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# Rethinking policy and institutional imperatives for integrated watershed management: Lessons and experiences from semi-arid India

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## Abstract

This study investigates the institutional and policy issues that limit effective participation of resource users in community watershed programs and identifies key lessons for harnessing collective action and its effectiveness in achieving economic and environmental outcomes. It shows that spatial and temporal attributes of watersheds and the associated market failures that accelerate degradation of agricultural and environmental resources require innovative policy and institutional arrangements for coordinating use and management of resources. Under enabling policies, IWM can effectively contribute towards diversification of production into high-value products, reversal of resource degradation, growth in the incomes of the poor and enhance the ability to mitigate the effect of drought. However, the degree of biophysical and social complexity within watershed communities could often undermine incentives for collective action, thwart distribution of benefits against the landless and resource-poor households and even lead to depletion of groundwater resources. Governments and other stakeholders have a unique role to play in kick-starting the process of transformation through strategic natural resource and productivity-enhancing investments that strengthen local capacity for collective action and generate local public goods. Such collective investments could serve as building blocks for private productivity-enhancing and risk-mitigating investments as they boost profitability of productive assets (land and labor) and encourage farmer adoption of beneficial conservation practices. The lessons and experiences also show that integrating interventions along watershed frontiers would require a flexible learning alliance of institutions and cross-disciplinary teams with complementary skills and competencies.

***Key words:*** Institutional and policy issues, community watershed programs, environmental resources, investments.

## Introduction

Rainfed areas in semi-arid India account for two-thirds of the cultivable land and house a large share of the poor, food insecure and vulnerable population of the country. Moreover, as productivity growth in the more favored Green Revolution areas is showing signs of slowing down or stagnation [16], future growth in agricultural production and food security is likely to depend on improving productivity in the semi-arid rainfed areas. There is also some evidence indicating that returns to investments would be substantially higher in these regions when compared to the irrigated regions, where the potential for productivity growth has been exploited through Green Revolution technologies [3].

Integrated watershed management (IWM) has been promoted as a suitable strategy for improving productivity and sustainable intensification of agriculture in rainfed drought-prone regions. India has one of the largest micro-watershed development programs in the world. Over $500 million is being spent annually through various projects supported by the government, NGOs and bilateral funds [4]. The watershed development program was expanded and strengthened since the mid 1990s by introducing new guidelines, additional funds and the creation of new institutional structures that aimed to increase community participation and sustainability of the program. Despite the progress in terms of coverage and effectiveness, the program has been rather slow given the magnitude of the problem; only about 10% of the land requiring treatment has been covered [18]. The benefits also tend to favor those who own land and could afford investments in tube and open wells for irrigation [19].

Today the concept of IWM is recognized to go beyond traditional integrated technical interventions for soil and water conservation to include multiple crop-livestock and market related innovations that support and diversify livelihoods to better withstand risks induced by market and climatic variability. The concept ties together the biophysical notion of a watershed as a hydrological unit with that of the community and institutional factors that regulate the demand and determine the viability and sustainability of such interventions. The hydrological approach helps to identify the appropriate technical interventions on the supply side while the village or community-based planning and implementation is fundamental for creating institutions for community empowerment and sustainability on the demand side. The landscape level but community-based IWM interventions create synergies between targeted technologies, policies and institutions that improve productivity, resource use sustainability and market access for the resource users [30].

However, effective implementation of an IWM program requires careful consideration of the special characteristics of watersheds both as biophysical as well as socioeconomic units and the implications for policy and institutional arrangements. Watersheds encompass diverse natural resources (soil, water, trees, biodiversity, etc.) utilized by diverse groups of people holding unequal use rights and entitlements [4, 7, 8, 11]. Watersheds are also inhabited by socially heterogeneous groups of people located at different points along the terrain creating potential conflicts in resource use between those on the upper, middle and lower reaches of catchment. Clearly, watersheds are ecologically and socially complex geographical units characterized by temporal and spatial interdependence between resources as well as resource users. This implies that effectiveness of watershed interventions will depend on the ability to treat the entire hydrological landscape, not just a portion of it.

