A Consortium Approach for Sustainable Management of Natural Resources in Watershed

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Abstract

The natural resource management in the dry regions imposes challenging pressure on the fragile ecosystems, as they are the source of livelihoods of people whose key occupation is agriculture. ICRISAT's earlier experiences indicated that in the past, watershed management emphasized soil and water conservation measures. Lack of holistic approach to natural resource management in conventional watersheds has led to the emergence of a new integrated watershed management model. Important components of this new model are farmer-participatory approach, use of new science tools, knowledge-flow from on-station to on-farm watersheds, holistic systems approach with integrated genetic and natural resource management (IGNRM) strategy providing site specific solutions, a consortium of institutions for technical backstopping, continuous monitoring and evaluation by the stakeholders, community and women empowerment, and environmental protection. The main features of the consortium approach are technical backstopping by the consortium of multi-institutions, linking strategic and developmental research on farmers' fields, reducing the lag for transferring results from research fields to farmers' fields, empowering the development workers and farmers to manage natural resources sustainably, and harnessing the strengths of the partners to make a win-win situation for all the partners. The consortium strategy has facilitated the exchange of knowledge and technologies amongst the consortium partners, reduced land degradation, and improved rural livelihoods through increased incomes.

The natural resources in the semi-arid tropics (SAT) are the "life line" of rural livelihoods, the key occupation being agriculture. These dry eco-regions are predominantly rainfed, marginal, and fragile, and prone to severe land degradation. Unpredictable weather, limited and erratic rainfall with long intervals of dry spells, and intense rainfall causing runoff and severe soil erosion characterize these dry regions. The overexploitation and reduced recharge of groundwater, along with low rainwater use efficiency is another serious threat to scarce water resources in the dry regions. Low levels of soil organic matter, accompanied by high rates of organic matter degradation aggravated by low literacy and poverty are the major causes of low productivity and depleting natural resource base in the dry regions. The challenge, therefore, is to develop sustainable and environment-friendly options to manage natural resources in this fragile ecosystem to increase the productivity and incomes of millions of poor farmers who are dependent on the natural resources for their survival. The way forward to address this gigantic task is by sustainable management of natural resources in a manageable land unit, which is a watershed.

A watershed is a logical, natural planning unit for sustainable resource management. Integrated watershed management is the rational utilization of all the natural resources for optimum production to fulfill the present need with minimal degradation of natural resources such as land, water, and environment.

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ICRISAT's Experiences

Scientists of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) have learned the following lessons over years working with watershed technologies in partnership with national agricultural research systems (NARS) (Wani et al. 2002a) for possible reasons of low adoption of watershed technology package.

- Efficient technical options to manage natural resources for sustaining systems are needed.
- Key processes and institutional lessons such as mere on-farm demonstration of technologies by the scientists do not guarantee adoption by the farmers.
- Contractual mode of farmers' participation adopted during Vertisol technology evaluation did not present the expected results. There is a need to have higher degree of farmers' participation through consultative to cooperative mode from planning stage up to evaluation stage.
- Appropriate technology application domains for region specific constraints need to be identified, e.g., broad-bed and furrow (BBF) for all Vertisols.
- Developmental watershed projects implemented by non-governmental organizations (NGOs) lacked technical support; thus technical backstopping is essential. Any single organization cannot provide answers to all the problems in a watershed. Thus, a consortium of organizations is needed for technical backstopping.
- Process of partnership selection for each watershed has to be undertaken carefully. A generalized formula-based selection does not guarantee success. For example, not all NGO-implemented watersheds adopted participatory approach and were successful.
- Technical change is intimately bound with broader institutional context of the watershed and the role of institutions and different players varies from location to location.
- Individual farmers should realize tangible economic profits from the watersheds; only then they would come forward to participate in community-based activities in the watershed.
- Most farmers considered watershed programs as source of employment in the project for soil and water conservation measures and not as programs which could generate long-term employment or increase incomes of most of the small farmers individually.
- Holistic systems approach through convergence of different activities is needed and it should result in improved livelihood options and not merely soil and water conservation in the watershed.
- Technological packages as such are not adopted and farmers adopted specific components that they found beneficial.
- Capacity building for all the stakeholders is critical.
- Women and youth groups play an important role in decision making in the families.
- Sustainability although desired is rarely visible after project duration is over. Exit strategies are not planned in almost all the projects.

