosion and surface water flow, earthen structures, loose boulder structures, gabion structures, percolation tanks and continuous contour trenches. The villagers contributed voluntary labor during construction, and continue to contribute labor towards repair and maintenance of these structures. One person from each family in the village contributed one day free labor for any particular activity in progress. Some villagers also contributed cash. Minor repairs like changing or replacing the gates of the structure are generally handled by the farmer in whose land the structure is constructed. If there is major damage, the matter is discussed in the Gram Sabha and the course of action to be followed is decided.

Benefits. Over the past few years, the groundwater table has increased from a depth of 35–50 feet to 10–15 feet. Prior to project implementation, water was available in the village at a depth of 35 to 50 feet during the monsoons and about 55 to 60 feet during summer. The number of wells in the village increased from 97 in 1993 to 217 in 2000 (Table 8). These wells are located near the village stream

Table 8. Social and economic impact of the project in Hiwre Bazar village in Ahmednagar district, Maharashtra, India under AGY watershed.

Details	1993	2000
Total number of wells	97	217
Seasonal wells	90	190
Perennial wells	7	27
Seasonal irrigated land (ha)	110	400
Assured irrigation land (ha)	10	200
Area under horticultural crops (ha)	3	38
Vegetables (ha)	2	25
Onion (ha)	2	100
Potato (ha)	2	80
Floriculture	1	20
Milk production (L day^{-1})	150	2200
Biogas plants	0	50
Smokeless *chulhas*	0	170
Two-wheelers	5	135
Four-wheelers	0	6
Tractors	1	7
Literacy (%)	30	99
Families below poverty line	198	53

Source: Documents provided by YKGPVS written in the regional language.

and near the percolation tank constructed by the Agriculture Department. The farmers in this part of the village could harvest two crops a year, while farmers in other parts of the village could only harvest one rainfed crop per year. The farmers are now able to cultivate high-value cash crops like onions, potatoes, other vegetables and fruits (Table 9).

Table 9. Changes in cropping pattern from 1995 to 2002 in Hiwre Bazar village in Ahmednagar district, Maharashtra, India under AGY watershed.

Crop	Original area (ha)	Present area (ha)	Growth rate (%)
Oilseed Crops	1	15	53
Pulses	15	45	3
Vegetables	2	25	12
Irrigated fruits	5	38	7
Fodder crops	2	50	25

Source: Documents provided by YKGPVS written in the regional language.

To control and regulate use of groundwater and surface water, the following important management decisions were taken in the Gram Sabha[5]:

- Bore wells would not be installed for irrigation purposes.
- Water intensive crops such as sugarcane and banana would not be grown.
- Resident villagers will not sell their land to non-residents. This decision was taken to prevent free-riding by non-residents, since the resident farmers had invested labor and cash in the development of water and land resources in the village.

The acceptance of the AGY principles like *charaibandi* and rules for the use of resources from the forest and common land increased the production of fodder greatly. This in turn increased the milk production in the village. The forestland, which was barren initially, is now getting transferred into a healthy forest with significant changes in the ecosystem. About 98% of soil erosion has been checked effectively through the construction of structures on the slopes, combined with controlled grazing. Due to restrictions on open grazing the loose soil on higher lands was allowed to settle. The small amount of silt that still moves down the slope is arrested and collected in the structures at higher levels. As a result of project interventions, about 280 to 300 mm of annual rainfall is enough to maintain the groundwater levels and the surface water levels in the percolation tanks for the whole year.

The local migration of the villagers to irrigated areas has stopped completely. Even with comparatively smaller landholding, the farmers can utilize their limited resources to the fullest due to availability of water. But the farmers with larger fields, despite having enough water, are able to cultivate only limited area due to labor scarcity. The large farmers have started leasing some of the land to landless families. This has equity implications, as landless families are directly benefited from the project, and cultivable lands in the village are used to their full potential.

Thus the annual income of the small farmers has increased from Rs 4000–5000 in 1993 to about Rs 100,000–200,000 at present[6]. The annual income of large farmers has now increased from Rs 15000 in 1993 to Rs 250,000–300,000 at present. The local migration of villagers in summer has completely stopped. About 31 families who had migrated out of the village permanently have returned to the village and resumed agricultural activities.

5. Under the AGY, the Gram Sabha is also the WA, since the village and not watershed is the unit of implementation.
6. Source: Documents provided by the organization YKGPVS, Hiwre Bazar.

Controlled grazing has also raised the income of the farmers through production and sale of fodder, and growth in milk production. The milk production has increased from 150 L day^{-1} for the village in 1993 to about 2200 L day^{-1} at present (Table 10). The fodder grown on the forest and common land is sold to villagers on cut and carry basis (one person per family can cut and carry as much fodder as possible in one day) for which the payment has been fixed at Rs 100. The remaining fodder is sold to the people from neighboring villages. The income generated from the sale of fodder is used for improvement of facilities in the village school, and other services to the poorer families in the village.

Importance of leadership. The village Sarpanch initiated the development activities in the village. He realized that the main problem in the village was the lack of basic infrastructure facilities, such as drinking water, education, electricity, good transport facilities and water for irrigation. These problems were discussed with the villagers. A five-year development plan for the village was drawn. An NGO (YKGPVS) was formed, and the village was selected under the AGY in 1993. The main focus was for watershed development activities on a large scale. The villagers agreed to provide voluntary labor as their contribution to development activities. Under the leadership of the village Sarpanch important management decisions were taken that helped in developing and maintaining the watershed development activities. Inspired by the success of this village, the NGO expanded to neighboring eight villages under the DPAP.

Ambadvet village

Background. Ambadvet village is located in Mulshi taluka in Pune district, and has an annual rainfall of 1000 mm. Though the rainfall was relatively higher, the village was selected under the AGY because it faced acute water shortage for most of the year. One of the reasons for shortage of water is the rapid industrialization and urbanization that was taking place in this district, causing loss of vegetation and depletion of groundwater resources.

Agriculture was not remunerative for villagers due to lack of irrigation. Villagers were selling their lands to the industrialists with the expectation to get employment in the industries. With growing industries, the bore wells were installed by the industrialists, and started groundwater exploitation at an alarming rate. It adversely affected the farming of those who were still dependent on agriculture. To overcome such problems, the watershed development program was introduced in the village. The watershed development program was started in the village in 917 ha under the AGY in 1996. This watershed was managed by an NGO, Vidnyaanvardhini Sanstha. Ambadvet was one out of six hamlets under the AGY. The same principles were applied in the village as discussed earlier. The villagers contributed voluntary labor for construction of a temple and a school building, and planted trees on the common lands. The same enthusiasm was not there among villagers for construction of soil and water conservation

Table 10. Growth in fodder and milk production in Hiwre Bazar village in Ahmednagar district, Maharashtra, India under AGY watershed.

Year	Fodder production (t)	Milk production (L day^{-1})
1994–95	200	300
1995–96	350	500
1996–97	1100	750
1997–98	1500	1000
1998–99	2500	1250
1999–2000	5000	2200

Source: Documents provided by YKGPVS written in the regional language.

structures under the watershed project. As the Government did not release funds in time, the physical work of construction of structures could not be started as planned. The farmers began losing faith in the project. The result was that when the funds were finally received the work was completed through contractors hired by the NGO, since the farmers were unwilling to participate in the project. The farmers expected the NGO to complete the work and also maintain the structures.

Benefits. To facilitate groundwater recharge and control soil erosion, continuous contour trenches were dug on the higher slopes of the watershed. Several such structures were constructed in the private lands of the farmers and the farmers were given the responsibility of maintenance of these structures. This area experiences acute shortage of even drinking water in the period after November. However, after construction of the trenches, the water became available until the next monsoon. When the continuous contour trenches became silted, the villagers did not desilt them, but kept waiting for the NGO staff to arrange for repairs and desilting. Even the landowners did not desilt the trenches on their private lands. With the silting up of the trenches the groundwater recharge slowed down and villagers again faced water shortage. Grazing was also not controlled, and the villagers let their cattle graze on the forestland and uncultivated private lands. These developments show that the villagers did not follow the principles of AGY in the village that led to collapse of an innovative program.

The structures like cement check-dams, which were constructed by the contractors, were not built as per the norms. According to the villagers, the contractors used poor quality material. The result was that the structures were ineffective. There were leakages and the structures failed to arrest the surface water from flowing downstream. Since the structures were made by the NGO through contractors without involving the villagers, there was no sense of ownership towards the project. Also, the villagers failed to recognize the importance and necessity of the structures. The farmers expect the NGO to repair and maintain the check-dams. Only 40% of the proposed work was completed during the six years of the project period. The village again faces acute shortage of water. There has been no improvement in agricultural production. Finally, the NGO withdrew from the village and closed the project activities due to lack of funds. The Gram Panchayat or Village Council was given the responsibility to maintain the structures but without any funds.

Lessons drawn from the AGY examples

- The AGY placed great emphasis on peoples' participation and expected the WA, Watershed Committee or the local village-level NGO to drive the project. However, it cannot be assumed that formation of Watershed Committees and other local institutions will ensure peoples' participation. A high degree of motivation needs to be maintained through incentives and benefits that are visible to sustain motivation for participation.
- Political support is required to ensure regular flow of funds to the projects. Since the AGY was a completely state-funded program, it was expected that the Government would dedicate funds to the program so as to ensure that implementation at the village level would not be affected. This did not happen and funds were released sporadically, due to which benefits were not always visible on the ground. This had a negative impact on the motivation of the people to work together.
- Strong leadership is essential that can motivate people to participate in the project activities. A committed leader can bind the community for a common purpose.
- *Shramdan* or contribution of voluntary labor is an effective cost-sharing mechanism that helps to establish peoples' ownership of the project, although in some cases, cash contributions by households might be even more effective.

- Visible benefits from investments on common and private lands, and clear policies for distribution of benefits and management of land and water resources enable people to remain committed to the project.
- It is important that decisions for physical interventions are taken by the people and executed by them, and not by the NGO or implementing agency. Getting work done through contractors or outside labor to complete planned works makes the people refrain from the project.

Rajiv Gandhi Watershed Mission (RGWM)

Background

The RGWM[7], launched on 20 August 1994 by the Government of Madhya Pradesh, has become India's largest watershed management program targeting to cover nearly 3.5 million ha. The objectives of the Mission are to: (i) augment and conserve soil and water resources (both surface and groundwater) for sustaining livelihoods and reducing vulnerability to droughts; (ii) develop an easily accessible repository of scientific and technological inputs for planning and implementation; (iii) maximize people's participation for sustainable resources development; and (iv) improve the environmental resource base. The watersheds under the RGWM were classified into three zones:

1. Recharge zone, which usually has lands having high gradients
2. Transition zone, which has gradients requiring in situ moisture conservation
3. Discharge zone, which has flat lands requiring efficient water spreading techniques

At the start of the Mission in 1994, key tasks were identified to: (i) integrate concerns of poverty reduction and environmental regeneration through participatory watershed management; (ii) focus action on degraded areas and dryland areas to build environmental security and food security; and (iii) improve agricultural production and incomes.

The Pani Roko Abhiyan (community-led campaign to conserve water) was launched after the drought in 2001, by promoting community-led water harvesting structures through Pani Roko Samitis (local water harvesting committees). Under this program, 'do-it-yourself' methods for water harvesting were developed. Information about these methods was given to each village. Most villages were already familiar with the watershed development work carried out by the Mission. The communities themselves were expected to identify the work or the structures that needed to be built in their villages and make a plan for implementation, using the prototypes in the 'Do-It-Yourself' information kit. The Government provided funds through the drought relief and rural development programs. The community was also expected to contribute towards the costs. Between January to June 2001, Rs 4150 million were spent under this program, of which the community contributed Rs 990 million.

Approach to watershed management

The mission essentially intensified the implementation of the centrally-funded programs such as the DPAP, Employment Assurance Scheme and Integrated Watershed Development Program. The Common Guidelines for Watershed Management of the Ministry for Rural Development were followed. A Mission Director with a Mission Office at the state level was appointed to oversee the Mission activities. The advantage of the Mission effort was a concentration of efforts in implementation of the watershed management programs resulting in extensive coverage. The flow of funds for the watershed activities was also maintained because of this concentrated effort.

7. Information has been sourced from documents provided by the Mission Office and from "Rajiv Gandhi Missions: Eight Years: 1994–2002, Report to the People".

The program at the local level was planned and implemented by the Watershed Committees, which control about 85% of the total program funds. The work is executed through Watershed Committees consisting of UGs, SHGs and Women Thrift and Credit Groups, while the State Government provides technical and financial support through the Mission. For the purpose of planning and implementation the watersheds are divided into project areas covering an area of 5000 to 10000 ha, which are known as Milli Watersheds. The implementing agencies are both government departments and NGOs.

Institutional arrangements

At the State level, the program is coordinated by various agencies, namely Empowered Committee, Technical Committee, the Department of Rural Development and the Mission Director. At the District level, it is managed by the District Watershed Management Team, along with the Chairman, Zilla Parishad as the Patron, the Executive Engineer as the Mission Leader at the District level, and a Hydrogeologist as the Planning Coordinator. At the village level, there are Watershed Committees, which are nominated by the Gram Panchayats or Village Councils. The Watershed Committees act as the executive committees to manage the watershed project at the village level and facilitate the participation of the entire village community. The Watershed Committees (consisting of 10–12 members as per the Guidelines) have representatives from all UGs, SHGs, PIAs, members of the Village Council, women representatives and representatives of the PIAs. One full time Secretary and two Volunteers are appointed with each Watershed Committee. The Watershed Committee organizes community meetings, draws up the watershed plans and executes them, maintains records and accounts, distributes funds to community groups for executing the activities, monitors the implementation and maintains the assets created under the project after the project period is over.

User groups are the groups of landowners who are directly benefited and affected by watershed management activities. Such groups of people are constituted for each of the identified watershed management activity like soil conservation, water conservation, horticulture, fodder development, etc on private land, community land and government land. The SHGs are groups of individuals who may not own land and may not benefit directly from the watershed works. They may, however, benefit indirectly through some income generating activities for which well defined forward and backward linkages are identified to sustain their livelihood.

Women as a distinct group form a priority area for the program as land and water related issues affect them the most. Therefore, the Mission has been trying to promote women's SHGs in all program villages. The basic thrust of these SHGs is thrift and credit.

Monitoring and evaluation

In addition to evaluation by Government agencies, the Mission has introduced a system of participatory evaluation by the community itself. In every village, which has undergone more than 3 years of work under the Watershed Management Mission, a public display board is maintained in a central place in the village on which information regarding the progress of activities is recorded. External evaluations have also been commissioned through agencies such as UNICEF.

