DOES DEVOLUTION LEAD TO SUSTAINABILITY? EVIDENCE FROM PARTICIPATORY WATERSHED MANAGEMENT IN SOUTHERN INDIA•

D. Suresh Kumar
Tamil Nadu Agricultural University. Coimbatore-641003. India
Email: rithusuresh@yahoo.com

ABSTRACT

Policies of devolution have been widely adopted in both the developing and developed countries. These policies aim at creating sustainable livelihood opportunities for its members by better managing the resource and ensure sustainable collective action. Devolutionary process has taken place in watershed management in India. This paper aimed to address how the devolutionary policies ensure collective action in watershed management. The present paper studies 12 micro-watersheds in South India to understand how villagers cooperate to manage watershed related tasks. The paper examines the factors that affect collective participation in watershed management and how cooperation changes once the State withdraws and hands control over management to *panchayat raj* institutions and other groups. The study finds mixed evidence of collective efforts to manage watersheds. There is certainly cooperation among watershed beneficiaries during project implementation. The study finds that watershed institutions in most cases become inactive once the project period is over. An analysis of factors that influence collective action indicates that cooperation emerges in areas where there is greater resource dependence and where there are homogeneous social groups involved. There is also a role for better information dissemination during the implementation phase. Many stakeholders were unaware of how their responsibilities change in the post-project period. Increasing awareness and providing clear information about rights and responsibilities will likely make for more empowered and involved stakeholders.

Key words: Watershed management, Devolution, sustainability, collective action, user groups, transaction costs

1. Introduction

Devolution of management rights from state agencies to the local user groups has acquired considerable importance as a solution to natural resource degradation (Meinzen-Dick, *et al.,* 2002). The past few decades have witnessed a major policy trend of devolving control over natural resources from government agencies to user groups. This type of devolution has not only cut across countries from Asia, Africa, and the Americas, but also across natural resource sectors, encompassing water (especially irrigation), forests, rangelands, fisheries, and wildlife (Meinzen-Dick and Knox,2001). In India, there has been significant devolution of authority to local communities in the forest sector under joint forest management, in the irrigation sector in terms of participatory irrigation management and in rainfed agriculture through community-based watershed management. The objective here is to promote local peoples' involvement in the management of natural resources and to ensure sustainable collective action.

Over the years, many researchers (Ostrom, 1990; Ostrom and Gardner, 1993; Rasmussen and Meinzen-Dick, 1995; White and Runge, 1995; Bardhan, 2000; Lise, 2000; Heltberg, 2001; Meinzen-Dick, *et al.,* 2002; Gebremedhin, *et al.,* 2003; McCarthy, *et al.,* 2004, Bouma, *et al,* 2007) have attempted to identify the conditions under which local collective action emerges in natural resources management. Though there is strong theoretical and empirical evidence about the conditions for the success and failure of institutions in natural resources management, designing policies to create local institutions still remains a challenge. In this context, this paper aimed to identify policy recommendations which will lead to more effective efforts to devolve the management of watersheds from governments to local communities.

In India, watershed management is an important rural development strategy, particularly in rainfed areas characterized by low-productivity agriculture, degraded natural resources and widespread poverty (Kerr, *et al.,* 2002). A watershed is a geographical area, which drains into a

---

• Paper presented in the 13th Biennial Conference of the International Association for the study of the Commons (IASC) on "Sustaining Commons : Sustaining our Future", 10-14 January 2011, Hyderabad, 2011, India

This paper is based on a research study conducted by the author with the financial support from the South Asian Network for Development and Environmental Economics (SANDEE), Nepal. The author expresses his sincere thanks to Dr. Priya Shyamsundar and all advisors for their valuable suggestions and comments offered during the study.

common point, and where soil and moisture is conserved ***in situ***. Most recently established watershed management programmes undertake some form of participatory natural resources management through local institution building. A standard practice is for the state to support new technologies and institutions in a watershed, transfer management of these over time to local communities and to slowly withdraw its own direct support and resources from the programme area. Such programmes have been established in several states with the support of multiple donors such as the World Bank, Department for International Development, UK, etc. (Palanisami and Suresh Kumar, 2002).

Watershed development requires the management of different resources and technologies. It involves a large number of resource users and hinges upon inter- as well as intra-village co-operation (Reddy, 2000; Palanisami and Suresh Kumar, 2006). As watershed management involves the common sharing of costs and benefits by different users, the incentives to participate in collective action assume importance. This raises a wide range of related issues such as the existence and emergence of collective action at different levels, factors that determine collective action, and appropriate policy measures which can enhance collective action.

Over the last several years, the rights of local communities over natural resources have been strengthened either through power-sharing agreements with the state, increased legal access to natural resources, or decentralization and devolution. Understanding the impacts of these institutional changes is important both for governments and other stakeholders. As devolution has been felt crucial and widespread implementation in natural resource management, it is crucial to understand in what way the devolution has contributed to better resource management (Priya Shyamsundar, *et al* 2005). Moreover, the chances of success of devolutionary initiatives are also related to the role played by collective action. Thus, it matters whether local institutions self-organize, or whether they are mainly the result of administrative fiat. Further, the chances of success of devolution also depend on the relationship between central actors who pursue devolutionary change and the interests of local actors. It is primarily when the interests and activities of actors at different levels of a political system match that we should anticipate successful devolutionary reforms.

Although the significant role that collective action can play in sustainable natural resource management is well recognized, little is understood about how collective action changes once the State withdraws from state-initiated programmes and hands control over management into the hands of local institutions and community groups. Evidence indicates that community-based natural resources management often fail after the state withdraws its support (Palanisami and Suresh Kumar, 2005). This less-than-satisfactory state of affairs is a result of a failure to understand how the long-term success or failure of collective action too is shaped by the different local issues (Meinzen-Dick, *et al.,* 2004). Devolutionary policies are not likely to be effective if such issues are not adequately addressed.

How devolution of watershed management programs are structured, or organized, will determine the extent farmers are willing to provide collective action for watershed management. Thus, in watershed management, it is essential that we understand the process of devolution and whether devolution leads to sustainable collective action and management. This paper is fundamentally interested in the ability of devolution to motivate and sustain collective action in rural areas. Thus, this paper seeks to answer three sets of questions: a) what kinds of collective activities take place in watershed development programs and what tasks, roles and responsibilities change as program moves from implementation to the post-implementation stage? and b) What factors are important for collective action in watershed programs?.

2. Watershed Management and Devolution in India

Watershed development has emerged as a new paradigm for planning, development and management of land, water and biomass resources following a participatory bottom-up

approach.[1] Watershed development programmes aim at: (i) optimal utilization of natural resources in order to mitigate the adverse effects of drought; (ii) employment generation and development of the human and economic resources of the watershed; and (iii) restoration of the ecological balance in the watershed through sustained community action (Government of India, 2001). Unlike, other development programmes, watershed development programmes heavily banking on peoples participation for its effective implementation and success.