The watershed programs were undertaken for managing natural resources and improving agricultural productivity thereby improving the rural livelihoods. However, the expected benefits from these investments were not realized mainly due to lack of people's participation, lack of scientific inputs, compartmentalized approach with maximum emphasis on construction of rainwater harvesting structures (many of which are of poor quality), lack of tangible economic benefits to individuals, involvement of contractors for executing works, and non-involvement of landless families and marginal landholders (Farrington and Lobo 1997, Kerr et al. 2000, Wani et al. 2002a, 2002b).

New Integrated Watershed Management Model for Efficient Management of Natural Resources

A new model for efficient management of natural resources in the SAT has emerged from the lessons learned from long-term watershed-based research by ICRISAT and NARS partners (Wani et al. 2002a). The important components of the farmer participatory integrated watershed management model are:

- Farmer participatory approach through cooperation model and not through contractual model with stakeholders' involvement at all the levels right from inception (planning and implementation) to managing the process and sharing the benefits in the watersheds.

- Use of new science tools such as remote sensing, geographic information system (GIS), digital terrain modeling, and crop simulation modeling for monitoring and management of watersheds.
- Link on-station and on-farm watersheds and facilitate the 'knowledge flow' of the successes of on-station watersheds at ICRISAT to on-farm watersheds, and to use feedback to guide further research in on-station watersheds.
- A holistic systems' approach with integrated genetic and natural resource management (IGNRM) strategy as a new paradigm.
- A consortium comprising several institutions for technical backstopping of the on-farm watersheds.
- A micro-watershed within the watershed where farmers conduct strategic research with technical guidance from the scientists.
- A holistic approach to improve livelihoods of people and not merely conservation of soil and water.
- Cost-effective technology approach such as low-cost soil and water conservation structures.
- Amalgamation of traditional knowledge and newly developed technologies.
- Minimize free supply of inputs for undertaking evaluation of technologies. Farmers are encouraged to evaluate new technologies themselves without financial subsidies.
- Emphasis on individual farmer-based conservation measures for increasing productivity of individual farms along with community-based soil and water conservation measures.
- Continuous monitoring and evaluation by the stakeholders.
- Empowerment of community individuals and strengthening of village institutions for managing watersheds with emphasis on women empowerment.
- Environmental protection.

Consortium model for developing and managing watersheds

The concept of consortium is an integral part of the new integrated watershed management model. The consortium model is a participatory watershed system with a multi-disciplinary and multi-institutional approach to technically support a process involving people who aim to create a self-supporting system for sustainability (Fig. 1.). The approach is built on the principle of harnessing the strengths of the consortium partners for the benefit of all the stakeholders including the farmers. The main features of the approach are:

- Technical backstopping by the consortium of multi-institutions.
- Links strategic and developmental research on farmers' fields.
- Cuts down the lag for transferring the results from research fields to farmers' fields.
- Empowers the development workers and farmers to manage natural resources sustainably.
- Harnesses the synergies of the strengths of the partners to make a win-win situation for all the partners.

The model is a holistic systems approach and it demands collective efforts of all the stakeholders to address the complex problems in watersheds. The approach is also a knowledge-driven management system, which operates in a watershed as a unit for efficient management of natural resources.

Process components and execution strategy

- Participatory and bottom-up approach to identify the problem, possible solutions, and approaches.
- Holistic systems approach and use of new science tools for managing and monitoring the watersheds to sustain/increase productivity, and improve livelihoods.
- Site-specific solutions through refinement of existing options.
- Consortium approach to address complex problems through technical backstopping. The consortium partners include farmers, NGOs, government organizations, advanced research institutions, extension agencies, private entrepreneurs, and farmers' training centers (FTCs), who share the broad goal of improving rural livelihoods in the watershed and not restricted sectoral goals such as water and soil conservation.
- Emphasis on empowerment of stakeholders to enable them to take decisions, implement the programs, and manage the processes.
- Continuous monitoring and mid-course refinement of technologies to meet the local needs.