Impact of the mission

The area targeted for coverage is 3.438 million ha, of which work has been completed in 1.426 million ha. About 7600 villages are under the Mission, whereas all 51086 villages in the State are covered

through the Pani Roko Abhiyan[8]. Since the pre-Mission period, groundwater level has improved in 3294 villages, area under tree cover has increased by 23579 ha, area under irrigation has increased by 59%, degraded lands have decreased by 34% and area under fodder production has increased by 52311 ha. Area under winter cropping increased by 16%, while production by 30%. Similarly, area under rainy season expanded by 21% and production by 37%.

There are 43612 UGs, 14005 SHGs, 7557 Women Thrift and Credit Groups. The total assistance given to SHGs was Rs 74.7 million. The income generated by SHGs is Rs 24 million, and the savings by Women Thrift and Credit Groups amounts to Rs 32.4 million.

For the case studies, two villages from the Nalchha Milli watershed were selected and are discussed.

The Nalchha Milli watershed

The Nalchha Milli watershed is located in Dhar district in western Madhya Pradesh, having about 97% Bhil tribe. The Nalchha Block (taluka headquarters) is nearly 25 km from the district headquarters. A prominent tourist place, Mandu, is 9 km from Nalchha town. The Nalchha Milli watershed covers 16 villages and nearly 6094 ha of land, which is divided into 10 micro-watersheds. The total number of households in the area is 1526.

Nearly all the streams and small rivers of the Nalchha Milli watershed area are tributaries of the Karam river which flows into the Narmada river. The Milli watershed has an undulating topography with steep slopes, deep gorges, steep ravines and hills of hard rock. In the rainy season, water flows at high speed causing heavy soil erosion. Soils range from red-yellow to black cotton. The area has nearly 27% forestland with medicinal plants, which is an important source of livelihood for the villagers. The climate ranges from semi-arid to dry sub-humid. The average rainfall of Dhar district is 750–1000 mm. The villages are mainly situated on the hillocks and rocky lands, due to which the villagers are mainly dependent on small and shallow wells or *bawdis*, which are hardly 20–25 feet deep, and village ponds. The *bawdis* (shallow wells) are the main source of drinking water. If there is enough water, it is used for irrigation of winter crops. Before implementation of the project, most of the villagers migrated during winter to Indore and nearby towns to do earthwork and work in brick kilns. The most important indicator of success of the watershed program was increase in area under wheat and adoption of improved variety Lok 1 (requires light irrigation) resulting in a shift from Pissi, an unirrigated variety. Another important benefit was shift from local to improved breed of buffalo, and increase in number of buffaloes as compared to cows. Milk production has increased because of increased availability of fodder. Surplus milk is sold in nearby towns like Nalchha and Mandu. The other important income generation activity that has emerged is vermicompost. The District Rural Development Agency is the main buyer of this compost. Poultry has also emerged as an important source of income for the tribal population.

The PIA in the watershed is the Institute of Resource Conservation (IRCON), an NGO. The NGO has maintained a transparent method of functioning, and villagers are aware about the funds allocated for the development of their watershed area. A large part of the proposed funds for training, community organization and plantation activity have not been utilized. The only activity for which planned targets have been completed is the construction of water conservation structures. This has led to increase in groundwater table, which was available in the village 3 months after the rainfall, which was not the case earlier.

8. Source: Rajiv Gandhi Missions: Eight Years: 1994–2002: Report to the People.

Two villages located in the Milli watershed were identified for the case study after consulting the Deputy Chief Executive Officer of the District. The indicators for identification were impact of the project after a period of five years and level of participation by the people. Hemabardi village was identified as the more successful village, and Jhabri was identified as a village that had made less progress.

Hemabardi micro-watershed. The Hemabardi micro-watershed in Hemabardi village covers an area of 681 ha. The village is divided into three hamlets, Patel Awar (Colony), Katar Awar and Bari Awar. The total number of households is about 37, with a population of about 260. All members in these hamlets belong to the Bhil tribe. The village is located about 7 km from Nalchha block (taluka) headquarters. The watershed project was initiated in 1996. The plan for implementation was prepared with the villagers and the people's participation was very good during the planning session. In the southern and the western sides of the village there is a large area of forestland, which is mainly barren. The villagers graze their animals here, but as the land was not productive, there was not enough fodder for the whole year.

The Watershed Committee formed as per the Common Watershed Guidelines has 14 members including 2 members from the Village Council, 5 women, 1 member of the NGO, and 6 members from UGs. The Committee members have appointed a Secretary for the management of work in the village. The Committee is expected to meet once every month to review the progress of the work being undertaken. The villagers explained that the meetings always occurred in the presence of the NGO and most of the resolutions have already been passed in the initial meetings of the project. There has been no meeting in the village for the past few months. Villagers do not find these meetings useful since resolutions related to development work have already been passed in the earlier meetings.

The soil and water conservation structures constructed in the village include 4 earthen bunds (check-dams) and 2 check-dams on common lands. Field bunds on private lands could not be made due to misunderstanding between villagers and government machinery. Silt from an old village pond was used for strengthening the new earthen structures. The Rural Engineering Service, a department of the government has also constructed one big pond, at the cost of Rs 1.6 million. Most of the water harvesting structures were small and dried up in 3–4 months. The NGO claims that the water table in the village has increased due to the earth works done in the adjacent village Gyanpura.

The main impact of the watershed development project was increase in area under cultivation during the winter season and reduction in migration. Crop production has intensified in the village and many farmers are cultivating two crops in a year. Few farmers have started cultivating cotton. Landless laborers got employment in the village and the period of migration reduced from 5–6 months to 2–3 months in the dry season. Few farmers have taken bank loans to purchase tractors, threshers and electric motors. Hand pumps installed by the Government for drinking water are viable throughout the year.

The degree of people's participation has differed in the village for different activities. Since it was important for the villagers to harvest surface water, villagers, particularly women, participated in the planning and construction of ponds and check-dams. Many farmers did not allow any type of treatment in their private lands. They did not participate in *shramdan* for desilting the percolation tanks.

While UGs meet nearly almost everyday informally by the village pond, the Watershed Committee meets only when the NGO is present. The Committee members were of the opinion that since nothing happens in the Watershed Committee meetings, there is no point in having them. This

indicates that the Committee is still dependent on the NGO for guidance and has not been able to function independently.

The Nalchha Milli watershed has almost 1230 ha of forestland and this is located close to Hemabardi village, making fuel-wood and fodder easily available to the villagers, who have open access to the forestland. The village also has some grazing land, which is used for open grazing. The villagers refused to impose a ban on grazing on this land, partly because they are afraid to take their domestic animals into the forest area (they fear that wild animals will attack their cattle) for grazing, which they would have had to do if open grazing was banned on village lands. No plantation work has therefore been done on these lands.

Although villagers are happy with the project, they are worried that the project may not be sustainable after the project period is over. They are concerned that the project period is getting over without the allotted funds being utilized. The villagers feel that the project period should be extended by three years so that the remaining funds can be utilized. There is scope for further work in community mobilization and putting in place mechanisms for management of common property resources. Villagers lack confidence in the Watershed Committee and question whether the maintenance fund, which was collected through voluntary contributions[9] from the villagers, would be utilized properly after the NGO withdraws from the village.

Jhabri micro-watershed. The Jhabri micro-watershed in Jhabri village is one of the ridgeline micro-watersheds in the Nalchha Milli watershed. This is also a tribal village, situated about 21 km from Nalccha town, and 10 km from Mandu. The village is about 6–7 km from the '*pukka*' road and nearly 10–12 km from the National Highway. The area of micro-watershed is 199 ha. The approach to the village is difficult and no transport facilities are available in the village. The village is divided into two hamlets, Patelpura and Girwalpura. The population of the village is about 500 with 70 households. Cotton and wheat are the important crops.

The Watershed Committee and action plans were formed as per the watershed guidelines. The action plan included: (i) fodder and fuel-wood development in the village common lands; (ii) soil and water conservation in private lands; (iii) construction of two percolation tanks; and (iv) construction of one gabion structure. None of these activities have been completed during the past five years of the project period. Instead, some contour bunds were made along the hill slopes on common lands and an old tank has been repaired. Many villagers are not aware of the project being implemented in the village. One SHG was formed which was non-functional. Women did not attend the meetings and they had to depend on men to go to the bank in Mandu to deposit the money.

The forestland of the village has been treated by the Forest Department and the NGO has constructed contour bunds. This has resulted in regeneration of vegetation. After the bunds of the tank were repaired with project expenses, the tank is holding water. The tank is a major source of conflict because it overflows during the rainy season and submerges the fields of several farmers. However, few farmers are benefited from the recharge from this tank. Some farmers are directly lifting water for irrigation and harvesting two crops. This has resulted in decrease in migration.

Poor connectivity of the village with town, lack of public transport and conflict on water tank were some of the reasons mentioned by the NGO and the villagers for the failure of the watershed program.

9. When villagers contribute free labor (*shramdan*), the equivalent amount in wages is kept aside in a fund to be used later for maintenance of structures.

Lessons drawn

The interesting aspect of this case study is that although in the first village the level of cooperation, trust and participation seems to be quite low, it is still a successful case. It would be interesting to examine why this is the case and why the second village is doing worse. It seems that the broader socioeconomic context plays an important role in explaining the performance but based on the information provided this cannot really be concluded.

The following lessons are drawn from the watersheds discussed above:

- The mission approach, backed by political will and support, has resulted in intensification of implementation of centrally sponsored watershed development programs and ensured a regular flow of funds to the projects.
- Although the program is conceived to encourage the formation of Watershed Committees to implement the program, the effective representation of the village population on these committees and their functioning depends upon the quality of facilitation and support provided by the PIA.
- Benefit sharing mechanisms have not been put in place. Therefore, in both villages it was found that some farmers benefited more than others. The landless, however, have benefited from the increased demand for labor in the village.
- Since efforts at community mobilization have been inadequate, people are less willing to cooperate and resolve conflicts.
- The upstream-downstream impacts are evident because the whole Milli watershed is being treated through micro-watershed projects. However, no areas of conflict have as yet emerged.
- Villagers do not have a feeling of ownership for the project. One of the reasons could be the emphasis on the formation and capacity building of the Watershed Committee, as against the Association or the village community. There is a feeling that the Committee is responsible for the project. Capacity building is required at all levels.
- Although physical impact of the watershed interventions is evident, there is a lack of sustainable institutions to take this work forward. Emphasis on achievement of physical targets has compromised the development of sustainable institutions and collective action.
- The coordination between government departments takes place through the state-level mission office, but there is no similar structure at the district levels. At the district level, the Collector influences the implementation strategy of the project. A mechanism is required through which people's views can be taken into account.

Mysore resettlement and development agency (MYRADA)

Background

Spread over three states (Andhra Pradesh, Karnataka and Tamil Nadu), MYRADA works with the rural poor through a process of building and strengthening grassroot-level institutions[10]. Though MYRADA has an extensive reach and presence in the three southern states through sixteen project areas, the organization works in a decentralized manner. Each project has an identity of its own, with flexibility to make decisions and plans for implementation.

Between 1968 and 1978, MYRADA worked to resettle 3000 Tibetan refugees in the hilly areas of Kollegal taluk in Karnataka. The young organization created infrastructure by land development and housing and handed over the houses and cultivable land to the community in proportion to the

10. Information about MYRADA is from documents and publications by MYRADA and based on discussions with MYRADA staff.

number of members in each family. MYRADA formed the Dhonden-Ling Tibetan Cooperative to cover activities in 22 villages, named by alphabets starting from A to V, complete with houses, shops, and other civic requirements like roads, pathways and water sources. When MYRADA withdrew in 1978, the settlement was handed over to the community and is presently administered through a local assembly. MYRADA's micro-watershed development program, which began in 1985, is also based on the philosophy that local-level institutions manage the watershed development activities. Today the program covers over 50000 ha and 399 WAs.

Approach to watershed management

MYRADA is recognized as a pioneer in evolving the model of the self-help affinity groups (SAGs). It evolved through several years of experience. Between 1982 and 1986, several cooperatives that were being supported by MYRADA collapsed due to a lack of confidence in the leadership. Later MYRADA changed the strategy to develop the model of SAGs, which initiated a holistic process of empowerment.

Process of formation of SAGs

The process of formation of SAGs is through three phases: (1) identification and formation phase; (2) group stabilization phase; and (3) withdrawal phase. The time duration in each phase varies with the degree of awareness and exposure of the group.

The first phase is very critical in the process since the future development of the group depends upon the identification of appropriate members. This phase includes identifying a group, which has a common affinity that binds them together. The group decides the modalities of the savings and credit and rules and regulations for meetings as well as identifies two members as representatives of the group.

The second phase is marked with regularity of all operations. Opportunity is given to all members to acquire managerial skills. All the members undergo SAG management training and manage the savings, credit and repayment schedules. Most of the members learn to conduct meetings and acquire skills in literacy, learn to work with numbers, and how to manage conflicts. The group changes the representatives every year.

In the third phase, the SAG takes a major role in the maintenance of the group. The group establishes linkages with financial institutions and pays for the services needed. It is empowered to take credit plus activities and the need for external intervention is reduced to a minimum. When the group matures into this phase, MYRADA gradually withdraws, keeping its intervention to a minimum, in the form of technical support only.

Micro-watershed Development Associations

MYRADA began their watershed development program by constituting a single WA in each micro-watershed. Due to heterogeneous groups in each watershed such arrangements failed. MYRADA's own study of their watershed institutions highlighted the following (Fernandes 2002):

- The basis of all institutions managing the watershed's resources were the credit groups. They played a role in forming and monitoring the WA and they provided the credit base if funds were required to maintain the structures installed. They ensured that poorer families had access to credit thus facilitating their participation and maintaining equity in the sharing of benefits.
- There were several such credit groups in one micro-watershed; where these groups had been functioning effectively for a longer period, the WA was stable and functioned properly.

- In some cases, families with land in high potential areas (high potential for watershed development interventions) like ravines where silt could be harvested came together to form a Watershed Development Association to treat these areas in the first phase; the membership, however, gradually expanded to include others.
- The tribal groups preferred to associate with tribal groups in other micro-watersheds rather than non-tribal credit groups in their own watershed. Marginal groups preferred to interact with other similar groups.
- Membership to the Micro-watershed Development Associations (MWDAs) was not restricted to credit groups. It was extended to all interested farmers, particularly to those whose lands were within the boundary of the particular association.
- Since the credit groups formed the base of the WAs, there is greater stability in the Association itself even if other members who were not involved in the credit activities join in.
- The process through which an MWDA emerges differs in each watershed. Poorer people need time and space to build up their skills and confidence to join others. Some groups with lands having potential for immediate returns may come together more quickly than others.
- The various groups within the watershed should have freedom to decide which MWDA they want to belong to. Where groups of poor families are given no option but to join a single WA initiated by external forces, or by larger farmers and dominant groups, the Associations have failed to function effectively and were unable to achieve the objective of regenerating and managing resources in the watershed.