To promote participation of local villagers in the implementation of watershed programmes, guidelines for watershed development were first issued in 1995 and subsequently revised in 2001. These guidelines emphasized the formation of community-based organisations. But, by and large, these community-based watershed management initiatives have not produced the desired results and have failed to ensure people's participation; particularly once the state withdraws its support (Rao, 2000; Jo *et al*, 2004; Palanisami and Suresh Kumar, 2002). This led to further revision of guidelines and the involvement of the *panchayat raj* (local government) institutions in the planning, implementation and management of watersheds. New guidelines called the *Haryali* guidelines were issued in April 2003. Under the new *Haryali* guidelines, the village *panchayats* take the role of the Watershed Committee and the higher-level *Gram Sabha* represents the Watershed Association.

In addition to all these guidelines, the guidelines for NWDPRA watershed development programmes, CAPART, NABARD and NGO were implemented separately over the period. Though these guidelines were by and large successful in implementation of various watershed development activities, these are not exempted from lacuna particularly in the context of institutional issues such as post-project maintenance, sustainability and monitoring and evaluation of watershed development activities. Realising the lacuna of different guidelines, the Government of India has recently issued a new guidelines called Common Guidelines for Watershed Development Projects, 2008. Though, the Government of India issued different guidelines, the implementation of watershed development programme depends on people's participation and collective action in watershed management. In this context, the government and other agencies implement watershed programmes through devolutionary process.

Devolution involves the transfer of rights and responsibilities to user groups at the local level. Generally it is understood that devolution of resource rights means a process by which state control over the use of natural resources is gradually and increasingly shared with local communities. This can happen with or without bureaucratic or political decentralization. This process is generally accompanied by the creation or strengthening of a subset of local institutions (Priya Shyamsundar et al, 2005; Vedeld, 1996, Knox *et al*, 1998). Devolution is often part of a number of related policy reforms, in which Central government agencies transfer rights and responsibilities to more localized institutions.

Devolution programs inherently involve a greater role for Community Based Organizations (CBOs) in watershed management. Increasing the accountability of users for resource management is often one of the major motivations for governments to engage in such reforms. This includes responsibility for monitoring resource use (by groups members and outsiders), enforcing rules, providing operation and maintenance services, and contributions for new investments in the resource base (eg. constructing new percolation ponds, check dams etc). However, the CBOs need not do all of these activities. Government agencies provide technical services, capacity building (training and exposure visits), rule enforcement and conflict resolution. A list of devolutionary process in different stages is given in Box.1.

The different types of reforms draw attention to the fact that devolution does not take place in isolation. There are a number of institutional actors involved in watershed management such as government bureaucracies, local government bodies, and CBOs. The roles of these actors and structure of interaction between these is important.

[1] Some important ongoing watershed development programmes include the Drought Prone Area Programme, Desert Development Programme, River Valley Project and international programmes supported by donor agencies.

Box.1. Devolutionary process in watershed management in India

Activities	Project period
Involvement of different state agencies in implementation	√
Involving local villagers and farmers in PRA exercises viz., transect walk, resource mapping, situation analysis etc	√
Involving local villagers and farmers in watershed development plan preparation	√
Formation of Community Based Organisations	√
Watershed Association	√
Watershed Committee	√
User Groups	√
Self-Help Groups	√
Registration of Watershed Association/Watershed Committee*	√
Training to the User group members and Self-Help Group members	√
Exposure visits to the User group members and Self-Help Group members	√
Facilitating the WA, WC, UG and SHGs in organizing meetings	√
Mobilising contribution	√
Cost sharing (peoples contribution)	√
Construction of various structures	√
Maintenance of structures	√
Creation of Watershed Development Fund (WDF)	√
Transfer of assets to local panchayats /community groups	√
Utilisation of WDF	**

* The new Common guidelines 2008 insist the Watershed Committee be registered under the Society Registration Act, 1860.
** As per guidelines, the WDF be utilized for the post project maintenance.

2.1. The Organisational functions of devolution

Devolutionary process in watershed management programs state an objective of change from top-down "command and control" to "client-oriented systems", which give resource users more control (Department of Land Resources, 2006). This kind of participatory approach is expected to create incentives to the government as it reduces the burden on budget and solve the problems of mounting constraints to manage natural resources. On the other hand, this will facilitate and ensure local collective action and better natural resource management in a sustained manner.

2.1.1. Roles of Government agencies

A state-level committee called the State Watershed Development Committee co-ordinates between different departments and evaluates progress. The District Watershed Development Committee undertakes similar tasks at the district level. It advises the District Rural Development Agency (DRDA) / Zilla Parishads (ZP) in selecting a Project Implementing Agency and members of a Watershed Development Team (WDT). The Project Implementing Agency (PIA) is responsible for implementation of watershed activities and extends support for various tasks undertaken by community-based organizations.[2] The Watershed Development Team is made of multi-disciplinary members who provide technical guidance to the PIA and to CBOs.

[2] The PIA prepares development plans, undertakes community organization training, provides technical guidance, monitors and reviews implementation and sets up institutional arrangements for post-project operation.

2.1.2. Role of Community Based Organisations (CBOs)

The community based organizations (CBOs) involved in managing watersheds are the Watershed Committee (WC), User Groups (UGs), and Self-Help Groups (SHGs). The WA is made up of members who are directly or indirectly dependent upon the watershed area.[3] The President of the WA is the chairman of the WC, which carries out the day-to-day activities of watershed management.[4] Self-Help Groups are homogeneous groups whose members share a common identity such as agricultural labourers, landless households, women, shepherds and scheduled castes/tribes. These groups focus on micro-finance thrift groups, small shops, goat-rearing, etc.

UGs have a key role to play in watershed management and are formed around certain specific interventions such as construction of new structures, monitoring, and maintenance activities. UGs consist of persons who are likely to derive direct benefits from a particular activity. The main functions of the UGs are to monitor construction activities, to collect and mobilize contributions, and to resolve possible conflicts. The UGs are responsible for the operation and maintenance of watershed structures constructed in common lands. Generally, watersheds in India are allotted a budget of approximately Rs. 6000 per hectare.[5] Thus, a watershed with a total area of 500 hectares receives Rs.30 lakhs for a five-year period. The bulk of this money (80 per cent) is meant for development/treatment and construction activities.[6] The WC opens a bank account and directly uses these funds.

2.1.3. Post-project maintenance

The DRDA/ZP in consultation with the State government will evolve proper exit protocol for watershed development projects. This will endeavour to motivate Village Panchayats to take over the assets created in the completed watershed development projects for the purpose of operation and maintenance. The watershed projects should generally be managed by the respective Watershed Associations/Watershed Committees under the overall supervisions of the Village Panchayat after the project period is over and after the external supporting agencies have withdrawn.

The post-project maintenance assumes crucial once the state withdraws its support from the local area. The mechanism for this is the creation of Watershed Development Fund (WDF). The contributions to WDF are at the rate of 10 per cent of the cost of works done on private lands and 5 per cent of the works on common lands. However, in case of SC/ST and persons identified below poverty line, the minimum contribution is 5 per cent of the cost of works. The contributions are accepted either in cash/voluntary labour or materials like water, sand, etc. This fund is deposited in a separate account and be used for post-project maintenance. The proceeds of this fund shall be utilized in maintenance of assets created on common lands after completion of project period. The DRDA/ZP should define proper institutional arrangements for operation of this fund. In case, no such arrangement is done by the DRDA/ZPs, the Chairman, Watershed Committee and the Secretary will operate this account jointly.