Moreover, because of the lateral and downhill movement of soil and water resources [29], unilateral action taken by any single resource user may impose positive or negative consequences (externalities) on any other resource user. The ability to exclude or prevent these externalities is determined by the nature of property rights held by the resource users. When negative externalities are difficult to exclude or prevent at low cost, some of the production and resource use decisions for certain resources may fall under the control of other agents. When the externalities are negative, the production or resource use levels may be socially supra optimal. The reverse is true for desirable externalities for which individual resource users are not fully compensated. The ability to internalize these kinds of mutual spillover effects resulting from spatial and temporal interdependence among resource users requires interventions mediated through targeted policies and institutional incentives that encourage cooperation and collective action. Fragmented land ownership and settlement patterns coupled with unequal access and use rights create conflict and diverging interests. This reduces the incentives for cooperation and increases the transaction costs involved in organizing resource users for collective action.

Based on the lessons and experiences in semi-arid India, this paper revisits the key policy and institutional needs for IWM and offers new insights on how the IWM approach, if complemented by suitable policy and institutional innovations, could contribute to improvement and reduced vulnerability of livelihoods and economic and environmental conditions in drought-prone regions. The paper reviews the key policy and institutional challenges that face integrated management of watersheds, highlights issues related to organization and governance of community watersheds and presents the key factors that determine the incentives for community participation and collective action. This is followed by discussion of the diverse livelihood and environmental impacts of IWM and the drivers of change based on a case study of semi-arid watershed villages in India. The final section concludes with a brief summary and implications for policy.

## Policy and Institutional Issues

A number of factors that determine incentives for collective action in natural resource management have been discussed [1, 6, 14, 15]. Three major factors seem to determine the incentives for individual participation in watershed management programs. These are spatial scale, temporal scale and property rights [27, 29]. These factors imply the need for certain policy and institutional arrangements to enhance individual incentives for collective action in watershed management.

A watershed is a catchment area from which all water drains into a common point, making it an attractive unit for technical efforts to manage water and soil resources. A watershed is a spatially defined unit that includes diverse natural resources that are unevenly distributed within a given geographical area. This creates interdependence between resources as well as resource users over time and space. For example, soil degradation from the upper reaches of a catchment affects economic and ecological functions in the lower reaches of a catchment. By definition, watersheds require a hydrologically defined spatial scale for technological interventions to succeed. The actual size of this unit depends on topographic and agro-climatic conditions and may range from a few hectares (ha) to over thousand ha. This implies that effectiveness of watershed interventions will depend on the ability to treat the entire hydrological landscape, not just a portion of it.

On the other hand, investments in several natural resource management (NRM) technologies required for watershed management do not payback in a short period. Typical examples are tree planting, construction of check dams and terraces for soil and water conservation. Unlike the seed-based crop production technologies that provide returns within a single season, NRM technologies often have a longer gestation period. The costs are incurred upfront, while economic returns are often delayed and accrue in small incremental flows over a long period. Some of the social benefits from watershed management are non-tangible public goods such as improvements in ecological functions and environmental services that improve sustainability and ecosystem health. Such benefits are not fully captured by individual resource users. This means that unlike other short-duration agricultural technologies (e.g., new varieties) the resource-improving IWM interventions require a relatively longer planning horizon [24].

Another important factor in IWM is related to the property rights regime that governs the use of land, water, forest and other resources. 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 with such investments. Excludability depends on biophysical conditions (e.g., topography), property rights and the prevailing legal and institutional framework, including customary laws. In many cases, land is either privately owned or leased from the government or other rights owners based on some defined contracts. In the latter case, land cannot be sold and may not be used as collateral to access institutional loans. Surface (rivers and lakes) and groundwater resources are mainly held under common property regimes. This means that resource users belonging to certain group will have unregulated access to exploit these resources typically without payment. These resources are not priced and in the absence of collective action, there is lack of incentives and institutional mechanism to regulate use. This can cause a major problem in watershed management. For example, when water is free and regulatory systems are now in place, the groundwater level in watersheds begins to decline while the individual cost of drilling a new well increases. A study in 12 semi-arid villages of Andhra Pradesh has shown that more than 65% of the open wells and 28–45% of the tube wells have dried up. In many of the villages, more than 90% of the open wells have completely dried up [26].