The MWDAs are therefore different in structure and function compared to the SAGs although they are established on the base formed by the SAGs. They represent smaller units of the micro-watershed, and there could be several MWDAs within a micro-watershed. As against the SAGs that grant loans for any type of credit need of the member, the MWDAs give loans only for treatment of private lands as well as for agricultural inputs, ie, for any land-related activities. The MWDA members participate in the whole process of development and designing the plan for natural resource management and watershed development.

Further, to ensure a high level of sustained participation, along with a strong institutional base, what was required was a clear understanding and commitment to the program. MYRADA measured this commitment by the willingness of the members to invest in their own lands. Therefore, the organization introduced the concept of contributions ranging from 30 to 50% of the costs, in cash, for activities taken up on individually owned lands. These contributions were kept as a fund in each MWDA, which could be used in future for upgrading and maintenance of the micro-watershed.

MYRADA gave a grant to the MWDA for both common and private lands. The association converted the grant to a soft loan for activities on private lands. The loan amount was repaid to the association by the farmers and is being revolved on a loan basis, with interest, for upgrading and maintenance of private lands. Seeing the performance and credibility of the MWDA, some banks have come forward to finance these associations locally. NABARD has also given portfolio loans to MWDAs based upon the plans made by individual members for development of private lands. Where common lands are concerned, MYRADA still gives grants, since it is difficult to raise large contributions from the members of the MWDA for works on common lands. MYRADA believes that in the present context of existing demand and urgency for scaling up the interventions on watershed management at national level, and with the limited availability of funds to meet the growing requirement, this unique strategy can provide an alternative to the present Government approach which provides grants for watershed development.

Interventions under the watershed development program

The physical interventions made under MYRADA's watershed development program can be understood through its key slogans: (i) make water 'walk'; and (ii) bring soil back to life. A series of activities are undertaken for better harvesting and utilization of rainwater and for conservation and improvement of soil. MYRADA believes that unless watershed activities are accompanied by agriculture development strategies, food security and protective livelihood systems, improvement in the quality of life for the poor cannot be ensured. Hence, through different awareness programs, training courses and credit facilities, a holistic program consisting of integrated agricultural development, off-farm livelihood activities, afforestation and use of non-conventional energy are undertaken in the micro-watershed.

Linkages

To ensure sustainability of the MWDAs, linkages are developed with financial institutions, agricultural extension services and other government departments. Members of the MWDA are encouraged to interact with the different departments so as to build their confidence and capacity to negotiate for accessing better services.

Process of planning and management of micro-watersheds

The treatment plan for each micro-watershed is completed by the members of the MWDA with the help of a team consisting of a civil engineer, agriculture specialist, soil engineers and training personnel. Once the exercises are completed, time is given for discussion and negotiation before the sites and treatments are finalized. For the common lands, management decisions related to control of grazing, prevention of tree falling, plantation activities and selection of species are taken. Men and women users of common property resources such as livestock owners also participate in the planning and become members of the MWDA. Contributions for work on common lands, 'cut and carry' charges and fines are also decided. All members of the MWDA are asked to make suggestions and the lowest amounts quoted are accepted as the norm. This ensures equitable access to the resources and benefits of the program to all members of the MWDA. Participatory impact monitoring is undertaken with the members of the MWDA on a regular basis. Capacity building is a continuous process as MYRADA trains members to participate in the planning, implementation and monitoring of the program, and in the process of building linkages for sustainability.

Impact of program and specific case studies

MYRADA currently has 399 MWDAs under its watershed development program, out of which 127 MWDAs (32% of the total) are the new generation MWDAs functioning entirely on loan basis, without any grants being given for treatment on private lands. For the purpose of this study it was decided that 100% loan-based MWDAs would be studied, since MYRADA is currently promoting this strategy for the implementation of their watershed development programs. This strategy is possible only for projects, which are not funded under any government scheme.

In Hollalkere district, a complete watershed of 2000 acres (809 ha), leading to one outlet has been treated in 5 years through 49 MWDAs. Two MWDAs from this watershed were studied as case studies. The MWDAs were identified on the basis of the indicators that MYRADA uses to decide which associations are functioning better than others. These indicators are level of participation, strength of the institution, and sustainability of the institution and watershed interventions. On the

basis of these indicators, the Vinayaka Jalanayana Abhivrudhi Sangha (JAS) or the Vinayaka MWDA of village Kudineerkatti was identified as a robust, successful MWDA, and Masikatte JAS or Masikatte MWDA of Venkateshpura village was identified as an MWDA, which had been facing problems in maintaining a strong institution. Kudineerkatti has two MWDAs and two SHGs while Venkateshpura has two MWDAs and one SHG.

Vinayaka JAS. Vinayaka JAS has 22 members who have lands located in the upper catchment of the watershed. The average rainfall in the area is 500 to 600 mm. The group was formed in August 1999 and the treatment was completed in June 2002. The micro-watershed is of 64 ha, consisting of 20 ha of common land and 44 ha of private land. The group began with a weekly saving of Rs 10 per head. At the end of six months the group had a saving of Rs 15000 in the bank account, after which watershed development activities began. The groups underwent training in management of savings and credit. For the first time interest free loans were given and repaid, after which an application was made for a portfolio loan from NABARD. The interest on loans from the NABARD portfolio was 18%. The installments and repayment plans were made with the group. Till date, the total investments on common land has been Rs 60450 and on private lands through loans has been Rs 402,080 of which Rs 286,500 has been repaid.

At present, the group has applied to NABARD for a portfolio loan of Rs 547,000 for a period of 6–8 years. The group has requested that the loan be given in three installments with a repayment period of 2 years for each installment. The activities for which the loan has been sought are land leveling, silt application, horticulture and fencing, with individual loan amounts ranging from Rs 20000 to 40000.

The crop productivity has increased from 0.6 to 1.4 t ha^{-1} in finger millet, 1.6 to 2.2 t ha^{-1} in maize and 0.7 to 1.7 t ha^{-1} in sorghum. The production of coconuts has also increased. There are 2 wells in the watershed, which used to have water for 6 months before watershed interventions, and at present water is available all round the year.

The group meets regularly and continues its saving activity. Repayment for loans is compulsory every month. To prevent over-exploitation of groundwater, the group has decided not to allow borewells to be installed in the micro-watershed. Grazing has been controlled on the common lands. The group has collected Rs 2000 as fine for violation of rules made to manage common lands. The contribution made towards treatment of common lands has been kept in a common fund.

Masikatte JAS. Masikatte JAS in village Venkateshpura has 23 members. The group was formed in April 1997. The watershed area is 280 acres (113 ha), of which the common land is 154 acres (62 ha) and private land is 126 acres (51 ha). The investment in common lands was Rs 193,290 and in private lands it was Rs 158,140. At present the group has repaid Rs 62470 and an amount of Rs 95680 is outstanding. This watershed is located higher up in the catchment and has poor soil cover. Productivity was generally low.

The membership fee of this MWDA was Rs 100. The members began the savings activity on a weekly basis. The group stopped the savings activity once the watershed work was started. Since members have been unable to repay the loans, the repayment period has been increased for defaulters.

Although there has been an increase in crop production, this increase might not be sustained if the maintenance of watershed works is stopped. The farmers are further indebted to the local seed merchants from whom they have been taking seed on credit, thus further reducing the profits they gain from their crops. This group has not been able to develop effective linkages for sustainability

because the farmers are still struggling to repay their loans. During discussions with MYRADA staff, they admitted that the Masikatte MWDA may not have received the support and attention it required after completion of the project.

Lessons learned

- The MWDA and MYRADA are partners in planning, implementation, management, monitoring and evaluation of the project. Smaller homogeneous MWDAs are more viable and sustainable than large and heterogeneous ones. The interests of marginalized groups are better represented in smaller groups. Equity can best be achieved through smaller interest groups.
- MYRADA implements government-funded watershed development programs in some areas, while in others the organization uses funds received from German Agro Action, such as in Hollalkere. The funds from German Agro Action are not dedicated to targets, giving the organization the flexibility to achieve their objectives of building and strengthening MWDAs.
- It is true that plans need to be made for development of the entire watershed area, but implementation is more effective when the watershed is broken up into smaller micro-units.
- There can be more than one MWDA in a village. The MWDAs generally look after the common lands adjoining their watershed area. When there is more than one MWDA in the village, they work together to address issues related to common lands and forestlands. The SHGs and MWDAs discuss issues jointly in the Gram Sabha to address larger issues related to common lands and forestlands, or distribution of benefits.
- MYRADA distinguishes between development and management of common and private lands. The focus remains on poor and marginalized families. When benefits from common lands are to be distributed through measures such as 'cut and carry' all the villagers are consulted and lowest quoted rates are applied, so that the poorest families can be benefited from the project.
- Capacity building is very important for making the MWDAs sustainable. MYRADA puts in a considerable amount of time and energy in capacity building of the MWDAs.
- MYRADA provides support for agricultural development and technical inputs through linkages with the concerned government departments.
- Upstream vs downstream: MYRADA looks at this issue in the light of 'coverage vs intensity'. Water harvested in the upper reaches through treatments is not used for irrigation. It is used only for recharge, and therefore as yet there have been no conflicts between upstream and downstream farmers. Since farmers in the region are poor, and soil fertility is poor in the upper catchments, there is a limit to the intensification of agriculture in the upper reaches. At present they feel that 'coverage' is important and the watershed needs to be treated to arrest soil erosion and further degradation.
- The example of Masikatte highlights that the resilience of the MWDA can be put to test if the resources available to the farmers are already so scarce that returns to investments are likely to be low or unsustainable, probably requiring a longer period of 'hand-holding'. The organization needs to recognize this and extend support to the MWDA if required.
- There can never be complete 'withdrawal' from the village until the MWDA has demonstrated a fairly long period of stability.
- Women participate only in the SHGs they are involved. Discussions with women's groups highlighted that many women were not even aware of the watershed development program being implemented; only those whose husbands were members of the MWDA knew about it. Very few women consulted their husbands before taking loans for land development. The SHGs support the investments in land development undertaken by their members.

Sukhomajri watershed

Background

Sukhomajri is one of the first model watersheds in the country, which is well acclaimed for its success on several fronts. This watershed has attracted attention of numerous authors in understanding and disseminating the successes. The studies were largely in the areas of key innovative processes (planning, implementation and monitoring), benefits derived and their distribution and people's participation. The empirical evidences from this watershed provided strong justification for expanding the investment in watershed development in the rainfed areas. This also provided foundation for developing innovative processes for the watershed development program in the country, which now commands over US$450 million annually from different sources (Farrington et al. 1999, Kerr 2002).

The village Sukhomajri is located in the northwest part of India, near Chandigarh. The village had a population of 538 in 1976; most of them belonged to the Gujar community, which is generally engaged in livestock activities. Crop and livestock production was the main source of livelihood. These contribute about 58% of total income from all sources. The average size of landholding was small (0.57 ha), with majority (71%) having land below 1 ha. The individual farmers owned about half of the land in the village and the other half was common property land (Singh 1991). Goat rearing was common in the village.

The watershed project covering an area of 135 ha was started in 1975, when Sukhana lake, a public recreation site located in Chandigarh, was seriously confronted with the problem of upstream soil siltation. The investigations carried out by CSWCRTI suggested that the problem originated from the village Sukhomajri, which was located 15 km upstream from the lake. The hillside of the village was denuded and highly eroded. A project was jointly developed by the CSWCRTI and the Government of Haryana to stop the siltation into the Sukhana lake. The project was fully funded by the Ford Foundation and the CSWCRTI, Chandigarh (headquarters in Dehradun) took the lead in planning, execution, monitoring and evaluation of the project. The major components of the watershed program were: (i) rainwater harvesting and recycling, construction of three earthen dams with a total storage capacity of 20 ha-m, and underground PVC pipe to irrigate winter crop; (ii) demonstration of improved crop production technologies; and (iii) rehabilitation of hilly catchment area with mechanical (gully plugs, trench, etc) and vegetative measures like planting of trees and grasses (Ram Babu et al. 1997). The unique feature of the project was that the villagers were involved in locating appropriate sites for check-dams and gully plugs. Check-dams and gully plugs were constructed in community lands at different levels to control soil erosion and conserve rain and natural stream water.

Processes of watershed management

The watershed witnessed complete transformation because every community action paid high private dividends. It was possible because concerted efforts were made to involve effective participation of local community for managing common property resources besides physical construction for conserving soil and water. Initially, the Water Users' Association was formed, which was later converted to 'Hill Resource Management Society' (HRMS). The concept of developing the HRMS was to: (i) enhance crop and livestock productivity; (ii) promote equitable distribution of benefits; and (iii) effective resource conservation. The project was viewed as the beginning of people's participation in preservation of environment and management of common property resources. The

HRMS was responsible to develop mechanism for equal benefit sharing. The harvested rainwater was shared equally by all families (including landless laborers), irrespective of the land ownership. All the members were given the right to sell water at a specific rate to any farmer in the village. Those having no land or tiny pieces of land were selling their share to other farmers. A good network of irrigation pipes was developed for water distribution. Similarly, each family was allowed to collect grass and fodder from the community land. The HRMS decided to conserve the grasses and protect the forest. The conservation and higher production of grasses increased the income through the sale of *babbar* grass to the paper mill and raised milk production with the availability of *mungri g*rass as fodder to the farmers. Revenue generated from the sale of grasses was used for repair and maintenance of the check-dams, gully plugs and water distribution network. Forestland was least disturbed by allowing one head load of fuel daily to each family. The success has led to replication of the model in the state of Haryana. The Haryana Government under a centrally sponsored scheme known as 'Operation Soil Watch' till 1986 and later from 1987 onwards by itself replicated the model in 60 villages in Shivalik hills. Until 1996, Haryana Forest Department built 102 dams covering 60 villages. The Government also promulgated the 'Joint Forest Management Policy' to protect, conserve and share forest benefits through participatory institutions.

Benefits from watershed development

The benefits were substantial in different forms. The foremost was soil conservation. The siltation in the Sukhana lake declined by 95% in 1980; it saved Chandigarh US$200,000 annually used for regular repair and maintenance. The effective people's participation came as a consequence of numerous private benefits to the villagers due to conservation measures. Within the village, the regeneration of grasses and trees contributed in improving the irrigation water availability, which intensified cropping patterns, and expanded the livestock enterprise. The regeneration of grasses increased from 40 kg ha^{-1} in 1976 to 3 t ha^{-1} in 1992 (Arya and Samra 2001). The number of trees also increased from mere 13 ha^{-1} in 1976 to 1292 ha^{-1} in 1992. *Mungri* and *babbar* grasses were common in the village. While the former was used for livestock in the village, the latter was sold to a paper industry located in Yamunanagar (approximately 100 km away from the project site). The decision of all villagers to stop animal grazing and strictly follow stall-feeding has dramatically changed the livestock production and management pattern. The goats disappeared (declined from 246 in 1976 to 10 in 1986 and none in 2002) (Arya and Samra 2001), while buffaloes for milk became the principal source of income generation. Their number increased to 291 in late 1990s from 79 in 1975. Milk production has remarkably increased from 334 L day^{-1} in 1977 to 2200 L day^{-1} in late 1990s due to shift in animal composition from sheep and goat to buffaloes, availability of grasses and better management. Cropping pattern has also shifted in favor of maize, wheat and vegetables with the availability of water. These together substantially raised the income of the villagers.