3. Study Area and Data

Our study was conducted in the Coimbatore district of Tamil Nadu, India. The major crops grown are sorghum, cotton, sugarcane, maize, coconut and vegetables. Of the total cropped area, the area irrigated accounts for 56.82 per cent. The chief source of irrigation in the district is through

---

[3] The watershed association is expected to be formally registered as a society.

[4] These activities include planning, resolving disputes, identifying procedures for the operation and maintenance of assets, facilitating the creation of the Watershed Development Fund, ensuring accuracy of accounts and so on.

[5] According to the new Common guidelines 2008, the budget allotment is of Rs.12000 per hectare.

[6] Funds are allotted for different activities as follows: Watershed treatment/development works -- 80 per cent; Community-based organizations including entry point activities -- 5 per cent; Training -- 5 per cent; Administrative overheads --10 per cent.

wells. Over the years, there has been a general decline in the water level in all of Coimbatore district, which is attributed to indiscriminate pumping of groundwater. Groundwater resource degradation has in turn resulted in changes in crop patterns, well deepening, an increase in well investments, pumping costs, well failure, and abandonment and out migration of farmers (Ramasamy, *et al.,* 2000). It is in this context that groundwater augmentation by artificial recharge through watershed development programmes gained momentum.

Different types of watershed treatment activities are carried out in the study area. Activities such as soil and moisture conservation measures are undertaken in private agricultural lands (e.g. contour/field bunding, land leveling, and summer ploughing). Village common lands are improved through drainage line treatment measures (loose boulder check dams, minor and major check dams and retaining walls), water resource development/management (percolation pond, cattle ponds and renovation of tanks), and afforestation programs (Palanisami *et al.,* 2003). Building capacity through training on watershed technologies and related skills is also given periodically to farmers in watersheds. In addition, members are also taken to other successful watershed models and research institutes for exposure. These efforts appear to be contributing to ground water recharge.

A problem in many of these watersheds, however, is community participation. An evaluation study of 15 watersheds in the Coimbatore district found that the community participation rate in all activities (defined as the community's contribution in terms of cash, labour and other materials towards development of watershed structures and participation in planning and identifying locations for water harvesting structures) was 42 per cent (Sikka, *et al*, 2000). The community participation rate was 55 per cent at the planning stage, 44 per cent at the implementation and 27 per cent at the maintenance stages (Sikka, *et al.,* 2000). In several watersheds, structures are not maintained due to lack of funds and co-ordination among the beneficiaries. After the project period is over, community-based organizations have become defunct and hence maintenance is neglected (Palanisami, *et al.,* 2002).

3.1. Data

This paper studies 12 micro-watersheds in the Coimbatore district. Our interest was also in understanding whether User Groups actually take over the operation and maintenance of the completed works or activities on common lands. Thus, a sample of 30 User Groups was selected from 6 watersheds where the PIAs had withdrawn its support and 30 User Groups were selected from the additional 6 watersheds where the programme is ongoing. Data were collected during 2005-06. Details of the selected watersheds and User Groups are given in Table 1.

A leader who is identified by the officials heads each user group. Thus, user group leaders and members were interviewed regarding a variety of activities. We collected data about the investment made by the PIA, contribution from the UGs, the operation and maintenance of structures, meetings organized and attended, participation in PRA exercises, cost and benefit sharing mechanisms followed and local resource management.

As records are maintained by Watershed Committees, additional information was collected from committee secretaries. Details at the watershed level were collected from the WCs, PIAs, and VPs. In addition, interviews were held with village elders and local leaders about village history and local institutions for resource management. Of the 60 User Groups studied, 33 User Groups (17 in completed and 16 on-going watersheds) were created to manage percolation ponds, 14 were started to build and maintain check dams and 13 were associated with tank renovation activities.

Table.1. Details of study Watersheds and User Groups

Name of watersheds	Name of the block	Stage of watersheds	Project Period		Actual completion	Number of User Groups	No.of households
			From	To			
Paruvai	Sulur	Completed	1998	2002	March 05	4	20
Salaiyur	Annur	Completed	1998	2002	2002	4	12
Karegoundampalayam	Annur	Completed	1999	2003	March 05	4	40
V.Kallipalayam	Pongalur	Completed	1999	2003	March 05	3	10
K.Ayyampalayam	Palladam	Completed	1999	2003	March 04	5	45
Kallakinar	Pongalur	Completed	1999	2003	2003	10	62
Chettipalayam	Tirupur	On-going	2002	2007	..	4	32
Thulukkamuthur	Avinashi	On-going	2002	2007	..	7	55
Giddampalayam	Palladam	On-going	2002	2007	..	5	22
Pattanam	Sulur	On-going	2002	2007	..	7	22
Vadavalli	Annur	On-going	2003	2008	..	4	25
Pogalur	Annur	On-going	2002	2007	..	3	23

Proportionate random sampling procedure was employed to study the farm households. As the size of User Group varies across the type of structures, 80 per cent of the User Group members were randomly selected and studied for the purpose. A sample of 189 farm households was selected in completed watersheds and 179 farm households were selected in on-going watersheds. Thus, a total sample of 368 farm households were selected and studied. The details on household general particulars, contribution in terms of labour, cash and other forms were collected.

4. Methodology

For the purpose of the study, household participation in collective action is defined as action taken by the individual household to manage watersheds in terms of contribution in cash, kind, labour, and participation in PRA exercises, watershed development plan meeting, monitoring activities etc. Though the collective action is defined at community level, individual household's action may be referred as private action is also important (Sakurai, 2002). Private action affecting collective action in watershed management include participation in Participatory Rural Appraisal (PRA) exercises, attending watershed development plan meetings, decision making process, adoption of soil and moisture conservation measures in the private lands, contribution towards construction and maintenance of watershed development structures and participation in training and exposure visits.

It is assumed that a household's decision to participate in collective action depends on the expected net benefits of such participation. This in turn determined by (i) the expected cost of participation and (ii) expected benefits of participation in collective action.

4.1. Cost of participation in collective action

The cost of households' participation in collective action comprises of contribution in terms of cash, human labour, machinery, materials like water etc in both during construction and maintenance stage of watershed development, imputed value of labour in attending PRA exercises, watershed development plan meeting, training and exposure visits, monitoring during construction and maintenance activities. The cost of participation of a household is determined by various household specific characteristics such as wealth position, cropping pattern, resource availability and dependency, educational level, off-farm and non-farm income sources, location of the farm and group level factors like size of the user group, social homogeneity, and type of structure.

4.2. Benefits of participation in collective action

Private benefits from participation in collective action include the expected present and future benefits from development of watershed structures. The benefits like enhanced groundwater recharge, increase in water resources potentials and increase in agricultural production and thereby farm income. The indirect benefits include savings due to reduction in well deepening costs and drilling of new bore wells. Farm households participate in watershed development in order to get maximum benefits in the form of acquiring more information, subsidy benefits and provision of public goods and services to the watershed communities. Thus, the households' private benefits from participation in watershed management lie mainly with the impact on expansion in water resources at farm level. This may be influenced by various household specific characteristics, and user group level variables.