Clearly defined and secure property rights would combine the elements of excludability, duration, robustness and assurance [17]. Duration measures the temporal extent of the rights; robustness measures the scope and depth of the rights held; assurance measures the ability to enforce the agreed rights. In watersheds, there is a lateral movement of soil and water resources. Unilateral action taken by any single resource user may impose positive or negative consequences (externalities) on any other resource user. In some cases, the externalities move in one direction (unidirectional externalities) while in other cases they may move in multiple directions (reciprocal externalities). Lack of excludability of undesirable effects means that part of their resource use decisions and production choices fall under the control of other farmers. In the presence of negative externalities, the level of private resource use is in excess of what is socially optimal while the reverse is true in cases where the effect is positive. These kinds of mutual spillover effects that emerge from spatial and temporal interdependence among resource users require interventions mediated through targeted policies and institutional incentives that encourage cooperation and collective action.

The social dimension is also important for IWM; diverse social groups with differing entitlements and rights to use natural resources inhabit watersheds. Ethnic and tribal heterogeneity as well as unequal rights to land and water among the inhabitants often imply that costs and benefits from watershed investments are unequally distributed. Fragmented land ownership and settlement patterns coupled with unequal access and use rights create conflict and diverging interests. This reduces the incentives for cooperation and increases the transaction costs involved in organizing resource users for collective action. The classic mismatch between the boundaries of the watershed and a village or a community is well known. Rivers and other natural boundaries often delineate villages or local administrative units whereas they often lie at the interior of a watershed. A good strategy to overcome this problem is to identify a village that coincides with a micro-watershed that will in turn form a watershed when multiple villages are brought together. The biophysical and social complexities and the need to harmonize the two for sustainable NRM will require appropriate policy and institutional arrangements that promote both private and collective efforts.

## Organizational Issues

The success of collective action in natural resource management has been associated with organizational structure and governance. However, the form of organizational structure is likely to depend on the type of problem and the existing socio-cultural conditions within the communities. Organizational and governance structures imposed from the top or from outside agencies are less likely to function effectively. Those emerging from local practices and traditions may have a better chance, but often tend to maintain the status quo (i.e., benefit powerful sections and exclude the voiceless and marginalized). A related factor is the need for a legislative framework within which farmer organizations operate to develop and promote good governance. Legislative frameworks that limit the role of governments to provision of an enabling policy environment and that encourage farmer organizations to function as private sector and business-oriented enterprises are considered useful for the success of collective efforts [5].

However, collective action in watershed management is very unlikely to emerge autonomously on its own. This is mainly because small farmers and resource users are often disorganized and scattered and face high transactions costs in mobilizing communities. Building institutions for collective action in watershed management requires formulation of rules, regulations and guidelines that facilitate effective implementation of community programs [20]. There is a clear role for the state in terms of defining proper guidelines and rules, which facilitate cooperation and collaboration among resource users and provide a legal framework for existence of community organizations. There is also a role for the state in terms of providing strategic public support in establishing community and local public goods that serve as the founding blocks for emergence of successful and effective collective action. However, the level of such support that communities may require is likely to be context specific. Proper targeting of such support and establishing the legal checks and balances needed to prevent misappropriation of funds and opportunistic behavior is also essential.

Proper organizational structures are critical for the success of community action. India has established institutional arrangements for community watershed management that extend from the central and state levels to the grassroots level. At the local level, a number of land owners form user groups (UGs) while landless and marginal farmers form self-help groups (SHGs) that together establish a watershed association (WA), which will be led by a watershed committee (WC). The WA serves as the rule and decision-making body with the WC as its executive arm. The WC is made up of representatives from SHGs, UGs, the Panchayat (Village Council) and the Watershed Development Team (WDT). The WDT is a multi-disciplinary team of advisors constituted by the District Watershed Committee. Selected watersheds receive about US$50,000 from the government in the form of public strategic investment to establish local institutions for collective action and to implement IWM activities. User SHGs are expected to make additional cash and in-kind contributions towards this strategic public support.

This shows the clear responsibility that the governments could play in creating enabling conditions. What roles should other players in the process of watershed management play? Obviously, it will be the primary responsibility of the individual farmers to manage privately owned land and other resources. It will, however, be the primary role of the community to invest and manage common property resources. The non-governmental research and development institutions will have an important role in supporting farmers, communities (and the government) in providing essential resources, innovations and best practices for improving productivity and the environmental resource base. It is critical that the different actors work in close partnership with a common goal and vision. Such a coalition of the willing should be established based on a team spirit and based on the principles of complementarity and comparative advantage.