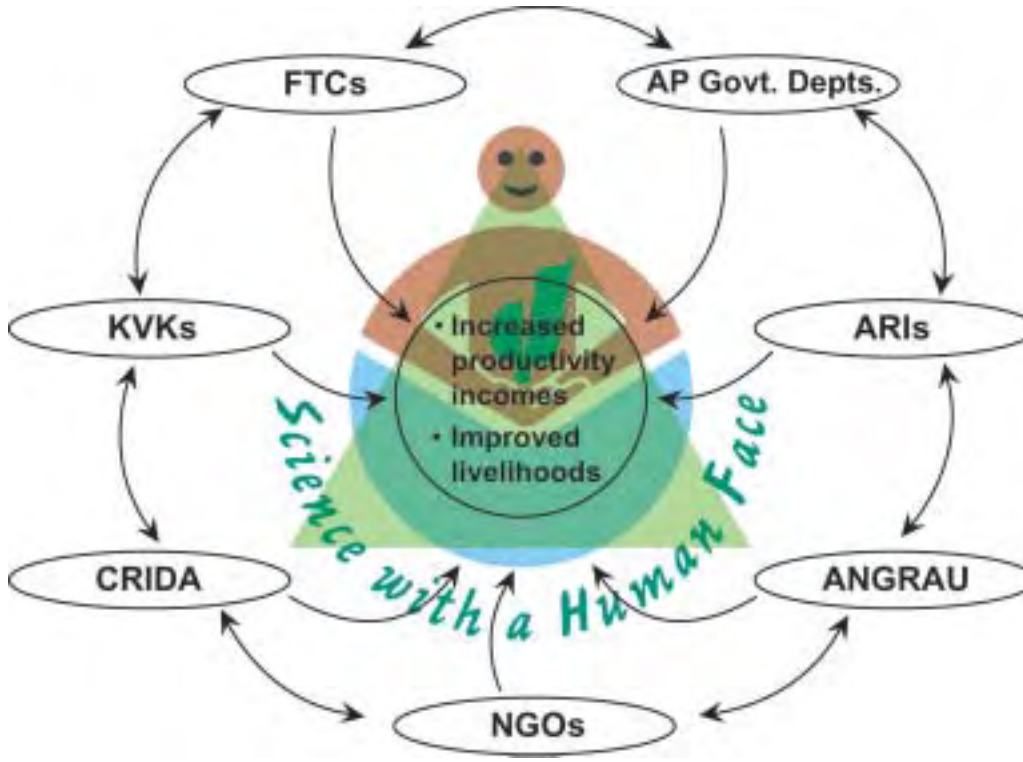

Figure 1. Consortium model for watershed management.
(Note: AP Govt. Depts. = Andhra Pradesh Government Departments; FTCs = farmers' training centers; KVKs = Krishi Vigyan Kendras; CRIDA = Central Reserch Institute for Dryland Agriculture; NGOs = non-governmental organizations; ANGRAU = Acharya NG Ranga Agricultural University; ARIs = advanced research institutions.)

Scaling-up of the watershed approach

To scale-up the benefits of integrated watershed management observed in operational-scale watersheds at research station to the real world on-farm watersheds, the approach followed is in a participatory mode in Asia under ICRISAT's project "Improving Management of Natural Resources for Sustainable Rainfed Agriculture", funded by the Asian Development Bank (ADB). All the on-farm technology evaluation trials are conducted on benchmark watershed sites in partnership with farmers. The on-farm watersheds vary from 30 ha to 10,000 ha with varying agro-ecological potential. Currently, we are evaluating the model of technical backstopping the on-farm watersheds, which are planned, developed, and monitored in partnership with NARS, NGOs, and farmers, using new science tools. Five on-farm watersheds in India, Thailand, and Vietnam are in operation. The model followed adopts a multidisciplinary and multi-institutional consortium approach for technical backstopping the development projects. "Islanding approach" is the strategy for linking strategic research done in micro-watersheds within a community watershed with applied on-farm research for development to provide effective mechanisms to more effectively transfer technologies for managing natural resources to farmers. Holistic farming systems approach to sustain productivity and to improve land and environment quality is adopted. At the village and community level women have been empowered through group training. Women are usually the critical group involved in decision-making regarding natural resources management. Continuous monitoring and impact assessment is considered an integral part of the program right from the initial stage.

Community Participation – An Essential Element for Successful Watershed Management

Programs of development and management of natural resources have suffered due to inadequate participation of local people. For success of any strategy of natural resource management involvement of local people is important. People and livestock are an integral part of the watershed community and should be given utmost importance. They depend on the watershed for their needs and in turn influence the good or bad events in the watershed. Thus participation of the people is essential for the success of the watershed programs. The detailed analysis of successful watersheds revealed that community participation played a significant role in making the watersheds successful.