4.3. Theoretical framework

Let a farm household, " i " will participate in watershed management (through attending watershed development plan meetings, PRA exercises, contribution towards construction and maintenance activities, participation in training and exposure visits). Further, the expected benefits from participation in watershed management EB^P_i is determined by the individual household and user group level factors. These include contribution to watershed development and maintenance, Q, (including construction and maintenance of watershed development structures and opportunity cost of labour in attending meetings, PRA exercises, training and exposure visits), various household specific characteristics, H, and user group characteristics, G.

$$EB^P_i = f\ (Q, H, G) \qquad \text{....(1)}$$

The expected cost of participation in collective action in watershed management (EC^P_i)is determined by the contribution to watershed development and maintenance, Q, various household level characteristics, H, and user group level characteristics G. i.e.

$$EC^P_i = g\ (Q, H, G) \qquad \text{.....(2)}$$

Let Q be the household contribution. It is assumed that there is decreasing marginal benefit and increasing marginal cost of contribution towards watershed management. Following Gebremedhin (2003), the benefit and cost functions, which are assumed to be quadratic, can be written as

$$EB^P_i = a\,Q - b\,Q^2$$

$$EC^P_i = c\,Q + d\,Q^2 \qquad \text{.....(3)}$$

Where a,b,c and d are positive constants. The optimal level of household contribution Q* is affected by vector of household specific factors (H), and user group level factors (G). It is assumed that the set of exogenous factors are assumed to shift the marginal benefit and cost curves but do not affect the slope of the curves. Incorporating the effect of these exogenous factors into the cost and benefit functions, we get

$$EB^P_i = (\alpha X + \varepsilon_B)Q - bQ^2$$

$$EC^P_i = (\beta X + \varepsilon_C)Q - dQ^2 \qquad \text{.....(4)}$$

Where, α and β are coefficients to be estimated and ε_B and ε_C are stochastic disturbance terms. X includes the vector of household specific characteristics and user group level factors.

The marginal benefit and marginal cost of participation in collective action in watershed management can be derived using the eqn (4). The marginal benefit of participation is

$$\frac{\partial(EB^{P}_{i})}{\partial Q} = (\alpha X + \varepsilon_{B}) - 2bQ \qquad \text{.....(5)}$$

The marginal cost of participation is

$$\frac{\partial(EC^{P}_{i})}{\partial Q} = (\beta X + \varepsilon_{C}) + 2dQ \qquad \text{.....(6)}$$

We know that the necessary condition for profit maximization is MR=MC. Thus, from eqn (5) and (6), the benefit maximizing level of contribution could be derived. The benefit maximizing level of contribution Q*, is when

$$\frac{\partial(EB^{P}_{i})}{\partial Q} = \frac{\partial(EC^{P}_{i})}{\partial Q} \qquad \text{.....(7)}$$

i.e. $(\alpha X + \varepsilon_{B}) - 2bQ = (\beta X + \varepsilon_{C}) + 2dQ$

Rearranging and solving for Q, we get,

$$Q^{*} = \frac{(\alpha X - \beta X) + U_{i}}{2(b+d)} \qquad \text{.....(8)}$$

From, eqn (8), the amount of contribution made by the farm household is determined by various household level and user group level factors.

4.4. Households participation in watershed management

A key concern for policy makers is the fact that making the farm households participating in watershed development activities. Thus, an important research question is what factors influence households participation in the watershed development activities. For the purpose, the amount of contribution made by the farmers identified as key indicator to represent household participation.

An empirical issue that needs to be considered, however, is that few households have not contributed. Thus, the dependent variable takes the value zero for these households. Given that our dependent variable is censored at zero, a Tobit estimation rather than OLS is appropriate (Madalla, 1989; Tobin, 1958). Thus, the estimated reduced form model with the latent variable is specified as:

$$HC^{*} = X_{j}b + U_{j}$$

$$HC = HC^{*} \quad \text{.....if } X_{j}b + U_{j} > 0$$

$$= 0 \quad \text{.....if } X_{j}b + U_{j} \le 0$$

$$j = 1.....n$$

.....(9)

The error term U_j is independently normally distributed with zero mean and constant covariance σ^2. In the above functional relationship, the variable HC is endogenous. It is hypothesized that the farm household's decision to participate in collective action in watershed management is influenced by a set of household level factors as well as user group level factors. The exogenous variables viz., FSIZE, EDUCATION, NWORKER, NINCOME, NWELLS, DISTANCE, UGSIZE, CASTE,

PERCOLATION and CHECKDAM are expected to influence the household participation. The descriptive statistics of the variables studied are presented in Table.2.

Table.2. Descriptive statistics of the variables

Variable	Definition of variables	Number	Mean	Std.Dev.
HHCONTBN	Farm household's contribution in watershed management (Rs./year)	368	127.93	88.61
EDUCATION	Educational level of the head of the household in years	368	2.97	1.47
FSIZE	Farm size in hectares	368	2.08	1.34
DISTANCE	Distance between the well and water harvesting structure in meters	368	206.17	123.78
NWORKER	Number of workers in the household (in number)	368	2.37	0.93
NWELLS	Number of wells owned by the farm household	368	2.30	0.98
NINCOME	Participation in non-farm and off-farm income activities (1 if participation; 0, Otherwise)	368	0.64	0.48
UGSIZE	Size of the User Group (number)	368	8.35	3.29
CASTE	Social homogeneity; Dummy, 1 = if more than 75 per cent of UG members belong to the same caste, 0, Otherwise	368	0.56	0.49
PERCOLATION	Dummy for the type of watershed structure. 1 if percolation pond, 0, otherwise	368	0.53	0.49
CHECKDAM	Dummy for the type of watershed structure. 1 if check dam, 0, otherwise	368	0.21	0.40

5. Results

5.1 Impacts

Watershed development appears to benefit farmers in our study area in terms of groundwater recharge, preventing soil and water erosion and so on. The impact of watershed treatment measures such as percolation pond and check dams on groundwater recharge is quite visible. In interviews, farmers indicated that there was increase in water table, increase in perennial availability of water in the wells and in pumping hours. All of this appears to have contributed to an increase in area under irrigation and crop diversification.

5.1.1. Has devolution worked for local people? Are there improved benefits for local communities? The answer probably is yes. During our survey, discussions with the UG members revealed that water levels in dug wells had risen in the range of 1.0 to 2.8 meters, with an average of 1.8 meters increase evident in the area. This is commonly observed in both the completed and on-going watershed areas. Other studies have shown that water availability in wells increased from within four months to nine months with the introduction of water harvesting structures (Sikka et al, 2000; Palanisami et al, 2002). In our survey, when asked about the different benefits of watershed development, and farmers overwhelmingly ranked ground water recharge as the first key benefit. Thus, we can definitely argue that in this farming community, ground water benefits motivate user groups to contribute watershed development structures.

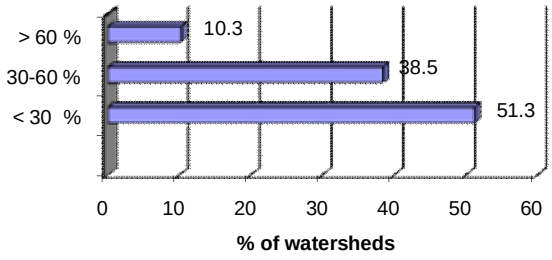
5.1.2. Experiences

Realising the importance of watershed development and to inform the policy makers and implementing agencies and other stakeholders, many studies attempted to assess the impacts of watershed development programme in the country over a period.