However, it will be the responsibility of all players to contribute towards building of effective and sustainable institutions (Table 1). As local institutions are developed, it is useful to note the need for an exit strategy for the partners and to hand over the primary responsibility for management of all the local public goods to the community. This does not mean that technical backstopping and periodic monitoring by the NGOs and governments should be

**Table 1.** The role of different players in community-based watershed management.

| Issue | Roles for different actors | | | |
|---|---|---|---|---|
| | Household | Community | Government | NGOs for research and development |
| Private land & water management | Primary | Secondary | Secondary (targeted subsidies, etc) | Secondary (advisory role and social protection) |
| Common property resources and assets | Secondary (compliance) | Primary (Collective action) | Secondary (cost-sharing for investments) | Secondary (support communities and households) |
| Policies, rules and regulations | Secondary (compliance) | Secondary (enforce rules and policies) | Primary (legislator) | Secondary (advice on good policies and best practices) |
| Institution building | Secondary | Primary | Primary | Primary |

stopped. Success will depend on the ability of the communities to adjust to the changing conditions as well as leadership and governance for coordination of resource use and conflict resolution

### Determinants of Community Collective Action

Incentives for collective action vary with the type of collective action problem that communities and resource users face. Conceptual framework that shows that adoption of HYVs is scale neutral while IPM technology and watershed management require spatial coordination and cooperation among affected farmers has been developed [12]. The emergence of collective action in a given context depends on the awareness of interdependence and realization of potential welfare gains from coordinating the activities of individual agents. Individual choices to participate in collective action are contingent upon expectations of the behavior of others. Even if the potential gains are high, cooperative behavior may not translate into practice unless individuals expect other potential beneficiaries to do likewise. The presence of assurance and trust facilitates the potential for reciprocity and emergence of cooperative behavior [21, 22, 31]. Individual participation may also depend on household-specific (idiosyncratic) factors that determine the transaction costs and benefits from participation. The household's existing stock of physical and financial assets as well as human and social capital can especially play a significant role in determining the relative gains from participation. The success of collective action in a given situation once it evolves depends on several factors. The classic impediments of collective action are group size and inequality [14]. Synthesis of case studies describes many success stories of collective action in governing commons – incidences where people, recognizing a need, have created institutions that overcome the problems of collective action and allow them to organize successfully for the collective benefit[15]. A number of factors, either internal or external to the group, were identified as important determinants for the success of collective efforts in managing commons. These include clearly defined boundaries, monitoring, mechanisms for conflict resolution, recognition of rights to organize and presence of graduated sanctions to penalize violators [15].

The empirical evidence on the role of any of these factors under specific situations is quite mixed. Some of the factors widely attributed to the success of collective efforts of farmer organizations have been synthesized and include homogeneity, size, choice of services, commercial activities, self-reliance and autonomy, finance, skills and education, participation, organizational structure and governance, legislation and focus [28]. Many of these factors are generally considered to be relevant for collective watershed management. The effect of these factors on collective action seems to depend on the socioeconomic and institutional context and the nature of the contested resources. Are homogenous groups more successful and what is the optimal size for effective collective action? There is no single answer to these questions. It is generally recognized that the size of the organization will depend on the type and scale of activities being collectively undertaken and should match the organizational abilities of its members. For example, national and regional organizations are more suited for policy advocacy while local level organizations are preferable for marketing, resource management and provision of credit [32]. Collective action reduces transaction costs and the economies of scale may increase to a certain level as group size increases. The transaction and managerial costs of cooperation may, however, increase faster than the gains as group size increases beyond a certain level [5]. This indicates that, among other things, the 'optimal' size will depend on the type of activity and skills of members.