Threat to sustainability of watershed

The Sukhomajri model demonstrated that watershed programs can be sustainable through people's participation. Regular availability of water, fodder and fuel motivated the community to participate in a collective mode. The society was sharing benefits of conserving rainwater, grasses, fodder and fuel. The project performed well until 1997–98, when two new developments threatened the sustainability of the watershed. These were: (1) the government's new scheme of sharing the benefits; and (2) absence of market for *babbar* grass as the paper mill changed technology in favor of eucalyptus. These developments have resulted in fall in total profit from Rs 30663 in 1997–98 to

Rs 7784 in 1998–99 (Arya and Samra 2001). Since the forest department owned the forest area, the mechanism of sharing benefit between government and the society was also developed. The Forest Department leased the fodder grass and *babbar* grass from the forestland to HRMS on the basis of average auction rates of the past three years. It was mutually agreed that every year lease amount would be raised by 7.5%. The society's profit was drawn from the sale of the fodder and *babbar* grass (less the lease amount paid to the Government). Under the new profit sharing system, the Haryana Forest Department was to retain 25% and remaining 75% was to be given to the community. The 75% amount was further divided as 10% for *kalyan kosh* (village welfare activities), 30% plow back and 60% to the HRMS. Computing the shares, it was estimated that the village was left with only 45% of what was earned through the sale of fodder, grasses and timber compared to 100% less the lease amount prior to 1997–98. Since 1993–94, the Government of Haryana also imposed a sales tax at the rate of 8.8% and income tax at the rate of 15% on sale of grasses. Since the profit of the HRMS has substantially fallen, the investment in repair of the dams and other structures has virtually stopped; this has adversely affected rainwater conservation in the reservoirs. The ultimate effect was non-availability of water to the members for irrigation. Such a policy change by the state government has affected the sustainability of not only the Sukhomajri watershed but also all those watersheds, which were developed on similar patterns in Haryana.

Another reason that has posed a serious threat to the sustainability of the watershed is the technology conversion by the paper mill from grass to eucalyptus. To improve the quality and cost-effectiveness, the paper industry has changed grass-based technology to wood-based technology. Eucalyptus is a fast-growing tree, which is invariably used by the paper industry. With this change, the paper mill is not buying the grass from the villagers. There is very little sale of the grass for rope making, which is not remunerative. In the absence of any remunerative market for the grass, the society is unable to pay even the lease amount to the Forest Department.

The following lessons are drawn from the success and the emerging difficulties controlling Sukhomajri:

- Community participation in planning, execution and management is a precondition for the success of the watershed. The entire village society was empowered to take decision on various aspects, including that of sharing benefits.
- The benefits of the conservation measures should be sufficiently high and fairly distributed.
- The watershed activities must be backed-up by assured prices and appropriate market arrangements for the resulting goods and services produced.
- The flexibility in changing enterprise portfolio should be quick with changing technology in primary and secondary sectors.
- The Government policies need to be favorable and induce society to conserve natural resources.

The Sukhomajri model was replicated in 60 villages in the Shivalik range by the Department of Forest, Government of Haryana. Majority of the watershed followed the same model of participation and benefit sharing. The emergence of the two problems, market of *babbar* grass and the government policies of sharing benefits with the community, has threatened the viability and sustainability of the watershed development in the Shivalik range.

ICAR model watershed

The ICAR launched few watersheds as action and research project under its ORP. The aim was to test and demonstrate the improved technologies in actual farm conditions. The main focus was

dissemination of new information to the farming community. An example of Fakot watershed is discussed[11].

Background

Fakot watershed is in Dehradun district, which is located in the western lower and middle Himalayas of Uttaranchal. It has an area of 370 ha covering 8 hamlets with a population of 912 in 1975. The baseline information revealed that the region was severely prone to the degradation of ecosystem, dominated by the resource-poor and poverty-stricken inhabitants and deprived of basic minimum infrastructure, like road, markets, power, etc. Agriculture was largely dominated by women folk as the men were forced to migrate in search of jobs to other parts of the country. Tiny and fragmented landholdings, massive unemployment, acute poverty and severe degradation of natural resources were posing challenge to the sustainability of agriculture.

To conserve soil, water and biodiversity, augment farm income, and generate employment opportunities, the concept of watershed was introduced in Fakot watershed in 1975. The project was conceived, developed, executed, monitored and evaluated by CSWCRTI, Dehradun. The purpose was to demonstrate the technologies that raise farm income through conserving soil, water and biodiversity and involving the beneficiaries. The project was started in 1974–75, initially funded by the Ford Foundation, with seed money of US$50000. Later, the project was financially supported through the ORP of the CSWCRTI. The watershed is located in the hilly terrain (slope 72%) with elevation ranging between 650 m and 2015 m above mean sea level. The watershed receives annual rainfall ranging from 1500 to 2600 mm. The size of landholding was too low (0.85 ha per household), with about 4–5 parcels distributed around 1–1.5 km distance. The majority of the farmers were poor and in debt. The crop and livestock production was at subsistence level to meet food security. There was not enough marketable surplus. The principal sources of income were wage earning, remittances by migrants, business and non-farm labor.

Rainfall and perennial natural streams were the important sources of water for agriculture, livestock and domestic purposes. Almost 42% of the rainfall was lost as surface runoff before implementation of the watershed. Similarly, the water in the perennial natural stream was lost and not effectively used due to erratic supply. The watershed was developed as per the farmers' preferences and priorities with refinement of indigenous technologies and as a resource sharing pattern. Participation of local beneficiaries was ensured in problem identification, determining solutions, implementing, and monitoring and evaluation. Project staff facilitated the execution of decisions jointly taken up by the beneficiaries. Bio-engineering structures for agricultural and non-agricultural lands were installed at appropriate places by involving the community. Seed money funded by the Ford Foundation was used for all engineering and bio-structures in agricultural and non-agricultural lands. The watershed plans were developed by the CSWCRTI in consultation with the community after several rounds of joint meetings. In the agricultural lands, the bio-engineering structures included construction of check-dams, *guhls* (water channels), bench terraces and vegetative barriers. In the rainfed areas, the farmers did not consider terracing profitable; therefore, these were leveled gradually. In the non-agricultural land, the measures included diversion drains, contour trenches, gully or *nala* plugs, retention of walls and vegetative cover to check roadside erosion. The aim was to conserve soil and water resources by utilizing maximum rain and natural stream water to enhance agricultural productivity. Besides these measures, improved cropping systems, agricultural technologies (including high-yielding varieties of

11. This section heavily draws from Dhyani et al. (1997).

suggested crops and fertilizer application) and management practices were developed and demonstrated by CSWCRTI to the farmers. The CSWCRTI paid for the cost of demonstration under the ORP. There was an understanding with the farmer that they will adopt the technology components from their own resources. The technologies included combination of erosion control and leguminous crops to improve soil fertility. Pulses (lentil and chickpea), horticultural crops (mango, citrus, jack fruit, banana, apple, apricot, peach, pear, walnut and plum) and farm forestry (*Grewia optiva, Celtis australis, Bauhinia retusa, Dalbergia sisoo, Eucalyptus* hybrid*, Leucaena leucocephala*) were also included in the cropping system with the twin objectives of improving soils and enhancing farm income. *Mandua, jhingora* and wheat were the principal crops in rainfed areas, while rice and wheat were important in the irrigated areas. The yield levels were too low. For example, the average wheat yield was 895 kg ha^{-1}, ranging from 600–650 kg ha^{-1} in rainfed areas to 900–950 kg ha^{-1} in irrigated areas. The yields of *mandua* and *jhingora* were less than 500 kg ha^{-1}, which were less than one-third of the national yield levels.

Processes of watershed development

The watershed development was a success due to involvement of farmers and local community in planning, implementation and management. Educational tours for the farmers were organized to visit the CSWCRTI for demonstrating to the farmers the modern technologies and their potential. Initially, the workers from the local community were hired as wage laborers for construction of the bio-physical measures. Informal farmers' groups were constituted for managing the natural resources. There were no formal arrangements for bringing people together. In this watershed common interest points among the beneficiaries were identified. They were asked to form their own groups with own rules, norms, etc to manage the resource effectively. Water harvesting and distribution was the entry point in the watershed. The common interest groups were for water harvesting, recycling, fodder supply, fruit and vegetable cultivation, etc. These groups were formed after the financial withdrawal from the project. This arrangement was unlike other watersheds, where one body of watershed beneficiaries was formed to manage resources.

Several smaller groups were formed having common interest. These smaller groups, consisting of 8–10 families depending on water from the check-dams, worked together for their cleaning, repair and maintenance. Since check-dams were constructed on the natural water stream, the flow of water was regular. The excess water of natural streams confluences in the river at the downstream. Therefore, water supply was sufficient and regular. The conflicts were rare for irrigating crops but resolved amicably. The informal groups were related to water management, pasture development, afforestation and promotion of horticultural crops. With the passage of time new groups are coming up. For example, the Thrift SHGs were recently formed for saving and integrated pest management (IPM) clubs for promoting bio-pesticides to minimize pesticide residues in vegetables.

The success of the watershed has induced adoption of similar models in surrounding areas. The whole region has been converted into a vegetable and fruit belt with surplus milk collected by few middlemen. The success was due to the adoption of soil and water conservation practices, which raised yields of high-value crops. Individual farmers got tangible benefits, which were realized in the form of raising agricultural productivity, food security and income rather than controlling land degradation. Regular availability of water and markets facilitated the process. As transformation progressed the importance of agriculture in rural livelihoods improved. The rural households were well integrated with the market system due to rising demand for vegetables, fruits, milk, etc and the increased value of vegetable crops provided strong incentives to invest in agriculture in some areas. Market access for vegetables and

proximity to urban center was responsible for such a transformation. Nearest markets were available approximately 10 km away from the watershed area. Markets were also available in Dehradun and Haridwar at a distance of about 50 km. In few cases, contractual arrangements were made for sale of flowers in Delhi market. Boyd and Slaymaker (2000) reported similar observations in Burkina Faso and Nigeria. Another important reason for the success was continuous flow of new information and improved technologies by CSWCRTI. The institute is regularly monitoring technical, hydrological and socioeconomic changes by posting two regular technical personnel in the village. These also act as extension agents and disseminate improved technologies.

Water is a binding force for the farmers to work together for regular repair and maintenance of the check-dams. Market opportunities induced to cultivate high-value crops, which require regular water for irrigation.

Benefits of watershed

The benefits of the watershed activities were quite impressive; increased water availability as a result of check-dams and *nala* plugs was important. Availability of water was responsible for shift in cropping pattern from coarse cereals (*mandua* and *jhingora)* to superior cereals (rice, wheat and maize), legumes and vegetable crops. The yield levels of different crops increased phenomenally: maize from 530 to 1480 kg ha^{-1}; paddy from 298 to 878 kg ha^{-1}; wheat from 896 to 1550 kg ha^{-1}; and chickpea from 327 to 693 kg ha^{-1}. Yield levels of important crops before and after (exit time) watershed development are given in Table 11. The cropping intensity increased from 111% in 1983/84 to 130% in 1994/95 due to the introduction of new cropping systems and availability of water (Table 12). The area under wheat and mustard increased from 12 ha in 1988/89 to 49 ha in 1994/95) and summer cropping started since 1993 by cultivation of summer maize and mung bean. About one-fourth of the watershed area, which used to be single cropped in 1983/84, was double cropped.

The watershed witnessed sea change from a high subsistence-based system into a commercial and market-responsive system. The millets (*mandua* and *jhingora)* were gradually replaced by rice, wheat

Table 11. Changes in yield levels of important crops in Fakot watershed area, Dehradun, India[1].

Crop	Variety	Yield (kg ha^{-1}) Before	After	Increase (%) in yield
***Kharif* season**				
Maize	Ganga-2	530	1480	179.2
Pigeonpea	Local/T-15-15	465	1245	167.7
Paddy	Local/Jaya	298	878	194.6
Cotton	H-6	489	924	89.0
***Rabi* season**				
Wheat	Kalyansona, Lok-1, Sonalika	896	1550	73.0
Chickpea	Local	365	775	112.3
Mustard	T-59	327	693	111.9
Summer season				
Maize	Local/Ganga-2	–	935	–
Mung bean	K-851	–	827	–

1. Before watershed development in 1983/84 and after watershed development in 1994/95.
Source: Dhyani et al. (1997).

Table 12. Changes in important indicators in Fakot watershed area, Dehradun, India.

Indicator	1974	1983/84	1994/95
Irrigated area (ha)	11.8	23	25
Cropping intensity (%)	100.0	110	130
Area under horticultural crops (ha)	0.5	18	26

Source: Dhyani et al. (1997).

and maize with the availability of irrigation water. The transformation continued and the watershed area was converted into a vegetable production region with tomato, cauliflower, cabbage, capsicum, chili, ginger, potato, onion, beans, etc. Few farmers have opted for floriculture (mainly *Gladiolus*) and cold water aquaculture. The production of millets declined annually by 697 kg while that of vegetables increased by 34 t annually. Similarly, the non-arable land was used for fruit crops, and their production increased substantially. The area of fruit crops has gradually increased in the watershed. Income from fruits, vegetables and spices continuously increased in the watershed area because of their area expansion and yield enhancement. Income from these three commodity groups increased from Rs 6500 in 1974 to Rs 522,500 in 1995. Due to rising production of these commodities, a Farmers' Cooperative was established in 1994 for farmers to take up horticulture as a business.

Availability of fuel, fodder and grasses increased substantially in the watershed area. The productivity of fodder and grasses substantially increased in the forest area due to conservation measures.

Composition of livestock also significantly changed. The sheep and goat, which shared about 30% in total livestock population in 1974–75, declined to 3% in 1994–95. On the other hand, population of buffalo increased from 20% to 38% during the same period. Both supply- and demand-side forces were responsible for shift in livestock composition from sheep and goat to buffaloes. On supply side, availability of quality fodder, and on demand side, growing market opportunities of milk were important reasons for such a diversification. Consequently, income from livestock increased.

Such a transformation has generated significant employment opportunities in the watershed area. The shift in the cropping pattern was from low-labor requiring crops (*mandua* and *jhingora*) to labor-intensive crops (vegetables and floriculture). This has led to decline in migration of male labor force from about 27% before the watershed development to 0.7% in 1994–95. Interestingly, the principal source of income changed from wage earners in 1974–75 to cultivation of rice-wheat in 1983–84 to vegetables and floriculture since mid-1990s. In few cases, the source of income has shifted to the service sector as the income generated from vegetables made it possible to buy transport vehicles. The farm-level evaluation of the project at 8% discount rate revealed that the investments made in the watershed activities were rewarding with a benefit-cost ratio of 1.93:1.