Many studies (Palanisami, et al, 2002; Ramaswamy and Palanisami, 2002; Ramasamy, et al, 2002; Palanisami, et.al, 2006; Palanisami and Suresh Kumar, 2006; Jeyabalakrishnan, 2006 ; Radhamani, et.al, 2006) employed before and after approaches to assess the impact of watershed development activities. Many researchers (Alemu, et al, 2002 ; Lokesh, et.al, 2006; Ramakishna, et.al, 2006) adopted with and with out approaches to asses the impact. These studies focused the impact of various watershed treatment activities on various impact domains like soil and moisture conservation, water resources development, impact of cropping pattern and yield, and over all economic impacts. These studies found that there is significant impact on soil and water erosion control, soil moisture conservation, water resources development, cropping pattern, and increase in yield. The watershed development has also produced desired results in terms of improvement in socio-economic conditions, and the environment.

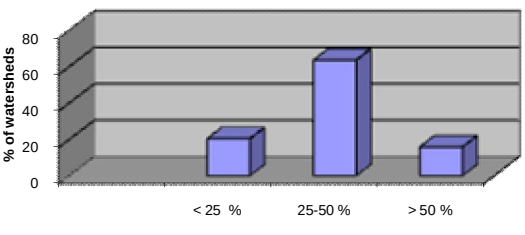
Experiences of most of the impact assessment studies report that watershed development interventions have produced desired positive impacts. But the magnitude of these impacts found to vary across regions, impact domains etc. As one expects the watershed treatment activities have produced significant changes in the bio-physical aspects of the watershed.

Fig.1. Percentage of watersheds by increased in cropped area



Most of the studies found that there is significant increase in cropped area and it ranged from 6.84 per cent to 52 per cent. The increase in cropped are further helped in increase in production and productivity. The productivity enhancement due to watershed development is a common phenomenon in most of the watersheds. The evidence shows that the cropping intensity is increased from 120 per cent to 146.88 per cent in kattampatti watershed and 102.14 per cent to 112.08 per cent in Kodangipalayam watershed (Palanisami and Suresh Kumar, 2004). Increase in Crop Productivity Index, Fertilizer Application Index, and Crop Diversification Index was also observed (Sikka et al, 2000 and 2001).

Fig. 2.Percentage of watersheds by increase in yield



It is lucid from the analysis that though there are differences in impacts, the watershed development activities have made significant positive impacts on the bio-physical aspects leading to increased soil fertility, cropping pattern changes, crop production and productivity.

The watershed development technologies aimed not only to conserve the natural resources but also improving the socio-economic conditions of the rural people who depend upon for their livelihood. The impacts of various watershed treatments is however widespread. The changes in

various bio-physical, environmental aspects will have significant impacts on the socio-economic conditions of the people. Watershed development programmes are designed to influence the bio-physical aspects, the environmental aspects and thereby bringing changes in socio-economic conditions (Deshpande and Rajasekaran, 1997).

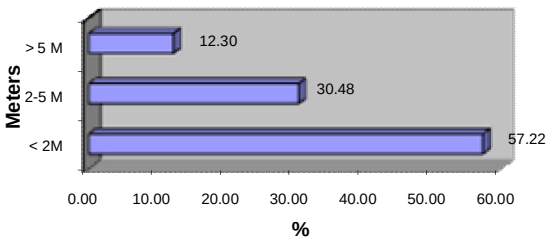
The socio-economic indicators like changes in household income, changes in per capita income, consumption expenditure, differences in employment, changes in persons migrated, peoples' participation, changes in household assets and changes in wage rate at village level were considered for the impact assessment. The watershed intervention helped the rural farm and non-farm households to enhance their income level. Evidences show that the rural labour households in the treated villages derive Rs.28732 when compared to Rs.22320 in control village, which is 28.73 per cent higher in Kattampatti watershed. Similarly, the per capita income also relatively higher among households of watershed treated villages. The percentage difference among households across villages worked out to 13.17 per cent in Kattampatti and 70.44 per cent in Kodangipalayam watershed (Palanisami and Suresh Kumar, 2004).

Experiences from evaluation study of 15 Drought Prone Area Programme (DPAP) watersheds conducted in Coimbatore district of Tamil Nadu, India show that the overall community participation was found to be as 42 per cent. The Participation was found to be 55, 44 and 27 per cent respectively at planning, implementation and maintenance stages. This suggests community participation in watershed development programme yet to reach more. Similarly, overall contribution for works on private land was found to be 14.71 per cent. It varied from a low of 7 per cent for fodder plots to a maximum of 22 per cent for horticulture and farm pond. However, contribution in terms of cash/or kind towards development of structures at common lands such as percolation ponds, check dams etc was found to be nil. Level of adoption of various soil and moisture conservation measures and their maintenance indicate that there is a wide variation in level of adoption, with a low of 2.4 per cent in farm pond, 30.40 per cent in summer ploughing, 36.80 per cent in land leveling, 44 per cent in contour bunding. Follow up by farmers is also found to be poor in most of the technologies and it account for 5.23 per cent in farm ponds, 21.58 per cent for contour bunding etc (Sikka et al 2000).

The Water Technology Centre, Tamil Nadu Agricultural University, carried out mid-term evaluation of 18 watersheds under Integrated Wasteland Development Programme (IWDP) in Pongalur Block of Coimbatore District, Tamil Nadu. The results reveal that Peoples' Participation Index at planning stage was 52.69 per cent followed by implementation stage (39.28 per cent). This shows low peoples' participation at both the stages of the project (Palanisami et al 2002). In several watersheds, the structures are not maintained due to lack of funds as well as lack of co-ordination among beneficiaries. Also because of the local (panchayat) elections, many of the presidents of the Watershed Association have not been reelected resulting in lack of co-ordination particularly during the post-project management. There is a decline in interest in watershed structures during the post-implementation phase and this can be attributed to (i) failure or collapse of the new institutions set up to manage watersheds; and (ii) lack of clear norms on how to operate Watershed Development Funds (Suresh Kumar 2007).

Thus ensuring peoples' participation in different stage of watershed implementation and management is crucial which would help achieving the objectives of watershed development in a sustained manner.

Fig. 3.Percentage of watersheds by water level in the wells



Few studies made an attempt to measure the increase in water level in the wells. The increase in water level in the wells is varied from 0.1 meter to 3.5 meters and this varied across seasons. Similarly, the expansion in irrigated area due to watershed development activities is varied from 5.6 per cent to 68 per cent across regions and seasons. Experiences show that the increase in water level in the wells is observed to be less than 2 meters (57.22 per cent of watersheds). About 30.48 per cent of watersheds witnessed an increase of 2-5 meters and only 12.3 per cent of watersheds have an increase of more than 5 meters increase in water level in the wells.

The rainwater harvesting structures constructed in the watershed help in enhancing the surface water storage capacity. Evidences show that on an average about 92 ha cm additional capacity was created and it varied from 63 ha cm to 136 ha cm. In addition to the fixed capacity, repeated storage will be available for different fillings once already stored water is percolated. The perenniality (i.e. duration of water availability) of water in the wells inspected during the sample survey was found to have improved as a result of watershed projects. The analysis of recuperation rate before and after watersheds indicates that recharge rate has now increased in the range of 16 to 39 per cent. It was also observed that recharge to wells decreased with distance of wells away from the percolation pond and influence could be generally observed upto a distance of about 500-600 m. (Palanisami and Suresh Kumar, 2004; Sikka et al, 2000). Watershed development activities produced significant positive impact on water table, perenniality of water in the wells and pumping hours that resulted in an increased irrigated area and crop diversification (Sikka et al, 2000; Sikka et al, 2001; Madhu et al 2005).