There is, however, a serious paucity of empirical studies in relation to watershed management at both household and group levels. Factors that determine the emergence and evolution of collective action to control soil erosion using data from 22 micro multi-owner catchments in Haiti have been investigated [31]. The study highlights how realization of interdependence, assurance about the behavior of others and a critical mass of motivated individuals contribute to successful cooperation in watershed management. Similar to the findings in the study of Indian watersheds [9, 10], this study also identifies the critical role that equity in the distribution of benefits can play in sustaining collective efforts. Other case studies on collective action in NRM have analyzed canal irrigation systems in India [13] and small irrigation systems in Mexico [2]. The study on the determinants of collective action in canal irrigation in India analyzed the correlates for existence of farmer organizations and collective action for irrigation management. It was found that communities far from markets are unlikely to have local organizations for irrigation management, perhaps indicating how market opportunities enhance the incentives for cooperation in irrigation water management. The presence of water user associations improved the probability of maintenance of irrigation canals while the increase in the number of villages in each minor system reduced it [13]. The Mexican study showed that social heterogeneity and landholding inequality are significantly correlated with lower maintenance of irrigation systems [2].

## Impacts of Collective Action – Some Examples

***Do communities benefit from IWM?*** Collective action in watershed management has the potential to provide multiple economic and environmental benefits – tangible and non-tangible – to rural communities. Such collective action allows smallholder farmers to jointly invest in management practices that provide collective benefits to all members. While watershed management contributes to enhancing resource productivity and sustainability, increased commercialization and market access provides the outlet for disposing the surplus generated and the opportunity to diversify into high-value crops and creates the economic incentives for agricultural intensification and adoption of new technologies. Based on quantitative and qualitative analysis of panel data collected from household surveys, PRA studies and focus group discussions, the environmental and economic benefits derived from implementation of IWM interventions in Adarsha watershed are presented. The study also documents the associated effects of IWM on commercialization of subsistence agriculture and increased participation of smallholder farmers in markets.

Adarsha watershed is located in Kothapally village (longitude 78°5' to 78°8'E and latitude 17°20' to 17°24' N) in Ranga Reddy district, Andhra Pradesh, nearly 40 km from ICRISAT, Patancheru. It covers 465 ha of which 430 ha are cultivated and the rest is non-cultivated marginal land. The IWM interventions were implemented through a consortium that included ICRISAT, Indian NARS, local government, NGOs and the local community. This drought-prone village/catchment was selected in 1997 based on its high vulnerability to drought, severity of water scarcity, the extent of land degradation and widespread poverty relative to other dryland villages in the district [30].

*(a) Environmental benefits:* The environmental benefits were not valued but measured using selected biophysical indicators such as changes in runoff, soil loss, groundwater levels and ground cover that were monitored over time. The soil and water management measures implemented in the watershed included field bunding, gully plugging and check dams built at certain intervals along the main watercourse that cuts across the village and catchment. In order to facilitate comparability, untreated areas within the catchment that contained only farmers' practices without any technological interventions served as counterfactuals to determine the effect of soil and water conservation measures. The evidence collected for two years (2000–2001) shows a significant reduction in runoff and soil loss from the treated segment of the watershed compared to the untreated portion (Table 2). The runoff has declined by about 20 to 60%, the highest reduction coming from years with high rainfall. Although soil erosion levels were not measured in all years, the results from 2001 show over 60% reduction in erosion levels.

**Table 2.** The impact of watershed management on runoff and soil loss, Adarsha watershed, 1999–2004.

| Year | Rainfall (mm) | Runoff (mm) | | Soil loss (t/ha) | |
|---|---|---|---|---|---|
| | | Untreated [1] | Treated | Untreated | Treated |
| 1999 | 584 | 16 | * | * | * |
| 2000 | 1161 | 118 | 65 | 4.17 | 1.46 |
| 2001 | 612 | 31 | 22 | 1.48 | 0.51 |
| 2002 | 464 | 13 | Nil | 0.18 | Nil |
| 2003 | 689 | 76 | 44 | 3.20 | 1.10 |
| 2004 | 667 | 126 | 39 | 3.53 | 0.53 |

[1]Untreated = control with no development work, Treated = with improved soil water and crop management technologies, * Not installed.

The changes in groundwater levels were monitored using 62 geo-referenced open wells located along the main watercourse in the watershed at differing distances from the check dams constructed for recharging groundwater levels. The results show a significant improvement in the yields of most wells, particularly those located near check dams (Fig. 1). The land cover and vegetation density studied using satellite images also shows an increase in vegetation cover from 129 ha in 1996 to 200 ha in 2000 [23].