Lessons learned

The lessons for the success of the watershed program in this area are as follows:

- Confluence of interest stimulated community to participate in managing natural resources. Water and pasture brought the community together.
- Regular flow of technology has substantially raised the farm income through diversification in favor of high-value commodities. Initially, the availability of improved technology of rice, wheat, maize and pulses, and later of vegetables and floriculture augmented the income from agriculture.

- Easy access of market stimulated farmers to diversify agriculture in favor of high-value commodities. The nearest markets for vegetables in Dehradun and Haridwar, and market for floriculture in Delhi led farmers to harness the potential of soil and water conservation measures.

Consortium model watershed: Adarsha watershed

Andhra Pradesh accorded high priority to the watershed program. It is reckoned that sustained improvement in the quality of life, especially for the rural poor, depends on efficient management and renewal of natural resources. Watershed program is considered to successfully harmonize the use of water, soil, forest and pasture resources, particularly in the rainfed areas of the state to raise agricultural productivity. The watershed program in the state is envisaged as a great opportunity for improving the productivity, profitability and sustainability of dry farming areas through social mobilization. Water resource development, management, harvesting and equity in sharing form the nucleus of watershed development (Government of Andhra Pradesh 2001). With assured availability of water, farmers become motivated to accept more profitable, sustainable and innovative farming systems. Watershed development is a promising solution for water-scarce areas as well as for areas where water requirement is high. It reduces vulnerability to drought and mitigates the distress caused by frequent droughts. To have better results from investment in watershed program, the state government adopted the Rao Committee recommendations submitted to the Government of India in implementing watershed development programs since 1995–96. This includes the organizational structure at state, district and local level. The purpose is to interface government machinery and beneficiaries, decentralize decision-making authorities and make all the stakeholders more accountable.

A major program for development of all the degraded lands in the state over 10 years was launched during 1997 as the 10-Year Perspective Plan. The action plan for development includes wetlands, degraded lands (ie, drylands which are being cultivated under rainfed conditions) and degraded reserve forests. It is envisaged that the plan would offer a sustainable opportunity to increase growth, reduce poverty and conserve water. Under the 10-Year Perspective Plan of watershed development aiming at developing 10 million ha from 1997 to 2007, 3.16 million ha land is under treatment by taking up 7135 watershed projects. The target is that every year 1 million ha area would be brought under the watershed program. So far 5472 watersheds covering an area of 2.736 million ha (Table 13) with an investment of Rs 5800 million using participatory approaches have been taken up. Over 0.2 million ha of watersheds were being treated under the Integrated Wastelands Development Programme.

In the following section, we discuss a case study from Adarsha watershed, Kothapally in Andhra Pradesh. The basis of selecting this watershed was that it was functioning in an integrated consortium

Table 13. Watershed development in Andhra Pradesh, India.

Year	No. of watersheds	Area (million ha)
1995–96	687	0.344
1996–97	94	0.047
1997–98	628	0.314
1998–99	2759	1.379
1999–2000	1092	0.546
2000–01	212	0.106
Total	5472	2.736

approach, where different research institutions, NGOs and community were participating in planning, implementing and management of watershed activities.

Background

The Adarsha watershed is an innovative farmer participatory integrated watershed management model. It is located in Kothapally village, Shankarpally mandal in Ranga Reddy district of Andhra Pradesh. It was in operation since 1998. It covers about 465 ha and has medium to shallow black soils, with a depth of 30–90 cm. The slope is 2–2.2%. Rainfall is intermediate (800 mm). There are 274 families in the watershed with a population of 1492 (Shiferaw et al. 2002). Majority of the farmers (70%) are smallholders having less than 2 ha land. The main purpose was to improve rainfed agricultural production through watershed development, and to reduce poverty of farmers through increased systems' productivity through sustainable use of natural resources. The unique feature of this watershed was that it followed the consortium approach. The purpose of developing a consortium was to provide technical backstopping of the on-farm watersheds, and draw expertise from different international, national, government organizations and NGOs. The consortium members were: ICRISAT, CRIDA, National Remote Sensing Agency (NRSA), M Venkatarangaiah Foundation (MVF), an NGO, DPAP of the State Government, and community in the watershed.

The watershed area was characterized as rainfed, low productivity, negligible irrigated area, without any water harvesting structure. ICRISAT and CRIDA provided technical support, DPAP provided financial support, and the NGO mobilized the community for collective action. Several forms of technological interventions were made. These are related to: (i) soil and water conservation; (ii) integrated nutrient management; (iii) IPM; (iv) improved cropping system; and (v) wasteland development. Technologies for soil and water conservation included earthen and masonry check-dams, gully control structures, gabion structure, broad-bed and furrow, use of tropicultor for planting, fertilizer application and interculture operations, field bunding and plantation of *Gliricidia* on the field bunds. Integrated nutrient management included vermicomposting, soil incorporation of *Gliricidia* and nutrient budgeting. Pheromone traps, nuclear polyhedrosis virus (NPV) and indigenous measures were used for IPM to reduce the consumption of chemicals. New cropping systems like sorghum and maize intercropping with pigeonpea and chickpea were introduced. Afforestation was done for development of the wastelands.

To plan, implement and execute various activities few committees were formed as per the new guidelines of the Ministry of Agriculture. These are democratically elected committees which included: (i) Watershed Committee consisting of a president, secretary and 270 farmers; (ii) WA consisting of a chairman, secretary and 8 members; (iii) women SHGs for vermicomposting consisting of 15 members in each group; (iv) UGs for water harvesting structures; and (v) SHGs to undertake watershed development activities. Constitution of SHGs was critical in the success of watershed development. The support for watershed development has been routed through the SHGs of the poor to ensure that the work taken up is demand driven and based on their needs, thereby ensuring better targeting of the interventions in favor of the poor. Capacity building was considered an important component for the success of the watershed. Therefore, farmers were trained on several aspects of integrated watershed development by ICRISAT, CRIDA, MVF and the DPAP staff. Important components of integrated watershed development were: (i) soil and water conservation technologies; (ii) IPM; (iii) vermicompost; (iv) use of tropicultor; and (v) improved varieties of maize, pigeonpea, chickpea and sorghum.

New integrated watershed management model

Based upon the previous experience on watershed research and development, the concept of the new integrated watershed management model was adopted in Adarsha watershed, Kothapally. The important features of this model are as follows (Wani et al. 2002a):

- The model involves participation of beneficiaries through cooperative mode, and not through contractual mode.
- Instead of replicating different components, it uses new science tools for management and monitoring of the watershed.
- The focus is to improve the livelihoods of the people through a holistic system's approach rather than merely addressing soil and water conservation.
- A consortium of various institutions is formed for facilitating technical backstopping, motivating beneficiaries, and arranging inputs and output markets.
- The model minimizes free supply of inputs for undertaking evaluation of technologies. It is based on farmers' participatory research principle.
- It recommends low-cost soil and water conservation measures and structures and amalgamates traditional indigenous knowledge with the new knowledge for efficient management of natural resources.
- It takes care of maximizing private benefits by emphasizing more use of individual farmer-based conservation measures for raising productivity in individual farms along with community-based soil and water conservation measures.
- It evolves a dynamic framework of continuous monitoring and evaluation by the stakeholders.
- It empowers individuals in the watershed and strengthens village institutions for managing the watershed program.

Benefits of watershed development

The watershed activities yielded promising results despite drought conditions during the last two years. The benefits were documented in the form of: (i) improved groundwater levels; (ii) reduced runoff from 12% to 6%; (iii) reduced soil loss to < 1 t ha^{-1}; (iv) increased crop yields; (v) higher income from new cropping systems; and (vi) improved greenery in the watershed area (Wani et al. 2002b). Water was the catalyst for improving the crop yields and enhancing farm income, which was due to soil and water conservation measures. Adoption of improved cropping systems and crop varieties benefited farmers near the check-dams more than those located far away. Availability of water induced adoption of improved varieties and technologies. Availability of water has also led to the adoption and spread of value-added activities such as horticulture. Area under vegetables increased from 40 ha in 1998 to 60 ha in 2001. Area under maize has increased three times from 60 ha in 1998 to 180 ha in 2001. A similar trend was observed in pigeonpea. Maize/pigeonpea and sorghum/pigeonpea have emerged as new cropping systems, which utilized the land for a longer time period most effectively. Cotton crop area in the watershed reduced to 100 ha in 2001 as compared to 200 ha in 1998. Wani et al. (2002a, 2003) reported that despite drought conditions in 1999, yield of maize increased to 3.25 t ha^{-1} in 1999 and 3.75 t ha^{-1} in 2000 from 1.5 t ha^{-1} in 1998 (Table 14). Similarly, yield of intercropped pigeonpea went up to 0.64 t ha^{-1} in 1999 and 0.94 t ha^{-1} in 2000 from only 0.19 t ha^{-1} in 1998. Sole sorghum yield went up from mere 1.07 t ha^{-1} in 1998 to 3.05 t ha^{-1} in 1999 and 3.17 t ha^{-1} in 2000. Yield levels were also substantially higher under farmers' practices. Thus both availability of water and improved technologies contributed to such an impressive increase in the yield of different crops.

The watershed is only five years old and started yielding high dividends. However, two aspects may be added in the project for deriving benefits in a sustainable way. First, the watershed committees need to evolve participatory mechanism for cleaning and maintaining the check-dams. The assumption is that the village organizations will be capable of maintaining both on-going and new activities when the PIA and other organizations withdraw. However, voluntary work (*shramdan*) is being considered for cleaning and maintenance of the check-dams. The example given is the successful voluntary work program for eradication of *Parthenium* weed. It would be appropriate that post-project processes are evolved for the sustainability of the watershed. Second, the watershed consortium may also include one private company or cooperative for strengthening linkage between production and marketing for high-value commodities like vegetables, milk, etc. There are some examples of contract farming and cooperatives in vegetables, poultry, dairy, oilseeds and wheat that have benefited farmers by ensuring markets and remunerative prices. Such arrangements also minimize the market and price risk particularly vegetables, milk, poultry, etc.

Lessons learned

Lessons drawn from the success of the watershed are as follows:

- Consortium approach consisting of research organizations, NGO, government departments and farmers used synergies from each other to effectively plan, implement and monitor the watershed. This model needs to be replicated in other watersheds for their success.
- The program resulted in tangible economic benefits to individual farmers through improved soil, water and nutrient management options on their lands.
- Participatory planning with the community for deciding the location of the check-dams benefited more number of farmers.
- Most of the check-dams are located in the government land and degraded private land. Since no private cultivable land was used for constructing check-dams, there was no conflict arising among the farming community.
- Adoption of improved technologies (varieties, machines, vermicomposting, water management, etc) substantially raised crop yields and augmented farm income. Improved varieties were sold to the farmers and machine (tropicultor) was available on rent in the village, which was extensively used by the farmers. The farmers expressed that row-sowing and fertilizer application with tropicultor contributed to higher crop yields.
- The principle of "No free rides" for new technology evaluations changed farmers' attitude towards the project and increased their attention and participation over time.
- Women SHGs were engaged in preparing vermicompost. The activity has become an important

Table 14. Crop yields in Adarsha watershed, Kothapally, Andhra Pradesh, India.

	Yield (t ha^{-1})		
Crop	1998 (baseline)	1999	2000
Sole maize	1.50	3.25	3.75
Intercropped maize (farmers' practice)	–	2.70	2.79
Intercropped pigeonpea (farmers' practice)	0.19	0.64	0.94
Sole sorghum	1.07	3.05	3.17
Intercropped sorghum	–	1.77	1.94

Source: Wani et al. (2002b).

source of their income. It is not only raising income of women groups but also improving soil fertility at least cost, augmenting crop yields and reducing unit cost of production.

This approach may have limitations because the international and national research institutions cannot participate in all the watershed projects in the country. Research cost of international institutions is too high and participation in all watershed programs is beyond the scope of their mandate. They may develop a model to show how different organizations should function in a watershed. They may play the role of facilitator. The question is who will take this role in the absence of international institutions. The answer is very difficult at this stage. National research institutions can play that role to some extent but their limited resources constrain them to participate in all the watershed projects. At this stage, under the present government structure and the role of NGOs, no agency is visible that can substitute the role of international and national research institutions as facilitator to encourage watershed in a consortium approach. The Kothapally watershed should answer this question of finding a suitable facilitating institution through scaling up process for wider adoption of the consortium model for watershed management.

Lessons Drawn for the Success of Watershed Development

Historical evidences of watershed development programs provide useful information for future planning. There is increasing evidence on factors determining the success and sustainability of the watershed management programs in the country. This section uses the information collated from the case studies, supplemented by results from earlier studies, to draw lessons for targeting future watershed management programs in the country. Depending upon the objectives and local needs, different watershed programs stress different aspects of watershed development. The success of the interventions in terms of environmental recovery and/or improving livelihoods also varies depending on the balance and attention given to the different components. Some programs give greater emphasis to development of land and water resources, while others stress promotion of better agronomic practices and input use, or building and strengthening local-level institutions for better management of resources and effective participation of the community. We compared the different case studies using qualitative ordinal scales along the following major components of a holistic and integrated approach to watershed management (Oikos and IIRR 2000):

- Simultaneous development of land, water and biomass (because of the symbiotic relationship between them)
- Integrated farming systems
- Catering to the fuel, fodder and food requirements of people and livestock
- Ensuring environmental sustainability along with economic viability (through the promotion of low-cost technologies)
- Improving land productivity through the promotion of better agronomic practices and input use
- Creation of non-farm employment (either to release population pressures on land, or to create employment for the landless households)
- Development of local institutions (for future management using participatory approaches and capacity building)
- Cost sharing by the community
- Addressing equity issues among the households in the watershed

The comparative results for the selected watershed management programs in relation to the priority given to various components of integrated watershed management is presented in Table 15. The

Table 15. Priority given to various components of integrated watershed management in the different programs identified for the study[1].