Experiences show that watershed development activities have over all positive impacts on the village economy. Thus, it is essential to assess the impact of these watershed development activities using key indicators such as Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR). Though these indicators show the over all impact of watershed development activities, only very few studies have quantified the benefits and arrived the NPV, BCR and IRR. The reason for this is attributed to many: (i) most of the evaluating agencies are not familiar with these techniques, (ii) inadequate data availability for quantifying benefits and costs, and (iii) non-familiarity with computer softwares. The overall impact of watershed development activities in terms of NPV, BCR and IRR are reviewed and discussed hereunder.

It is evidenced that the BCR varies across regions and depends upon the agro-climatic conditions. For instance, it is found that the BCR is The financial analysis of impact of watershed development indicates that the BCR varied from 1.43 to 1.51 implying that the returns to public investment such as watershed development activities are feasible. Similarly, the IRR is worked out to 26 per cent and 24 per cent respectively for Kattampatti and Kodangipalayam watersheds, which is higher than the long-term loan interest rate by commercial banks (12.75 per cent) indicating the worthiness of the government investment on watershed development (Palanisami and Suresh Kumar, 2004). The studies proved that the watershed development activities have high benefit-cost ratio of 3.5 (Lokesh, et.al, 2006) and fairly a high internal rate of return of 38 % (Ramaswamy and Palanisami, 2002).

5.2. Local factors that matter

Despite evidence of benefits from watershed management, there are clearly some collective action failures that are prevalent. While there are examples of communities coming together to manage irrigation tanks that recharge ground water, for the most part community owned irrigation tanks in southern India are depleted and degraded (Balasubramanian and Selvaraj, 2003). This type of classic failure of cooperative behavior is also seen in our study area. When asked what were the main problems associated with managing and maintaining watershed development structures, 'non-cooperation of members' was ranked highest by user group members.

5.2.1. General characteristics of households

The average size of holding is worked out to 2.20 ha and 1.99 ha respectively in completed and on-going watersheds. The cropping intensity is worked out to 103.65 per cent and 100.56 per cent respectively. Where as the irrigation intensity, account for 103.35 per cent in the completed watersheds and 100 per cent in the on-going watersheds (Table.3).

Table.3. General Characteristics of sample households

Particulars	Completed watersheds	On-going watersheds
Number of farm households	189	179
Number of workers in the household (Number)	2.43	2.33
Farm size (Hectares)	2.20	1.99
Net sown area (Hectares)	1.91	1.69
Gross cropped area (Hectares)	1.96	1.69
Cropping intensity (%)[a]	103.65	100.56
Net irrigated area (Hectares)	1.84	1.60
Gross irrigated area (Hectares)	1.89	1.60
Irrigation intensity (%)[b]	103.35	100.00
Status of soil erosion (Index)[c]	105.57	105.76
Fertility status of soil (Index)[d]	128.09	114.40
Number of livestock (Number)[f]	2.04	2.98

a : Cropping intensity is defined as the ratio of gross cropped area to net sown area and expressed as percentage
b : irrigation intensity is the ratio of gross irrigated area to net irrigated area and expressed as percentage
c : Weighted index from different class viz., *1 = Non-detectable , 2 = Slight / moderate, 3 = Severe*
d : Weighted index from different class viz., *1 =Good, 2 = Medium, 3= Poor*
e : Livestock include only cattle, sheep and goats.

Maize and sorghum dominate the cropping pattern in the study area. Among the different crops cultivated by sample farmers in both type of watersheds, Maize occupies higher proportion accounting 27.88 per cent in completed watersheds and 23.55 per cent in on-going watersheds. Next to maize, other unirrigated crop sorghum and water consuming crop banana dominate in both the situations. Significant proportion of area under maize and sorghum implies that depleting groundwater table forces the farmers to go for unirrigated rainfed crops to sustain their livelihood thus having cushioning effect.

5.2.2. Farm Households participation in collective action

Membership in formal watershed management institution can be treated as an indicator of household's participation in collective action. The analysis reveals that farm households become member in watershed institutions like Watershed Association, Watershed Committee, User Groups etc. But it is interesting to note that the farm households did not pay any membership fees after the closure of the project as most of the watershed institutions become inactive in the post-project periods (Table.4).

Table.4. Membership in formal/informal organisations at watershed level

Particulars	Completed watersheds		On-going watersheds
	During programme implementation	Post project period	
Membership in different organisation (% of households)			
Watershed Association	100.00	100.00	100.00
Watershed Committee	..	..	3.91
User Group	100.00	100.00	100.00
Per cent of farm households paid membership fees (%)	76.72	..	58.10
Amount paid towards membership fees (Rs./year/household)	20.53	..	15.87
Duration of membership (Years)	5.56	..	1.58

Peoples participation in different stages of watershed implementation indicate that farm households show inclination towards participation in planning, project formulation, attending meetings, training and exposure visits (Table.5). Percent of farm households participated in forming CBOs is found to be 28 per cent in completed watershed and it is 43 per cent in on-going watersheds. Similarly, per cent of households participated in training and exposure visits is worked out to 5.30 per cent in completed watersheds and 1.11 per cent in on-going watersheds. It shows that in addition to the presence of PIA, there are other socio-economic and contextual factors responsible for households' participation in watershed management. It is evidenced that peoples' participation in watershed management activities dramatically reduced after the project period. One reason attributed for this is non-functioning of watershed management institutions in post project period.

Table.5. Farm households participation in formulation of watershed development plans, meetings, trainings and exposure visits

Particulars	Completed watersheds		On-going watersheds
	During programme implementation	Post project period	
A.Project planning and formulation			
Per cent of farm households participated in PRA to identify problems and structures (%)	78.84	..	88.83
Per cent of farm households participated in watershed development plan meetings (%)	19.58	..	16.20
Per cent of farm households participated in forming CBOs (%)	28.04	..	43.02
Per cent of farm households participated in electing office bearers of CBOs (%)	24.34	..	6.15
B.Meetings attended			
Per cent of farm households attended meeting			
Watershed Association	62.43	12.17	81.01
Watershed Committee	12.17	1.05	1.68
User Group	20.63	4.23	5.03

C.Training and exposure visits attended per year			
Per cent of households participated in training and exposure visits	5.30	..	1.11
Number of training and exposure visits attended (Number / year/person)	0.07	..	0.02
Duration of training and exposure visits attended (Days/year/person)	0.11	..	0.02

5.2.3. What affects household's participation in watershed management?

Estimation of the factors that determine the farm households' contribution towards watershed development is presented in Table 6. It is evidenced that the household contribution towards watershed development and maintenance are influenced by household level and supra household level factors. The number of workers in the farm family (NWORKER) is found to significantly and positively influence the household's contribution towards watershed development. More the number of workers in the farm family enable the household to participate in the meetings, contribute labour for watershed development and maintenance activities.