*(b) Economic benefits:* The average net income from the three major sources (crops, livestock and off-farm) and their relative share in 2001 and 2002 is given in Table 3. The income from crops is computed as returns to family labor and land, i.e., net of all variable costs other than owned land and family labor using the 2001 constant prices. Did IWM make a significant contribution to crop and total household income? In 2001, the average crop income was about 20% higher in the project villages, but the difference increased to about 300% in 2002. Overall household income was 47% higher in the project villages in 2001, but declined to 37% in 2002. This seems to indicate a significant effect of IWM. In order to isolate the effect of other correlated influences, an econometric model was used to estimate the relative effect of IWM and drought factors on crop income and total household income. The results have shown a significant effect of IWM on crop income and overall household income even in years where drought occurs [27].

*(c) Drought mitigation benefits:* The basic goal of watershed management in drought-prone rain-fed systems is to improve livelihood security by mitigating the negative effects of climatic variability while protecting or enhancing the sustainability of the environment and the agricultural resource base. As shown above, adoption of soil and water conservation interventions resulted in significant reductions in runoff and soil erosion, rise in the groundwater level and increase in vegetation cover. Hence, additional land is brought under cultivation in the project villages using small-scale and supplemental irrigation in the post-rainy season using improved varieties and cropping systems. Adoption of improved practices has resulted in increased land productivity and profitability of crops and cropping sequences. The mean income for the two groups of households from alternative sources (crops, livestock and off-farm) in 2001 and 2002 is given in Fig. 2. The average rainfall in 2002 (571 mm) was about 16% less than that in 2001 (676 mm).

The results show that crop and household incomes are generally higher in 2001 than in the drought year 2002. In 2001, crop incomes constituted about 36 and 44% of household income in Adarsha watershed and in the non-project villages, respectively. In 2002, crop income for the non-project village declined by 80% while it only declined by about a third in the project village. Hence, the contribution of crop income to household incomes in the non-project villages declined to a mere 12% while it remained unchanged at about 36% in the project villages. This was largely compensated by increased migration and off-farm employment in the non-project villages, where the share of off-farm income increased from about 50% in 2001 to almost 75% in 2002. This shows how IWM has contributed to stability of crop incomes in the watershed despite the serious drought conditions in 2002.

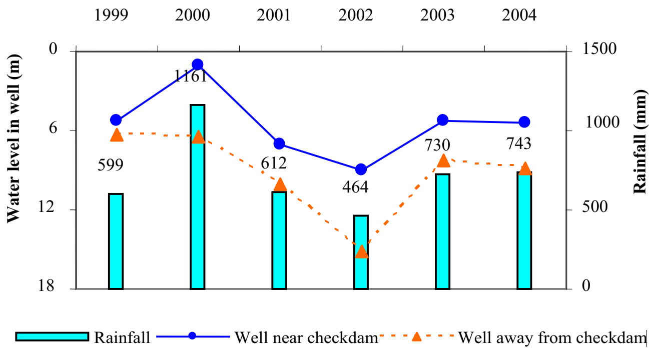


***Figure 1.*** The effect of watershed management investments on groundwater levels [23].

**Table 3.** The effect of watershed management interventions on alternative sources of household income (Rs 1000).

| Year | Village group | Statistics | Crop income | Livestock income | Off-farm income | Household income |
|---|---|---|---|---|---|---|
| 2001 | Non-Project | Mean | 12.7 | 1.9 | 14.3 | 28.9 |
| | (N=60) | Std. dev. | 23.3 | 3.8 | 12.6 | 26.3 |
| | | % | 44.0 | 6.6 | 49.5 | 100.0 |
| | Project | Mean | 15.4 | 4.4 | 22.7 | 42.5 |
| | (N=60) | Std. dev. | 16.4 | 6.4 | 45.0 | 51.3 |
| | | % | 36.2 | 10.4 | 53.4 | 100.0 |
| 2002 | Non-Project | Mean | 2.5 | 2.7 | 15.0 | 20.2 |
| | (N=60) | Std. dev. | 13.4 | 4.7 | 30.0 | 36.9 |
| | | % | 12.2 | 13.3 | 74.5 | 100.0 |
| | Project | Mean | 10.1 | 4.0 | 13.4 | 27.6 |
| | (N=60) | Std. dev. | 19.4 | 6.7 | 17.8 | 31.3 |
| | | % | 36.7 | 14.6 | 48.7 | 100.0 |