Activity	RGWM	AGY	MYRADA	Sukhomajri	ICAR	ICRISAT
Simultaneous development of land, water and biomass	High	High	High	High	High	High
Integrated farming systems	Limited	Limited	Limited	High	High	High
Catering to fuel, fodder and food requirements of people and livestock	High	High	High	High	High	Moderate
Ensuring environmental sustainability along with economic viability (through the promotion of low-cost technologies)	High	Limited	High	Limited	Limited	Limited
Improving land productivity through the promotion of better agronomic practices and input use	Limited	Limited	High	High	High	High
Creation of non-farm employment	Low	Low	Limited	Low	Low	Low
Development of local institutions	High	High	High	High	Limited	Limited
Cost sharing	Limited (as per norms)	Limited[2] (as per norms)	High	Limited[3]	High	Limited
Addressing equity issues	High	High	High	High	Limited	Limited

1. RGWM = Rajiv Gandhi Watershed Mission; AGY = Adarsh Gaon Yojana (Model Village Project); ICAR = Indian Council of Agricultural Research; ICRISAT = International Crops Research Institute for the Semi-Arid Tropics.
2. Under the Guidelines for Watershed Development, 1994 and revised 2000, Ministry of Rural Development, Government of India, landowners have to contribute 10% of the cost of work done on their private lands and the community has to contribute 5% of the costs incurred on common lands.
3. Initially the project supported the activities; after the project was over, the community has been meeting all costs from the revenue generated from the project.

analysis shows the emphasis given to the different components in the program and not the degree of impact of these components. The latter is difficult to measure based on this kind of methodology. It is interesting to note how the different watershed management approaches differ in terms of creating economic opportunities to the poor, enhancing environmental sustainability and mobilization of local communities and resources. Watershed development programs that give greater emphasis to cater to the needs of the people, and to develop local institutions are more likely to address social and equity issues and strengthen local institutions and their linkages to external organizations. The major implications of these results and broad lessons are presented in the following section.

People's participation

People's participation in watershed planning, implementation, monitoring, execution and management is as vital as the scientific input in deciding the technology intervention (Deshpande and Ratna Reddy 1991). People's participation is critical for the success of the watershed program because the sum of individual choices has collective consequences on management of natural resources.

Insufficient participation leads to inadequate watershed management of an agricultural parcel (or piece of land), and to environmental degradation, while sufficient participation yields benefits in the form of reduced erosion and increased productivity (White and Runge 1994). In community participation people act collectively and influence the outcomes. Collective action in watershed development is necessary because many activities require coordination between neighbors and among members of the community. Participation in watershed development program requires that the implementing organization does not follow a blueprint for development but involves the communities in analyzing soil and water conservation problems and identifying strategies to alleviate them. For success of this type of participation, three aspects are critical: (1) the ability of members to participate as a community or to have a collective voice; (2) decision made jointly by the community and implementing organizations; and (3) communities bearing a share of costs.

In most of the case studies discussed earlier, people's participation in planning, implementation and management was an important factor for the success of watershed management projects. People's participation was rated very high in Sukhomajri watershed, MYRADA watersheds and AGY and high in ICAR model and integrated consortium model. The watershed programs under these models are considered successful. On the other hand, community participation, cooperation and trust were quite low in the watershed studied under RGWM. It was noted that though there is strong political will to intensify the watershed program, the community does not show feeling of ownership for the project. Since efforts at community mobilization have been inadequate, people were less willing to cooperate and resolve conflicts in ways that would benefit the community.

Effective people's participation

It is clear that one of the important precondition for the success of the watershed is effective people's participation. More success was achieved where smaller, homogeneous groups were formed. In such cases interests of marginalized groups were better represented. In most WAs that were large and heterogeneous, the interests of poor are marginalized while the interests of the dominant groups are addressed. Equity considerations are also better achieved through smaller groups.

The evidence revealed that lack of people's participation is often responsible for the failure of the watershed program. Even the Mid-Term Appraisal conducted by the Ministry of Agriculture, Government of India revealed that projects have failed to attain sustainability because of failure of government agencies to involve the people (Government of India 2001c).

A number of international studies on managing natural resources also highlighted similar observations. A major reason for poor performance is inadequate orientation towards clients and inadequate participation by them in the design and implementation; also, the public sector has generally not performed well in difficult areas (Farrington and Thiele 2000). Earlier results of meta analysis in India based on 310 watershed studies have supported these evidences and showed that the benefits were highest in the watersheds where people's participation was high (Joshi et al. 2000) (Table 16). The benefit-cost ratio was much higher (2.4) in watersheds where people's participation was high in comparison to the watersheds with low participation (1.24). Equally important is the typology of the beneficiaries coming together for sustainable management of the watershed.

The key issue is: Why and under what circumstance do people voluntarily come together to manage watershed management programs? The obvious reason may be to maximize their revealed preferences and minimize their private costs. The following section discusses this aspect based on the lessons drawn from the case studies and experiences from other watersheds.

Table 16. Summary of efficiency, equity and sustainability gains from watershed development.

Benefit	Indicators	Sample	Per capita income of the region[1]		
			High	Medium	Low
Efficiency	Benefit-cost ratio	128	1.98 (16.86)	2.21 (12.28)	2.46 (7.73)
Equity	Employment (person-days ha^{-1} yr^{-1})	39	132.01 (4.14)	161.44 (5.29)	175.00 (4.66)
Sustainability	Irrigated area	97	40.34 (9.73)	23.01 (6.24)	36.88 (4.19)
	Cropping intensity (%)	115	77.91 (8.67)	36.92 (11.99)	86.11 (7.64)
	Rate of runoff (%)	36	–12.38 (5.31)	–15.82 (3.39)	–15.43 (6.01)
	Soil loss (t ha^{-1} yr^{-1})	51	–0.82 (40.32)	–0.88 (37.55)	–0.69 (4.60)
	Extent of people's participation		High	High	Low

1. Figures in parentheses are the t-values to test of H_0 = Indicator is not significantly different from zero.
Source: Derived from a meta analysis of various studies (bibliography is available with the authors); Joshi et al. (2000).

Conditions for people's participation

Traditionally, the watershed programs in the country were supply-driven. The Central and State governments allocated resources for watershed development. Subsequently, the officials used to identify locations and decide various activities for implementation. Such an approach did not match the needs of stakeholders in the watershed. In the absence of people's participation, the potential benefits of the watershed programs could not be harnessed. Recognizing this, the Government of India initiated the concept of Participatory Integrated Development of Watershed (PIDOW) in the 1980s. This contributed to partial success. In due course, the people's institutions, like Zilla Parishad (a democratically elected body in a district), SHGs and watershed implementing committees were gradually involved into the project management system. With more funds allocated for watershed development, several NGOs aggressively participated in implementing this program and demonstrated the importance of people's involvement in the success of watershed programs. Most of the arrangements were informal and varied across watersheds and implementing agencies. To make it formal, the 1994-watershed guidelines specifically included people's involvement as one of the conditions in watershed development. It is important that people's participation is voluntary. Only voluntary (not coercionary) participation would sustain the watershed programs. It is, therefore, important to identify the conditions under which the watershed beneficiaries would involve themselves in its implementation, both during the project tenure and in maintaining structures built after the project is formally over.

Broadly, there are four conditions for facilitating people's participation: (1) making people aware about the potential benefits of collective action in conserving and managing natural resources; (2) demand-driven activities in the watershed program; (3) empowering people in planning, implementing and managing watershed programs; and (4) sufficient private economic benefits to create incentives for participation.

Making people aware. The evidences from the case studies showed that people's participation was more in the watersheds managed by NGOs and ICAR and in the consortium approach adopted by ICRISAT as compared to those managed by the government. Government programs witnessed low people's participation. For example, in one of the case studies under the RGWM, many villagers were not aware of the project being implemented in the village. The evidences were that the rich and the

prosperous participated in the government programs and the large share of benefits went to them. Farrington and Lobo (1997) also noted that cases of participatory watersheds especially those managed by NGOs have become abundant. Yet they were small in scale. By contrast, many government sponsored approaches have expanded rapidly, but often lack the local ownership and group coherence necessary for sustainable management of the common pool components of watersheds. Most of the watersheds managed by NGOs and ICAR were able to convince people about the cascading effects of watershed development. These organizations devote substantial time to facilitate collective action. Intensive and face-to-face approaches with small and local groups facilitate the emergence of a 'critical consciousness' of wider social, economic and political conditions facing rural communities that may bear on agricultural and natural resource constraints (Farrington and Thiele 2000).

It may be noted that all the NGOs were not effective and successful in facilitating people's participation. The successful NGOs are characterized by: (i) strong interest in low external-input agriculture; (ii) ability to identify farmers' organizations and the needs and opportunities to which technologies need to be adapted; (iii) ability to identify indigenous knowledge and practices, and to help in negotiating how they might complement modern technologies; and (iv) awareness of the wider context of livelihood in which initiatives toward agricultural change need to be located (Farrington and Thiele 2000). Similarly, Kerr et al. (2000) described the following characteristics of successful participatory project: (i) they devote time and resources to social organizations; (ii) they build each group's interest into the project; (iii) they work with farmers to design interventions and select technologies; (iv) they chose the village, not the watershed, as the unit of implementation; (v) they screen for enabling conditions for the success of the watershed program; and (vi) they work in coordination with different agencies and beneficiaries. Unless these conditions are met, construction of technical and mechanical structures per se may not lead to the success of a watershed program.

Demand-driven programs. Demand-driven watershed activities attracted higher people's participation. Since there are diverse groups of beneficiaries in the watershed areas, their needs cannot be overlooked. There are often reports that only influential and large farmers were involved in planning, implementing and managing watersheds. Invariably, the small and marginal farmers are omitted. Often the women and landless laborers were silently left out of watershed-related decision-making processes. The successful watersheds involved all the stakeholders in the watersheds, including farmers, landless laborers, and women, among others to understand their needs. Unsuccessful ones involved a select group and failed to include a sizeable group. It is necessary that need assessment of the stakeholders should be the precondition in designing and developing the watershed activities. Also, there is a need to stimulate confluences of interests among different stakeholders, and search for corresponding checks and balances for their effective participation.

Empowering the community. Another important condition for people's participation was empowering the beneficiaries for decision-making in the watersheds. When people are empowered to take decisions and execute the activities, they own the program. They run the watershed activities according to local, social and cultural systems. The external agencies (such as the NGOs or the government agencies or the research institutions) facilitate the processes that empower the community in managing watersheds. For example, if the external agency promotes the decision of sites for constructing structures, technologies, distribution of costs and benefits, etc to the people, the management becomes effective. It is necessary to make the decision-making process more decentralized. In the case studies under AGY and Sukhomajri models, key decisions for physical interventions (for example, location of check-dams, reservoir, bunds, etc) were taken and implemented by the community, and not by any NGO or research organization. Similarly in Adarsha

watershed in Kothapally, participatory planning with the community for deciding location of the check-dams benefited more number of farmers. An interesting study from Haiti by White and Runge (1994) empirically examined the factors responsible for successful collective action in one of the least auspicious environments. People participate in watershed development and management programs if they are organized and empowered to do so. A great deal of resources are required for empowering local people and for building people-centered local institutions and organizations and linking them to higher level of institutions engaged or interested in similar work (Singh 1991). NGOs are better oriented to enlist people's participation and possess necessary skills and patience to work with them. There are evidences that certain social groups have consistently been marginalized by watershed development projects. These include the landless, families in the upper levels of catchment, marginalized tribal groups and women. It was suggested that unless women play a central role in the decision-making process, the long-term sustainability of development efforts is threatened. In the long-run, people's participation can be garnered through PRIs. Decentralization of decision-making and involving PRIs would facilitate in sustaining the benefits from the watershed programs.

Substantial expected gains. Notwithstanding altruistic motives, generating substantial economic gains is perhaps the most important feature that attracts society to come together and work for a specific cause. Equity in the potential gains is the key determinant for the uniformity of interest and effective community participation. In the selected case studies, when distribution of gains (in terms of access to water, sharing benefits from common property resources, etc) was relatively equitable among all the stakeholders, it led to the success and sustainability of the watersheds. In the case studies, particularly in RGWM, it was found that the mechanisms for sharing benefit were not in place; hence, influential farmers were benefited more than the less privileged. Therefore, in the watersheds studied under RGWM the participation of village community was quite low.

The evidences revealed that people came together for immediate and private gains rather than the long-term social gains. As long as the collective action yielded sufficiently higher private gains, people participated actively in watershed programs. There are many conflicting objectives among the stakeholders in a watershed. Often there are problems of free riders. These arise because the benefits are not commensurate with the cost incurred and the labor invested in the watershed activities. Sharing of benefits in accordance to the costs will go a long way in sustaining the watershed programs. Another complicating factor is how to benefit the landless, the resource poor, etc with low ability to pay for the different programs.

Technology targeting

Identifying appropriate target locations and technologies for watershed management is critical for the success of watershed programs. Target locations can be identified based on the potential benefits from different agro-ecoregions. In the case studies, the target locations were having different land capability classes and slope, ranging from high hills to low hills, with annual rainfall ranging from 500 to 1900 mm and housing different social classes. The case studies did not lead to any conclusion that could help in targeting the watershed development programs. However, results from a meta analysis based on a large number of watershed studies (Table 16) showed that watershed interventions in low-income regions with rainfall levels ranging from 650 to 1000 mm performed better (Joshi et al. 2000). Based on the ecoregions, the same study also showed that the Western Himalayan regions and the southern zone of rainfed India performed relatively better than other regions. In the case studies, ICAR (Fakot) and Sukhomajri watersheds fall in Western Himalayan region, while watersheds under

MYRADA and the consortium approach in Kothapally were in southern rainfed zone. These regions performed better with respect to productivity impacts than watersheds located in other regions.

The benefits (in terms of benefit-cost ratio and internal rate of return) from watershed management programs were higher in low (per capita income <US$300) and medium (per capita income between US$300 and 500) income regions than in higher income areas (per capita income >US$500). In the low-income regions, it seems that the beneficiaries own substantial unemployed and underemployed family labor, which could be used to undertake labor-intensive watershed management activities. Employment generation was also higher in watersheds located in low-income regions, where the beneficiaries effectively participated with the government organizations and/or NGOs in various watershed activities. Such an approach of interfacing beneficiaries and the government organizations and/or NGOs has a multiplier effect on returns to investment in watershed management programs. These results have a strong bearing on investment priorities for watershed programs. On these grounds it seems justified to prioritize states and regions falling in the low-income range and low-to-medium rainfall range in the rainfed zone.

Regarding the impacts of technologies, the case studies demonstrated that a regular flow of improved technologies has generally contributed to enhancing farm incomes. Good technical support for construction and maintenance of structures is necessary to regenerate land and water resources, and enhance crop productivity. Periodic updating of the technologies based on market trends and user needs is equally important for the sustainability of the watershed programs. The technology backstopping examples are quite revealing from the watersheds largely supervised by the research institutions (for example, ICAR and ICRISAT). The continuous change in the production portfolio (shift from low-value to high-value commodities) as a result of strong technology support from research institutions seems to have strengthened livelihood security and increased farm incomes.