Table.6. Factors determining the farm households' participation in watershed development

Variables	Regression Coefficient	Elasticity of Index	Elasticity of E(Y)
CONSTANT	67.012 (2.5176)		
FSIZE	1.142 (0.2972)	0.0186	0.0172
EDUCATION	-0.78135 (-0.14682)	-0.0141	-0.013
NWORKER	9.1505 * (1.8409)	0.1699	0.157
NINCOME	-11.756 (-1.2063)	-0.0589	-0.0544
NWELLS	8.134 ** (2.6015)	0.1890	0.1746
DISTANCE	- 0.15629 *** (- 3.9635)	- 0.2519	- 0.2328
UGSIZE	-2.3713 (-1.6422)	-0.1549	-0.1431
CASTE	25.961 ** (2.599)	0.1149	0.1062
PERCOLATION	26.104 ** (2.2801)	0.1093	0.1011
CHECKDAM	39.88 ** (2.905)	0.0663	0.0613
Log-likelihood function	-2052.32		
Number of observations	368		
Dependent variable	HHCONTBN		
Model	TOBIT		

NOTE: *** significance at 1 % level; ** significance at 5 % level; * significance at 10 % level
Figures in parentheses indicate estimated 't' ratios

The number of wells owned by the farm households (NWELLS) significantly and positively influences the contribution by the farm households. This implies that more the number of wells in the farm, more will be the contribution borne by the households as they depend on rainwater harvesting structures for groundwater recharge. This again confirms theoretical assertions that resource dependency is a major factor determining collective action. The variable DISTANCE representing the access to the rainwater harvesting structure influences the household's participation on the expected negative line. Nearer to the rain water-harvesting structure implies more the benefits to the household. Our result shows that the extent of social homogeneity as represented by caste (CASTE) at group level significantly influences the household's contribution towards construction and maintenance during the project period on the expected positive line. This confirms the fact that social homogeneity enhances collective action as this leads to increased social interaction, understanding, cooperation and cost- and benefit sharing. The type of watershed development technology is expected to positively influence the household participation in watershed management. Check dams perform many functions such as preventing soil and water erosion and groundwater recharge. Similarly, percolation ponds produce potential benefits in terms of groundwater recharge. The results show that CHECKDAM and PERCOLATION positively and significantly influence household contribution.

One of the reasons why participation in collective efforts falls once the state withdraws support is because there are differences in the tasks required during the project period and post-project period. As Table.7 shows, many tasks are not needed during the post-project period. However, key tasks such as organizing meetings, monitoring and maintenance, are essential in both phases and the operation of the Watershed Development Fund is crucial in the post-project period.

Table 7: Collective Tasks Performed in Watershed Management

Activities	What is required?		Who undertakes?		Incentives change?
	Project period	Post-project	Project period	Post-project	Post-project
1.Planning					
PRA	R	NR	PIA,WDT	..	..
Identification of locations and Structures	R	NR	PIA,WDT,WC	..	..
Preparation of WS development plans	R	NR	WC – WDT&PIA	..	..
Organising meetings	R	R	WC-WDT&PIA	VP WC –UG	↑ TC
2. Implementation					
Mobilising Contribution	R	NR	WC,UG	..	..
Construction of Structures	R	NR	WC,UG	..	..
Monitoring	R	R	WC,UG	Unclear	↑ TC
Maintenance	R	R	WC, UG	VP WC –UG	↑ TC
Operation of project Funds	R	NR	WC	..	..
Operation of WDF	NR	R	..	?	Unclear
Training and exposure visits	R	NR	PIA	..	..
3. Administrative and financial support from VP	R	R	YES	YES	IMP

R: Required; NR: Not required; PIA: Project Imple. Agency; WDT: Watershed Development Team; WA: Watershed Association; WC: Watershed Committee; UG: User Group; VP: Village *panchayat* ; TC: Transaction costs; IMP: Inadequate man power. WDF= Watershed Development Fund,

In the post-implementation stage, the WA and its WC are meant to sustain watershed activities. However, for many reasons, this institution fails and this is one of the primary reasons why collective efforts towards maintenance decline. An important question is why WA/WC becomes inactive during post-implementation.

Government guidelines recommend that the WA be registered in order to offer some mechanism of continuity. But in practice, though these associations are formally registered, many are found to be inactive in the post-project period. Often, when the project period is over, the local villagers think that the programme is truly over and there is no need to organize meetings and mobilize funds. There is therefore a problem of lack of awareness and information on the part of stakeholders. Lack of leadership in the post-implementation stage contributes to the decline in cooperation. The day-to-day activities of the WC in the post-project period are looked after by temporarily appointed secretaries. However, there is generally no provision made for paying a salary to these secretaries. Hence once the PIA leaves, the temporary secretary is no longer active and the functioning of the WC is jeopardized.

An additional problem relates to lack of continuity is overall leadership. In most cases, the President of the village *panchayat* is the WA President. If the same *panchayat* President is not re-elected, then the WA may likely to falter. Local changes in leadership result in increasing the transaction costs associated with organizing meetings. Similarly, the transaction costs associated with organizing maintenance and monitoring activities also increase in the post-project period.

Government guidelines emphasize that UGs are supposed to manage and maintain watershed structures once the project period is over. However, the role of UGs is rather limited even when the project is on-going – unlike User Groups in the case of forestry, tank water or canal water users' associations, watershed groups are not even well-defined; they do not have decision-making authority in terms of either physical or financial aspects; they do not manage accounts, and have to rely on the WC for executing most activities. Even the latest *Haryali* guidelines have not defined clearly the status of these UGs in terms of decision-making and action. Thus, they seem ill prepared in the post-implementation period to take on full responsibility for maintenance even though they are the primary builders of the structures and their members are the primary beneficiaries. Here there is a clear case of a mis-match between who benefits and who is responsible for decision-making during implementation stages.

The Watershed Development Funds are created in all completed watersheds. The community contribution to these funds ranges from Rs 53,343 to Rs 194,000. However, both the survey and discussion with officials indicate that the funds are not being utilized. One reason might be that clear guidelines for operating this fund are yet to be finalized. A second is that most watershed associations become inactive after the project period and there is no leadership available to implement activities. Essentially in the post-implementation phase, there is often limited awareness, a leadership vacuum, un-clear guidelines regarding the use of the watershed development funds, and few of the most directly involved beneficiaries – members of UGs -- are ready to take on increased responsibilities because they have little decision-making power during implementation. All of this means that the transaction costs associated with collective action increase in the post-implementation period.

6. Conclusions and Policy Recommendations

As devolutionary policies through institution building become widely adopted across the world, it becomes important to understand the circumstances under which these policies succeed. This paper attempts to examine watershed management in Southern India and understand the conditions that appear to sustain collective institutions. The study finds mixed evidence of collective efforts to manage watersheds. There is certainly cooperation among watershed beneficiaries during project implementation. Though monetary contributions of villagers are less than the mandated 5 per cent of construction costs, they indicate that villagers recognize the need for these structures and are willing to take some of the required action.

Peoples participation in different stages of watershed implementation indicate that farm households show inclination towards participation in planning and project formulation, attending meetings, training and exposure visits. There are evidences for farm households' participation in watershed management in post-project period by way contribution of voluntary labour for maintenance activities.