In the past, watershed management was synonymous to soil and water conservation. In the new approach, it is more synonymous with people's livelihoods and is used as a vehicle for overall development of rural people through poverty alleviation and sustainable development for the welfare of the people. With the new focus on poverty alleviation and food security through appropriate natural resources management, the people rather than the natural resources become the first focus for watershed management. The degree of peoples' participation in watershed management varies from location to location and is described below:

- Contractual – Contract farmers to provide land and/or services for experiments to be conducted by scientists.
- Consultative – Farmers consult scientists about their problems and solutions but decision is made by the researchers.
- Collaborative – Farmers and scientists collaborate as partners in the research process.
- Collegiate – Farmers conduct the research and researchers provide technical advisory support.

Participatory watershed management aims at farmers' and community involvement in planning and management of natural resources in a watershed for sustainable use. Since farmers and other land users are the main stakeholders in watershed management, they themselves are to take charge of the processes for development of watershed resources. Participation means the act of partaking by farmers in all the stages of watershed programs right from planning, designing various structures, execution, monitoring and evaluation of their performance. Such participation requires that the target farmers voluntarily spend their time and energy for the program and adopt the recommended measures and practices, repair and maintain them in good condition on a sustained basis.

The traditional systems of use of natural resources in the village communities have evolved over a period of centuries. However, the traditional systems that once met the test of sustainability have not been able to respond adequately to modern rates of growth in demand as demanded by current population pressures and rapidly declining quality of land and water resources. To achieve sustainable use of natural resources there is a need to increase farmers' participation in efficient management of natural resources.

Basic principles for effective community participation

Some basic principles which facilitate effective community participation are: compelling vision; strong and shared leadership; shared problem definition and approach; power equity; interdependency and complementarity; mutual accountability; attention to process; communication linkages; explicit decision-making process; trust and commitment; and credit and recognition. The participation process also includes a combination of indigenous and traditional approaches, which may pave the way for long lasting participation. This is critical in case of integrated watershed management.

Promoting community participation

The previous projects had sufficient expertise in implementing soil and water conservation measures and were largely based on technical perspective and involved only land and water management activities. The activities in those projects did not involve people who are actually the important players within the watershed and whose activities have a significant impact. To make the watershed program successful, the primary goal should be the participation of the

local community. Project implementation can only be successful if the people participate and contribute adequately to the development program. In an effort to achieve community participation for managing natural resources in the watersheds, ICRISAT is working to build stronger partnerships with state and local agencies, community leaders, and people. These efforts are based on a strong commitment to involve those affected by or responsible for environmental regulation in finding the most effective workable solutions possible. Successful partnerships are critical for understanding participatory watershed management, as several players with varying interests are involved.

Model Application in Project

The project "Improving Management of Natural Resources for Sustainable Rainfed Agriculture" was funded by ADB in 1999 in an effort to improve the natural resource base and to have sustained increase in food production by SAT farmers. The project involves watershed research in three countries (India, Thailand, and Vietnam) at both on-station and on-farm watersheds. The on-farm benchmark watersheds in India, Thailand, and Vietnam are in operation since 1999. This project demonstrated the consortium approach model application in a number of ways by encouraging community participation in watershed management, by empowering the farmers, and also by building stronger working relationships with state and local governments, and NGOs and encouraging voluntary initiatives for improving sustainable use of resources. Five on-farm and three on-station watersheds covering varying agroecological, socioeconomic, and technological situations were selected. A case study of one on-farm watershed, i.e., Adarsha watershed in Kothapally village, Ranga Reddy district in Andhra Pradesh, India is described.

Consortium partners and process

The consortium partners involved in integrated watershed management in Adarsha watershed were:

- ICRISAT – international agricultural research center
- Central Research Institute for Dryland Agriculture (CRIDA) – NARS
- Drought Prone Area Programme (DPAP) – government organization
- M Venkatarangaiya Foundation (MVF) – NGO
- National Remote Sensing Agency (NRSA) – national institute
- Farmers – Kothapally village