Sharing costs and benefits

Individuals must derive private tangible benefits from the watershed activities. These include raising agricultural productivity, augmenting income, meeting food security and controlling land degradation (Boyd and Slaymaker 2000). It was noted that one of the key determinants for the success of the watershed activities was that the expected private benefits must substantially exceed the expected private costs. In many of the selected case studies, the arrangements for sharing costs and benefits seem to have been satisfactory to the beneficiaries and encouraged them to willingly participate in the watershed programs. Sukhomajri was a unique case where the benefits were distributed equally to all the villagers. The benefits generated from grasses, fodder and water were equally distributed to each household in the village regardless of household size. In this scheme, the landless laborers and the marginal farmers sell the excess water to large farmers. Under such an arrangement, every household in the watershed has the incentive to conserve grass, fodder and water. On the other hand, in the watersheds under RGWM, benefit sharing has not been developed and only the beneficiary group participates in the watershed activities. Therefore, sharing of benefits proportional to the costs will go a long way in sustaining the watershed programs. For example, in the watershed framework, the farmers located at the upper reaches have to invest more but farmers at middle or lower reaches receive more gains from this action (Joshi et al. 1996). A necessary condition for success is that the benefits must commensurate costs or the benefits should be more than the costs incurred by the individual household. Singh (1991) reported similar findings based on few watersheds in the country. The problem of sharing costs and benefits arise between upstream and downstream beneficiaries. Invariably it is observed that the benefits are relatively less for upstream beneficiaries than the

downstream ones. The reverse is true for costs. It is therefore necessary that formal systems for sharing the benefits from collective action among the local people involved should be evolved and enforced by the people themselves supported by legal provisions or appropriate policies (Singh 1991).

Private benefits vs social benefits

Individuals always give more importance to immediate and private gains of any action and/or efforts. Less emphasis is accorded to long-term social benefits. One of the determinants for the success of the watershed programs is that each community action must generate high private gains. In selected case studies, the watershed development activities have contributed to increasing private gains. It was noted that tangible benefits from investment on common and private lands induced the community to actively participate in watershed development activities for the sustainability of the watershed project. These were often related to higher crop yields and income. Households were not much concerned if soil degradation is prevented or not; their interest was to maximize crop production and income. Individuals attach high value to private gains because agriculture is the mainstay of rural livelihoods. Therefore, any activity that improves the quality of life would receive wholehearted support. Evidences from the case studies showed that watershed activities directly benefited the individual farmers, landless laborers and even women in most of the cases. It is therefore necessary that appropriate arrangements be made to convert as much of collective benefits into tangible private benefits. This can be done through developing need-based institutional arrangements, which assess the needs of the stakeholders in the watershed and accordingly plan distribution of benefits. Hanumantha Rao (2000) suggested that watershed programs need to be integrated with agricultural development programs. An early integration of the interventions by the two departments, Ministry of Agriculture and Ministry of Rural Development, in watershed areas is suggested. The programs of these departments intend to raise productivity and conserve natural resources, which induce farmers to sustain their efforts towards watershed development. Integration of activities across issues will enhance effectiveness and impact of the program interface through exploration of synergies.

Property rights (water vs land)

Property rights and collective action institutions fundamentally shape the outcomes of resource governance (Knox and Meinzen-Dick 2001). Rights to land and water are important incentives for the household to undertake private soil and water conservation investments. When rights are properly defined and secured, there is an incentive to invest on fixed assets and optimally allocate these for enhancing input productivity and augment income. Appropriate institutional arrangements are required for strengthening property rights. The process of building strong property rights institutions involves negotiating and defining rights, their underlying procedures, and corresponding responsibilities.

A strong case of property right was noted in the Sukhomajri watershed project, where the rights on water, fuel and fodder were accorded to each household in the village irrespective of land ownership. Each household was allocated equal rights on water, fuel and fodder. Even the landless laborers enjoyed such rights. The landless laborers can sell the water to any farmer at mutually agreed rates. Such arrangements provide incentives to every household (including landless labor) to conserve and judiciously use natural resources. A similar arrangement was observed in ICAR watershed (Fakot) for fuel and fodder. In both the cases, the number of goats declined to avoid grazing, and number of cows and buffaloes increased. On the other hand, in the absence of appropriate property rights in the watershed under AGY, the grazing could not be controlled in the forestlands, and villagers let their

cattle graze the regenerated grasses. It is therefore important that the interest of all households in the watershed is protected and equal rights of regenerated natural resources are accorded to encourage them to participate in conserving these resources.

Access to knowledge

Regular flow of information about improved technologies and markets is the key to the success of watershed programs. The concept of integrated genetic and natural resource management (IGNRM) is that watershed technologies should include those related to crops, grazing land, livestock and management of trees (vegetation) besides soil and water management. The experiences from ICRISAT's on-farm watersheds in Madhya Pradesh, Maharashtra and Andhra Pradesh during 1980s revealed that continuous support for watershed development, credit supply, wheeled tool carriers and infrastructure facilities for supply of seeds, fertilizers and information are important for the success of the watershed program. There is a need for strong cooperation between various stakeholders (researchers, administrators, extension workers and bankers) to enhance farmer participation and to realize the full potential of watershed-based technologies for increasing and providing the much sought stability to agricultural production in SAT regions (Kshirsagar and Ghodake 1991). The case studies gave a large spectrum of information on this. For example, a strong information and communication technology (ICT) support is provided by ICRISAT not only to Adarsha watershed (Kothapally) but also to all the watersheds located in Andhra Pradesh and other states through development of ICT modules. The Virtual University for Semi-Arid Tropics (VUSAT) established recently would go a long way in providing necessary knowledge support for watershed and other related aspects of rainfed agriculture. This provides information on a wide range of issues related to rainfall, crop planning, improved technology and their availability, market and price trends, etc. Farmers located in any watershed can access the required information. Such mechanisms are not in place in other watersheds.

Lack of information has adversely affected the sustainability of the Sukhomajri watershed. The village community was ignorant about what was happening in the industry and where they were supplying raw material (ie, grass) for paper manufacturing. The paper industry changed the technology from grass-based to eucalyptus-based, threatening the disposal of grasses, which was the main source of income in the watershed. If the villagers in the watershed had information that the industry was switching-over to more efficient technology, they could also have started cultivating eucalyptus for the industry.

These studies show that a strong network of information is necessary for the sustainability of watersheds. In the changing economic regime, the technologies are changing very rapidly and affecting competitiveness, markets, consumer preferences and prices. To sustain the watersheds, it is important to keep pace with the changing socioeconomic patterns. The right information at the right time can help in developing appropriate strategy to take benefit of the changing scenario. ICRISAT has set up a unique example of linking all watersheds through satellite in Andhra Pradesh. This program is now extended to Madhya Pradesh and Rajasthan. There is a need to up-scale such a program to benefit larger target population.

Market opportunities

Access to both input and output markets is one of the most important conditions for the success of the watershed activities. This enables beneficiaries to buy inputs and sell their produce at reasonable prices. Improved access to markets often induces farmers to diversify agriculture in favor of high-value

commodities. The case studies have clearly brought out how availability of markets was responsible for the sustainability of the watershed program. For example, in Fakot watershed, a perfect blending of water and market availability for the local produce has completely transformed the women dominated subsistence coarse cereal-based agriculture into a commercial and export oriented enterprise. Another example is of Sukhomajri watershed, where market access for grasses in the paper industry generated enormous profit that encouraged households to make every effort to conserve the grass in the upstream areas of the watershed. As mentioned earlier, the marketing of grasses became a serious problem when the paper industry changed the technology from grass-based to eucalyptus-based system. It has adversely affected the repair and maintenance of the Sukhomajri reservoir and surrounding watersheds. Lack of appropriate prices and markets has threatened the sustainability of the watershed. Often in the watershed programs, conservation and production are given considerable importance than access to markets. Invariably, conservation, production and markets are not linked perfectly in watershed programs. There is a need to integrate production with the market for the success of the watershed programs. In cases where such arrangements have evolved, the watersheds often become successful. Availability of water, marketable products and markets bring the households together for collective action in the watershed area. Boyd and Slaymaker (2000) have advocated a similar point and suggested that policy must provide market access and attractive producer prices as an important condition for the success of soil and water conservation programs in Burkina Faso. They further stated that market access explained the difference in adoption rates between the sites in Burkina Faso. High adoption and introduction of high-value crops was in areas with proximity to urban centers. In Uganda, the collapse of markets for cash crops and general reduction in commercialization activity proved a major constraint to investment in agriculture and consequently soil and water conservation program (Boyd and Slaymaker 2000).

Strengthening forward and backward linkages

A watershed program is not a panacea for rainfed areas. Watershed activities alone cannot meet the objectives of augmenting production, increasing income and conserving natural resources. The success of watershed programs often relies on how strong backward (input-delivery system) and forward (postharvest system) linkages have been established. The backward linkages include credit delivery system, seed sector, labor markets, technology transfer mechanisms and other input delivery systems. The forward linkages include access to output markets, transport facility, agro-processing, etc. In some of the case studies, strong linkage of watershed programs with various institutions yielded desired outputs. The SHGs, UGs and NGOs indeed strengthen backward and forward linkages. Effective linkages between SHGs or users' associations and various institutions are critical in making a watershed program a success. Presence of local processing units may add value to the local products and further augment income of the beneficiaries.

Governance issues

Governance issues are very critical in planning, implementing and monitoring watershed activities. The governance may be effective if all watershed programs come under one umbrella. As mentioned earlier few Central Government ministries have taken up some watershed programs. It would be appropriate if all the watershed activities are consolidated under a single ministry. All watershed programs, afforestation and soil and water conservation activities should be addressed by the single ministry for effective planning, monitoring and evaluation. Such an initiative would also avoid duplication of activities and erosion of resources.

Within the watershed area, governance issues are important for making a sustainable program. Village politics, group politics and conflict between different actors in implementing and managing the watershed seriously affect the efficiency and sustainability of watershed investment. Boyd and Slaymaker (2000) reported that party politics could potentially undermine village unity and adversely affect the watershed management programs. These were corroborated by White and Runge (1994). The study revealed that most socioeconomic indicators of landholder heterogeneity (levels of wealth, age, religious preference, membership) did not constrain the emergence of collective action in watershed development and management.

Other issues include appropriate coordination between different agencies, and improving the knowledge, capacity and skill of the community in planning, managing and developing watershed programs. The evidences from the case studies in some of the watersheds under RGWM showed lack of sustainable institutions to sustain the work already done. Emphasis on achievements of physical targets has compromised the development of sustainable institutions and collective action. The coordination between government departments takes place through state-level mission office, but there is no similar structure at the district level. There is a need to develop a strong cooperation among different line departments for the success of the watershed programs. A study by Singh et al. (1991) quoted one of the important reasons for poor performance of the Kandi Watershed Program in Punjab as the lack of sufficient integration and cohesiveness between the line departments. It showed that the project had an excellent theoretical organizational structure but lacked in execution that led to substantial shortfall in the economic rate of returns (8%) from the expected returns of 12 to 20% for various components. Similar results are reported from several watershed projects. On this issue, Yugandhar et al. (1999) noted, "… ironically, it appears that the very same factor, viz., people's participation and decentralization of program administration, which accounts for the success achieved so far, is highly inadequate for sustaining this development, especially in areas where the program has proceeded too fast by fulfilling the targets for completion of works without waiting for required institution-building and leadership formation at the grass roots level."

Equally important is the local leadership, which plays an important role in enlisting people's participation in watershed development programs by mobilizing people's resources and energy, and by assuring the people that they would have access to benefits from their participation in collective action for watershed development and that the distribution of the benefits would be fair and equitable (Singh 1991). The evidences are glaring from AGY, MYRADA and Sukhomajri that strong leadership motivated people to participate in the project activities. The need for developing local leadership is emphasized owing to the mutually conflicting interest of different groups for building up institutions and evolving leadership for rallying the rural community around common interests with adequate stake for weaker sections (Hanumantha Rao 2000). There is a need to identify potential leaders from the target areas and provide them adequate capacity building program in leadership and managing people in watershed development. The known leaders may be involved in developing leadership module and their unique qualities and approaches need to be replicated to up-scale the watershed program. Organizations like the Institute of Rural Management and the Indian Institute of Management may take the lead in designing and organizing such courses at regular intervals.

Capacity building

Capacity building for watershed development through training encompasses wide-ranging tasks such as awareness building or imparting resource-literacy, development of technical skills, and reorienting

motivations and attitudes of officials and political functionaries at all levels towards the need for empowering the people through decentralization (Hanumantha Rao 2000). The new guidelines emphasized this issue. The need for training has been emphasized at different levels in hierarchy in the government and for the PIAs, NGOs, SHGs, Watershed Committees, village volunteers and villagers. The training program is designed for: (i) successful implementation of the watershed projects; (ii) understanding various aspects of the watershed developments; (iii) skill upgradation; (iv) sustainability of the project; (v) confidence building; and (vi) planning, implementing and monitoring of watersheds. The new guideline has also developed the criteria for selecting training institutions. These include: (i) experience in implementation of watershed development projects as PIA; (ii) good library and availability of communication; (iii) technology and other facilities for imparting training; (iv) faculty for training with adequate qualification; and (v) linkages with other academic and research institutions involved in watershed development. The training course may include: (i) concept of watershed development; (ii) community organization; (iii) technical issues; (iv) accounts and administration; (v) issues of equity and sustainability, scientific inputs related to geographic information system (GIS) and role of remote sensing in watershed development; (vi) role of PRIs; and (vii) involvement of women and weaker sections of society.

The role of government should be confined to provide financial and capacity building, and basic infrastructure, enabling legal and political environment conducive to people's participation in watershed development programs (Singh 1991). Direct involvement in watershed development activities is not therefore essential. It is important to delineate the roles and responsibilities of the government, NGOs and local communities in watershed management activities. Institutions should be developed for capacity building. The mandate of already existing institutions should be tuned to meet the needs of rainfed areas. More proactive role in capacity building would develop better coordination between departments and communities.

Institution building

Social institutions are critical for the success of the watershed program. The role of such institutions is to develop rules for planning and managing watershed activities, sharing costs and benefits and dispute resolution. With the growth of watershed programs in India, different forms of institutions are evolving for managing watersheds. Some of the key factors that facilitate development of social institutions in the context of watershed are listed below:

- Capacity building is the key to making sustainable institutions. It is more than creating awareness, technical training and exposure visits. It should lead to empowerment of the community and informed decision-making. Capacity building has to be approached as a human resource development strategy for sustainable management of the natural resource base and for addressing poverty and livelihood security.
- An assured flow of funds to the project maintains a high level of motivation. If project activities cannot be completed, or project implementation is delayed, then people's commitment to the project cannot be sustained. Lack of motivation and commitment weakens the local institutions.
- Cost sharing has to be 'real'. *Shramdan* or contribution of voluntary labor does not necessarily create a feeling of ownership of the assets created for land and water development. Cash contribution and private investment with or without credit ensures commitment to the institution as well as to the project as a whole.
- Strong dedicated and committed leadership helps to bind groups and give direction to the fulfillment of goals and objectives.

- A shared perception of benefits by all group members is needed. The benefits may not be equal, but equitable, in that every member perceives some benefit for himself.