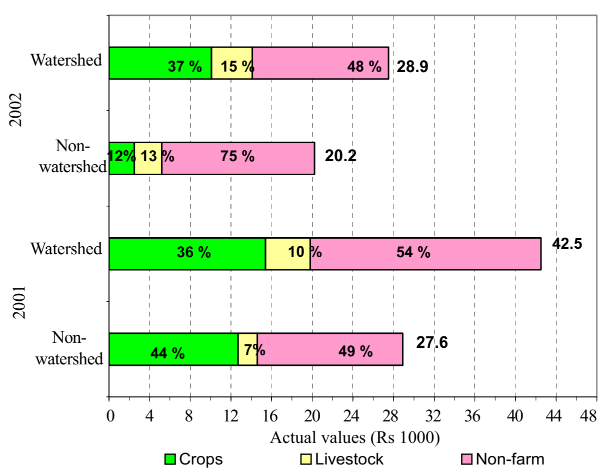


***Figure 2.*** Effects on income sources and stability and resilience of livelihoods.

*(d) Agricultural diversification and commercialization:* Another potential social benefit of IWM is related to its contribution for transforming and re-orienting traditional agriculture towards commercial farming. Integrated watershed-based interventions that combine improved soil, water and pest management with new cultivars and livestock management options seek to address the binding biotic and abiotic constraints in the system. This reduces the pervasive production risk and improves the productivity of the system. Improved water availability helps to diversify production towards high-value products (e.g., legumes, vegetables, fruits, trees, livestock, etc.), boost the productivity through supplemental irrigation and mitigate the risk of drought-induced crop-livestock losses. Adoption of integrated and complementary interventions and the associated higher productivity allows hitherto subsistence or sub-subsistence level households to be able to diversify income sources and generate sizable marketable surpluses. The reduced production and market risk creates opportunities for largely subsistence farmers to begin to trust local markets and gradually reduce self-sufficiency. This would create opportunities for diversification into high-value products and enhanced market participation although risk-averse farmers may still prefer to ensure food security for products for which markets cannot be fully relied on.

A similar process of change has taken place in Adarsha watershed. An analysis of the crop choice decisions and the level of marketed surplus of sample farmers support these observations. Based on census data for 2001, Fig. 3 shows the percentage of farmers that grow the different crops within and outside the project villages. About 26% of the growers (compared to 33% in the non-project villages) in the project village grow low value cereals (mainly sorghum). In terms of diversification into high value cereals (paddy, wheat and maize) the comparative shares are 29% within the watershed project villages and 22% in the adjoining non-project village. In general, except for low value cereals and pulses, a larger percentage of farmers in the project villages have diversified production into high value cereals, oil crops and cash crops (cotton, sugarcane, vegetables and fruits), which contributes to growth and diversification of income sources.

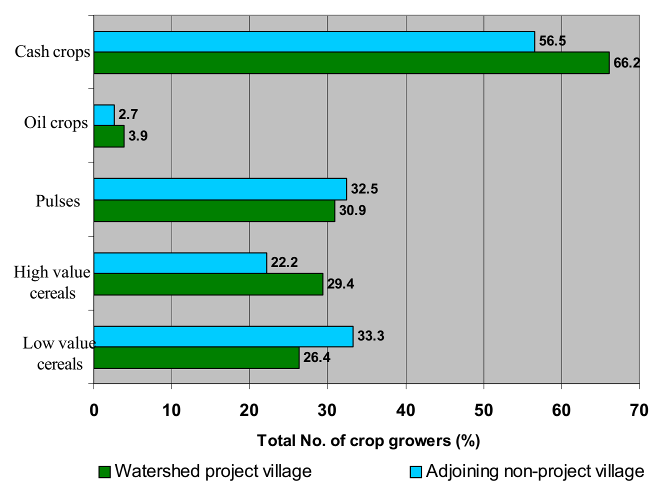


***Figure 3.*** Effect of integrated watershed management on commercialization of production.

***The drivers of change in Adarsha watershed:*** Preliminary assessment of data collected through household and community surveys and participatory rural appraisals show several driving factors that contributed to the success of collective action in Adarsha watershed. These include the following: a) acute water stress, b) shared goals and common interest, c) good leadership, d) active participation in design and implementation, e) knowledge-based interventions for private benefits and equity, f) training and capacity enhancement, g) a coalition of partners with a shared vision.