In Adarsha watershed, the total irrigable area was very less and no single water harvesting structure for human and animal use was seen in 1998, i.e., at the start of the project. A large area is under rainfed farming in the village. ICRISAT, DPAP, and MVF jointly selected this watershed to evaluate integrated watershed management options for improving rainfed agricultural production through integrated watershed development and thus reduce poverty through increased system productivity. A micro-watershed of 30 ha was selected in partnership with the farmers. The watershed is equipped with hydro-meteorological equipment and is also monitored for inputs, outputs, productivity, incomes, etc., for preparing detailed budgets for water and nutrients at catchment level and also to assess the impact of technical interventions. All the activities in the watershed are planned, executed, and evaluated by the farmers through the watershed committee and watershed association with technical support from ICRISAT. These prime committees form further sub-committees for specific activities such as site identification for check-dams and farm ponds, and for identifying farmers to evaluate the improved options. User groups were formed for development of water harvesting structures. Self-help groups (SHGs) were formed to undertake watershed development activities. A system of social auditing is also an integral part of the integrated watershed development activity. New tools such as remote sensing and crop simulation models were used for planning and monitoring the development activities. Human resource development was considered an important component of the model. Farmers were encouraged to undertake income-generation activities.

Monitoring and impact assessment

Continuous monitoring of several parameters was done in Adarsha watershed as described below:

- Weather: An automatic weather station was installed to continuously monitor the weather parameters.

- Runoff and soil loss: Runoff, soil, and nutrient losses were monitored using automatic water level recorders and sediment samplers.
- Groundwater: To monitor the groundwater levels, open wells in the watershed were geo-referenced and regular monitoring of water levels was done.
- Crop productivities: Productivities were recorded for every crop in each year.
- Nutrient budgeting: Studies on optimum doses of fertilizers were conducted to have balanced nutrient budgets.
- Biological nitrogen fixation (BNF): Quantification of BNF in farmers' fields was done using N difference method and ^{15}N isotope dilution method.
- Satellite monitoring: Changes in cropping intensity, greenery, water bodies, and groundwater levels were monitored. Also, GIS maps indicating soil types, soil depths, and crops grown during rainy and postrainy seasons were prepared.

Community-based soil and water conservation measures such as grassed waterways and gabion structures were constructed in Kothapally. Ninety-seven gully control structures, 60 mini-percolation tanks, 4 water storage structures, and 1 gabion structure for increasing groundwater recharge were completed. Wasteland development was undertaken by contour trenching, planting horticultural and agroforestry plants, and developing grasslands. Along with water harvesting for enhancing water use efficiency, several improved land, crop, pest, and nutrient management options and soil conservation measures were taken up and all of these together made farmers reap rich rewards. Ten SHGs were formed to undertake vermicomposting as a micro-enterprise in the village. Improved cropping systems with high-yielding stress tolerant crop cultivars were introduced in the watershed. Bullock-drawn tropicultor was used for sowing and fertilizer application.

The normalized difference vegetation index (NDVI) images showed that the spatial extent of moderately dense vegetation cover in Kothapally increased from 129 ha in 1996 to 152 ha in 2000. The groundwater level increased. Crop productivities, farmers' incomes, and profits also increased. Farmers were exposed to new methods and knowledge for managing natural resources through training, video shows, and field visits to on-station and on-farm watersheds. Educated youth were trained in skilled activities such as HNPV (*Helicoverpa* nuclear polyhedrosis virus) production. Adarsha watershed is a model watershed with significant achievements (Wani et al. 2003).

Emerging Issues

- Scaling-up from benchmark watersheds.
- How to institutionalize consortium.
- Harmonization of existing village institutions and watershed-based institutions.
- Ensuring effective functioning of user groups.
- Common property resources – How to ensure sharing of benefits between user groups and panchayats.
- Equity and gender issues need special attention.
- Efficient and sustainable use of water resources (water use policies, water markets).
- Financial operations and resources for functional viability of associations.
- Linking with markets and enterprises.
- Identification of quantitative indicators for build-up of social capital and processes.

Conclusions

A holistic consortium approach in watersheds enables to have "win-win" situations for sustaining productivity and reducing land degradation which are the main causes of poverty in the rainfed areas of Asia. The current model of watershed research followed at ICRISAT links on-station research to on-farm situation and adopts the consortium approach by technical backstopping. This model seems to have very high potential for bringing favorable changes in drylands of the SAT. On-farm watersheds managed through community participation could sustain productivity of drylands and preserve the quality of the land resources and environment in the SAT. Holistic systems approach through integrated watershed management can result in sustainable management of land resources and in achieving food security in the SAT.

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