Similarly, there are many factors that impede the process of institution building in the watershed programs. These need to be amicably addressed for the success of the watershed interventions. Some of the important factors are discussed below:

- Unreasonable quotas and targets: To meet the requirements of the watershed guidelines a target-oriented approach is adopted wherein funds have to be spent in specified time but does not allow time for institution building. However, the society is completely ignorant about the purpose, plan and action of watershed development. In the absence of sufficient time, Watershed Committees and other groups get formed quickly and capacity building remains at the level of creating awareness about the watershed project. This neither empowers the committee nor gains the trust of the WA. Such an observation was noted in the watershed under the RGWM and in one case in AGY, where the community was unaware about the watershed development program.
- Lack of self-reliance: Excessive dependence of the Watershed Committee or WA on the PIA for decision-making and implementation is an indication that effective capacity building has not taken place. This reduces the sustainability of the institution.
- Lack of transparency: This creates distrust about the motives of the Watershed Committee and weakens the WA. Lack of transparency leads to lack of confidence and trust between the community and the committees. Until now there was a concentration on building Watershed Committees for the implementation of the watershed management programs. However, these Committees do not always inspire confidence and trust from the community. It is necessary to ensure that these Committees truly represent the interests of the community, and have been formed with the consent of the community and not by an external agency.
- Failure to mobilize local resources: Institution building and consensus building takes time. If outside labor is brought to complete the physical works so that targets can be completed, without waiting for the community to get together and take decisions, there is little motivation for institutions to be formed and strengthened.

Equally important in managing watershed programs are political will, support and commitment to the watershed program. Regular flow of resources and funds is critical for the success of the watershed program. One of the case studies under AGY showed that funds did not flow in time that reverted the process of watershed development. Overall, at present there is strong political will at the national level and many states (eg, Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan) are following the same. Effective planning, regular monitoring and evaluation are part of strong political will. It is done through convergence of government departments associated with watershed development programs like agriculture, rural development, soil and water conservation, groundwater, animal husbandry, etc. These departments participate at all levels from the State down to the line departments at the village level. As discussed above, in addition to a strong political will, good governance is very crucial. It is noted that a bureaucratic approach in the implementation of the watershed programs will jeopardize the basic objectives of participatory watershed management. There is a need for a flexible approach that takes into consideration local conditions and provides for locally adapted implementation strategies that are more successful in meeting the objectives of watershed management. Similarly, the roles of external institutions and organizations as stakeholders need to be well defined. External linkages with research institutions, credit institutions, markets, and government departments are necessary for sustainability of interventions. However, local-level

institutions should be empowered to access these linkages as was noted in ICRISAT's consortium approach at Kothapally.

Conclusions

Water is one of the most limiting factors for further intensification and sustainability of agriculture in the Asian SAT. Access to irrigation is the major contributing factor to the slow progress towards agricultural transformation in the rainfed areas of SAT India. India has initiated the watershed development programs as a mechanism for improving agricultural productivity and mitigating resource degradation in the rainfed and drought-prone regions. The watershed research and development program has a long history and has evolved through a long process of learning by doing. The program was shaped with time to meet the specific objectives in the rainfed areas with more emphasis on involving community in planning and management of watershed. The three Ministries currently implement the watershed programs: Agriculture, Rural Development, and Environment and Forests. The annual budget of the various ongoing national, bilateral and internationally-aided projects is estimated at US$500 million per year. A strong commitment by the Government and good policy support for the program has led to widespread recognition of the role that watershed programs could play in agriculture and management of the natural resource base in the drylands. Available estimates indicate that by the end of the IX Plan in 2002, about 27.5 million ha have been covered under the watershed programs. This is approximately 25% of the potential area for watershed development in the rainfed regions.

Yet a large portion of the rainfed area (75%) is yet to be brought under the watershed programs. While there are some visible gains from the various watershed development programs, the sustainability of the investments undertaken by the different agencies has not been ensured mainly because of insufficient participation of the local communities. The first generation watershed programs suffered from a top-down approach and technical focus on soil and water conservation without sufficient emphasis on livelihood benefits to the rural poor. Along with several socioeconomic studies, which documented the weaknesses of various watershed management approaches, experience has shown the difficulties of the top-down approach to natural resource management. This has led to the development of new policies and guidelines for a common approach to watershed management across the different implementing agencies in the country. These policies combine the technical strengths of the older programs along with the lessons learned about the role of community participation. Even after the new policies have been issued, the watershed development program suffers from second and third generation problems. The review of literature on the policy and institutional issues for watershed management and major lessons from the case studies examined in this study indicate the few critical areas that continue to affect the success of participatory community watershed management in the country. These are mainly related to profitability of interventions, problems of collective action and active participation by the community, cost-sharing between individual farmers and the community/state, distribution of the gains from watershed management (equity) and negative externalities (eg, upstream-downstream tradeoffs). These are inter-related problems. For example, the problems of collective action are related to inequity in the distribution of benefits within the community. The geographical and social diversity creates difficulties in sharing costs and benefits of the program.

These challenges are made more complex by lack of supportive policies and legislations that encourage cost-sharing and private and collective action in watershed programs. The landless households and marginalized groups are especially vulnerable to exclusion from accessing the benefits

of the programs. The high subsidies provided for the program, including soil and water conservation investments on private lands, make it difficult to effectively assess the real farmer and community demand for the programs. The required contributions from the private farmers specified in the different guidelines are not also fully recovered from the farmers either in kind or in cash. Although external support would be needed to encourage investments on communal lands and local public goods, lack of some positive level of financial commitment from the individual farmers for soil and water conservation investments on private lands undermines the objective of the program and threatens the sustainability of the valuable investments created in many watershed villages. More research and corrective policy measures are needed to address these problems.

Further, it is essential to overcome the conflicting objectives and share benefits and cost evenly in the heterogeneous rural setting. Given the diversity of the rural social structure, different groups and individual farmers have different and often conflicting interests. The conflicting objectives are to be minimized by evolving appropriate policies and institutional arrangements. The case studies assessed here have clearly shown that success in attaining the stated objectives is associated with an integrated approach where availability of profitable technologies for resource conservation and access to local markets encourage people's participation in the watershed programs. Depending on the focus given to this combination of technical support, social organization and market access, the review of diverse development experiences indicates that most of the government-managed watershed programs performed poorly, while those managed by research institutions and some NGOs were quite successful. Lack of capacity in these important aspects are the principal reasons for poor performance and failure of many watershed development programs. Careful integration of these components in future policies and programs would help transform subsistence agriculture in rainfed areas while also protecting the vital resource base. Periodic monitoring and evaluation of the effectiveness and efficiency of the interventions and approaches as well as assessment of the multi-faceted impacts of the new generation of watershed programs implemented under the new guidelines would be useful to generate useful data and lessons for scaling up successful approaches.

Knowledge Gaps and Areas for Future Research

Based on the above discussion and selected case studies, it is clear that the watershed program has the potential to contribute to the development of rainfed areas. Success in attaining the livelihood and environmental objectives through watershed management relies on multiple factors, including access to markets, technology and equitable access to the conserved water and other economic goods and services generating tangible benefits to the poor. Equity in sharing the benefits is a vital consideration for effective community participation (collective action). Few important gaps have emerged from the earlier studies and selected case studies, which need to be addressed through appropriate targeting of research in multiple areas (viz., policy, institutional arrangements, and technology generation and dissemination). To address the second and third generation watershed management problems, the following research issues are identified.

Policy research

- Develop suitable methods and assess the impact of watershed development on poverty alleviation, employment generation, livelihood patterns and conservation of soil and water resources in the rainfed areas. Though the watershed program is reckoned a growth engine for the rainfed areas, no mechanism has been placed at the national and regional level for assessing the impact of investment made under the programs. Such initiatives at various levels could not be done because appropriate

methodologies for estimating the economic and social benefits are often lacking. Two aspects are important: (1) development of suitable impact assessment methodologies using knowledge-based techniques (eg, remote sensing, bio-economic modeling and GIS); and (2) decision support system mainly at the meso-level including multiple watersheds to assess the impact of different approaches and policies and to prioritize future investments.

- Formulate investment strategies for watershed development. There is a need to prioritize regions for watershed development. This may be based on income (or poverty), rainfall, degradation of soil and water resources, and potential benefits from watershed programs. At present the program is often launched based on physical conditions and characteristics. Ex-ante assessment of suitable approaches, technologies, etc for specific locations using simulation modeling will be useful.
- Develop policy options that would contribute to sustainability of watershed investments and collective action by the community.
- Develop policy instruments and strategies (including separation of water and land rights and establishing transferable water rights) for sustainable use of groundwater resources and for managing water as a scarce resource in rainfed regions.
- Identify and develop policy options that would encourage individual resource users to share the costs of conservation and resource-improving investments on private lands with the public (government) sector and the community.
- Evolve policy options that ensure equitable sharing of watershed management benefits across sections of the watershed community (including the landless) and for allocating water and sharing costs and benefits among upstream and downstream communities to mitigate the classic problem of externalities.
- Identify policy options for introducing high-value commodities and marketing strategies in the watershed areas to enhance productivity of water and other resources. This is needed because consumption pattern of the consumers is rapidly changing in favor of dairy products, fruits, vegetables, poultry, meat, etc. Rainfed areas could quickly harness such diversification opportunities because the high level of protection accorded to irrigated crops is likely to slow down the shift in the production portfolio in irrigated areas.
- Develop methods for effective integration of production, marketing and agro-processing to tap the full benefits of diversification into high-value commodities as part of the watershed programs. This is essential because high-value commodities are often perishable and need to be marketed and consumed quickly or processed by adding value. This requires developing innovative approaches for linking watersheds to markets by adding value to local products.
- Develop strategies for strengthening crop-livestock integration in watershed development to tap synergies between the complementary sectors. The UGs should be encouraged to build their livelihood strategies according to competitive advantages.
- Assess trade-offs between efficiency vs equity vs sustainability in the process of watershed development and identify options to enhance complementarities.

Institutional research

- Since watershed programs call for collective action, it is pertinent to develop more effective and transparent institutional framework for enhancing people's participation. Such an arrangement is necessary to overcome the conflicting objectives, free riders' problem, and sharing costs and benefits. Mechanisms for enhancing equity in sharing benefits and cost-sharing between the private resource user and the community and the public sector need to be explored.

- Understand more critically and analytically the determinants for effective people's participation.
- Institutionalize mechanisms for strengthening partnership between the government, private sector, non-government agencies, research institutions, and clearly defining their roles and responsibilities to achieve convergence and efficiency.
- Promote innovative institutions (for example, contract farming or cooperatives) to strengthen production and marketing in the watershed areas. The private sector is gradually promoting contract farming for numerous commodities. There is a need to attract the private sector to function in watershed areas. It will ensure farmers better prices and timely procurement.
- Devise innovative methods for speedy and reliable flow of information (specially technology and markets) to optimize the benefits of watershed development. Develop methods to up-scale VUSAT to disseminate information by making use of ICT on latest technologies, markets, prices, etc.

Technology-related research

- Develop targeted technologies to meet the needs of small farmers based on their resource endowments. There is a need to develop watershed management technologies that would conserve the resource base and also provide short-term economic benefits to the land users. Conservation technologies become attractive to small farmers when complemented with productivity enhancing options (eg, fertilizer use, new seeds, crop management, pest management, supplementary irrigation, etc).
- Improve productivity of groundwater and surface water through better management, harvesting and conservation structures, use of improved germplasm, and diversification of production that would allow multiple use of water. Methods for reducing losses and improving efficiency of supplemental irrigation or rainwater in crop growth.
- Utilize local resources and traditional knowledge for maximizing returns to investment in watershed development programs.

Problems of scaling up

- Up to a point, similar upstream-downstream tradeoffs apply for communities within larger watershed or sub-basin systems. Soil and water conservation by upstream communities may benefit the wells and tanks of downstream communities. However, once land and water use intensification upstream crosses a threshold of zero runoff or groundwater depletion, the downstream areas may actually suffer as a result of upstream watershed management. Significant areas in semi-arid Deccan India (characterized by high density of irrigation tanks to capture surface runoff coupled with limited groundwater recharge potential in granitic or basalt hard rock aquifers) have already reached this stage. This indicates the need to move from micro-watershed to meso-watersheds to understand the spatial interlinakges and externalities before effective approaches to scaling up are developed.
- There is a need to quantify social benefits including the various on-site and off-site economic impacts and environmental services provided by the watershed interventions and identify the long-term tangible and intangible benefits of such programs. This will help estimate the magnitude of benefits accruing to individual farmers and to society and to identify the level of external support that would be justified to motivate individual farmers to undertake private and collective investments.
- Suitable approaches and dissemination strategies need to be developed to scale up/out successful approaches that encourage collective action and generate attractive socioeconomic and environmental benefits to the community.

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Appendix

Checklist of Issues and Questions for Focus Group Discussions

Watershed profile

1. Name of the watershed:
2. Starting year for watershed development:
3. Year of withdrawal (completion):
4. Watershed area:
5. Watershed works:
6. What types of structures were constructed to conserve soil and water in the arable and non-arable areas?
7. How did villagers participate in developing the structures?
8. Which category of villagers participated in developing the structures?

Cost and benefits of watershed

9. How was the cost shared?
10. What types of benefits were realized?

Benefits of watershed program

11. How did the cropping patterns change?
12. Has groundwater improved as a result of water resource development?
13. Did surface water improve?
14. Did arable area increase as a consequence of watershed development activities?
15. Did irrigated area increase? If yes, how is the additional irrigated area used?
16. Has the rate of siltation in reservoir/tank changed?
17. Has the forest area expanded?
18. Have crop yields increased?

Maintenance of watershed

19. How are the structures maintained?
20. Who bears the cost of maintenance?
21. In case of any breach in structures, how are repairs made? Who bears the cost?
22. If the structures are not constructed, how would it affect irrigated area and cropping pattern?
23. What is the current status of the structure?

Benefit sharing

24. How was the benefit of watershed structures shared: Water, fodder, fuel-wood and drinking water?
25. Has income of the majority of farmers increased? If yes, which group benefited? How have watershed activities increased income?

26. Has employment of farmers (men and women) and landless laborers improved as a consequence of structures introduced?
27. Has migration of farmers/landless laborers changed?
28. Has the net income of farmers changed? If yes, how much?
29. Did watershed programs help in improving the quality of life?

Institutional arrangements

30. Are watershed association/watershed committees, user groups/self-help groups constituted for planning/execution/monitoring/maintenance?
31. If yes, how do they function? What is their present status?
32. Why watershed activities are not adopted in the neighboring villages?
33. What problems were encountered in maintaining the watershed structures?
34. What problems were faced in sharing cost and benefits within the community?
35. How were problems and social conflicts resolved?

Exit policy

36. What mechanisms have been developed for withdrawal (exit policy) from the watershed?
37. If yes, how does it function? Who manages it?
38. If not, what is the impact of lack of proper exit policies?

Beneficiaries' perceptions

39. In your opinion, how should the watershed programs be developed, monitored and managed? What should be the mechanism of distributing costs and benefits?
40. Are farmers, landless laborers, women and other stakeholders satisfied with the watershed development? If yes, why?