In summary, we find that when water scarcity is a commonly felt need for the community, and when local institutions that provide good governance and leadership are in place along with knowledge based entry points and local capacity building, the community with shared goal/s was able to participate more actively in implementing the watershed program which led to significant improvements in both economic and environmental conditions in the watershed. However, there are some remaining challenges (e.g., the threat of depletion of groundwater) that may influence the sustainability of the watershed interventions. There will be a need to spread the equity impacts of IWM and evolve local norms and mechanisms that help regulate utilization of groundwater.

## Summary and Conclusions

Smallholder farmers in the drought-prone areas of South Asia are poor, have low capabilities for risk taking and are unable to invest in best practices that enhance livelihood resilience and ecosystem health, especially when such investments are characterized by long gestation periods. However, experiences from semi-arid areas of India show that integrated interventions for watershed management and improved access to innovations and markets can be promising strategies for diversification into high-value products, improved resilience of livelihoods and enhanced resource use sustainability. However, a watershed is a complex biophysical and socioeconomic unit that necessitates special policy support and institutional arrangements for emergence of local collective action. Whereas technical considerations justify a watershed approach as a suitable spatial landscape unit for intervention, social considerations and the need for collective action dictate a community or village unit as a basis for such interventions. The biophysical and social complexities and the need to harmonize the two for sustainable management of water and soil resources require suitable policy and institutional instruments that encourage and stimulate both private and collective efforts. The emergence of local institutions for collective action can help internalize externalities and reduce transaction costs that limit the incentives for individual farmers to participate in sustainable management of local public goods in watersheds. This contributes to empowerment of communities and facilitates joint investments for improving productivity and resource use sustainability at the landscape level. Hence, the community-based but landscape wide IWM interventions create synergies between targeted technologies, policies and institutions that improve productivity, resource use sustainability and market access for resource users.

India is one of the countries in South Asia that has adopted micro-watershed development as a strategy for poverty reduction and sustainable rural development in dryland areas. Experiences in semi-arid areas of India show that when property rights to collectively held resources and investments are clearly defined and beneficiaries respect the agreed rules, farmers in drought-prone areas can benefit from increased availability of drinking and irrigation water, improved availability of fodder for livestock, reduced soil erosion, enhanced sustainability and improved environmental quality [4, 8, 10, 25]. Such collective investments also enhance the profitability of other divisible inputs like fertilizer and improved seeds, and encourage adoption of productivity-enhancing innovations by individual farmers.

The results from analyses of panel data collected from Adarsha watershed and adjoining project villages show that IWM interventions had a significant positive effect on crop and household incomes. Even after controlling for the effect of drought, the results indicated higher crop income shares, higher crop and household incomes in the IWM village compared to adjoining villages that do not benefit from such interventions. This shows the vital contribution of IWM interventions in terms of diversification of income sources into high-value products and mitigating the effects of drought-induced shocks on livelihoods. We also found that IWM had accelerated diversification into high-value products and significantly enhanced the marketed surplus of smallholder farmers, contributing towards commercialization of production. However, there are several cases where watershed management had failed in India and it would be useful to understand the major drivers for emergence and sustainability of effective community action. The experience of Adarsha watershed provides useful insights on these factors. Government support for establishing key local institutions and implement tested IWM interventions in partnership with the community was a critical first step that laid the foundation for collective efforts. The incentive problems for enabling the participation of small farmers in IWM were initially addressed through on-farm interventions that improved crop yields and incomes for individual farmers. This was further enhanced through linked livelihood opportunities (e.g., production of bio-pesticides and bio-fertilizers) for the landless and marginal farmers who may not directly benefit from irrigation and higher land productivity. In order to spread the benefits widely and more equitably, low-cost water recharging and harvesting structures were constructed along the watercourse. The remarkable progress made in Adarsha watershed needs to be replicated in other dryland villages across the region.

However, more work is needed to better understand why certain types of groups fail and others succeed; how governments and other stakeholders can play an active role in the process; how the benefits and costs of IWM can be distributed more equitably; how landless and marginal farmers can benefit from collective action; and how new kinds of institutional arrangements for collective action can be developed to regulate groundwater use, reduce depletion and ensure sustainability.

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