Factors determining households participation in watershed management reveals that number of workers in the farm family and number of wells owned found to be significantly and positively influence the households contribution towards watershed development. The variable DISTANCE representing the access to the rainwater harvesting structure influences the household's participation on the expected negative line. Thus, before implementation of watershed development, there is a need to define the zone of influence for different structures and the construction of structure may be followed based on the zone of influence. This will help in a big way for households to get involved in the watershed management. The supra household factors namely size of the user group and social homogeneity also found to significantly influence the households contribution towards watershed management. Adequate training on watershed development technologies will make them aware about the benefits and that help sustain the watershed management in the rural areas.

A key issue studied in this paper is the problem of post-project maintenance of structures in watersheds. There is a decline in interest in watershed structures during the post-implementation phase and this can be attributed to (i) low capacity of the new institutions set up to manage watersheds; and (ii) lack of clear norms on how to operate Watershed Development Funds. The Watershed Association, which is supposed to lead, instead becomes inactive in the post-implementation phase of watershed programs. There are several reasons for this. Perhaps the most important reason is lack of leadership. Leadership in the post-implementation period is supposed to lie with the *panchayat* leaders. However, if a new *panchayat* chairman is elected who had not been part of the initial phases of the watershed, there is less support that comes forth. Further, temporary secretaries who are supposed to manage day-to-day activities are not paid and they cease their activities.

There is little information available to beneficiaries on the main mechanism created to keep watersheds going – watershed development funds. We recommend that watershed development funds be jointly managed by Watershed Committee, village *panchayats* and the District Watershed Development Unit/Agency. A joint account could be operated by the three agencies. This will create responsibilities for all three groups and involve beneficiaries directly, engage the local leadership and bring in state accountability. Of course, setting up such a system is not without challenges.

There is also a role for better information dissemination during the implementation phase. Many stakeholders were unaware of how their responsibilities change in the post-implementation stage. Increasing awareness and providing clear information about rights and responsibilities will likely make for more empowered and involved stakeholders.

References

Baland, J M and J P Platteau (1996), *Halting Degradation of Natural Resources: Is there a Role for Rural Communities?* Oxford: Clarendon Press.

Balasubramanian, R and K.N.Selvaraj (2003). Poverty, Private Property and Common Pool Resources Management: The Case of irrigation Tanks in South India, SANDEE Working Paper No.2-03, South Asian Network for development and Environmental Economics,

Bardhan, Pranab (1993), "Analytics of the Institutions of Informal Co-operation in Rural Development," *World Development,* 21 (4): 633-639.

Bardhan, Pranab (2000), "Irrigation and Co-operation: An Empirical Analysis of 48 Irrigation Communities in South India," *Economic Development and Cultural Change,* 48(4): 847-865.

Bouma, J. Scaling up Participatory Watershed Management: Limitations to a Successful Approach, IWMI-TATA Water Policy Research Program, Annual Partners Meet, 2005, http://www.iwmi.org/iwmi-tata.

Bouma,Jetske Daan van Soest and Erwin Bulte. (2007). "How Sustainable is Participatory Watershed Development in India? *Agricultural Economics*, 36 (1) : 13-22.

Department of Land Resources. (2006). *Report of the Technical Committee on Watershed Programs in India, From Hariyali to Neeranchal*, Department of Land Resources Ministry of Rural Development Government of India.

District Rural Development Agency, (2004) Coimbatore, Tamil Nadu, India.

Edmonds. E.V. (2001). Government Initiated Community Resource Management and Local Resource Extraction from Nepal's Forests, Journal of Development Economics, 68:89-115.

Gebremedhin, Berhanu, J Pender and G Tesfay (2003), "Community Natural Resource Management: The Case of Woodlots in Northern Ethiopia," *Environment and Development Economics,* 8 (1): 129-148.

Government of India (2001), *Guidelines for Watershed Development* (Revised 2001), New Delhi: Department of Land Resources, Ministry of Rural Development.

Heltberg, Rasmus (2001), "Determinants and Impact of Local Institutions for Common Resource Management," *Environment and Development Economics,* 6 (1): 183-208.

Jo, K J, S Paranjape, A K Kirankumar, R Lele and Raju Adagale (2004), *Watershed Development Review: Issues and Prospects,* Technical Report, Centre for Interdisciplinary Studies in Environment and Development, ISEC Campus, India.

Kerr, John, G Pangre, Vasudha LPangre and P I George (2002), "An Evaluation of Dryland Watershed Development Projects in India," EPTD Discussion Paper, No.68, Washington D C: International Food Policy Research Institute.

Knox, Anna Mcculloch, Ruth Meinzen-Dick, And Peter Hazell, 1998. Property Rights, Collective Action And Technologies For Natural Resource Management: A Conceptual Framework, *CGIAR System-Wide Program Onproperty Rights And Collective Action,* International Food Policy Research Institute 2033 K Street, N.W. Washington, D.C. 20006 U.S.A.

Lise, Wietze. (2000). "Factors Influencing Peoples' Participation in Forest Management in India', Ecological Economics, 34 : 379-392.

Maddala, G S (1989), *Limited Dependent and Qualitative Variables in Econometrics,* Econometric Society Monographs, Cambridge: Cambridge University Press.

McCarthy, Nancy, Celine Dutilly-Diane and B Drabo (2004), "Co-operation, Collective Action and Natural Resource Management in Burkina Faso," *Agricultural Systems,* 82: 233-255.

Meinzen-Dick, Ruth, K V Raju and A Gulati (2002), "What Affects Organisation and Collective Action for Managing Resources? Evidence from Canal Irrigation Systems in India," *World Development,* 30 (4): 649-666.

Meinzen-Dick, Ruth, Monica Di Gregorio and Nancy McCarthy (2004), "Methods for Studying Collective Action in Rural Development," *Agricultural Systems,* 82: 197-214.

Ostrom, E. and R. Gardner, 1993, "Coping with asymmetries in the commons: self-governing irrigation systems can work", *Journal of Economic Literature,* **7**(4): 93-112

Ostrom, E., 1990, *Governing the Commons: The Evolution of Institutions for Collective Action,* Cambridge University Press, New York.

Palanisami, K and D Suresh Kumar (2002), "Participatory Watershed Development Programmes: Institutional and Policy Issues," Paper presented at the Workshop on "Rainfed Agriculture in Asia: Targeting Research for Development," 2-4 December 2002, ICRISAT, Patancheru, India.

Palanisami, K and D Suresh Kumar (2005), "Leapfrogging the Watershed Mission: Building Capacities of Farmers, Professionals and Institutions," *Watershed Management Challenges: Improving Productivity, Resources and Livelihoods*, Ed. B R Sharma, J S Samra, C A Scott and S P Wani, International Water Management Institute (IWMI) and International Crop Research Institute for Semiarid Tropics (ICRISAT) Publication, New Delhi: Malhotra Publishing House, 245-257.

Palanisami, K and D Suresh Kumar (2006), *Challenges in Impact Assessment of Watershed Development: Methodological Issues and Experiences,* Ed. K Palanisami and D Suresh Kumar, New Delhi: Associated Publishing Company Ltd., 2006.

Palanisami, K, D Suresh Kumar and B Chandrasekaran (2002), "Watershed Development: Concept and Issues," *Watershed Management: Issues and Policies for the 21st Century,* Ed. K Palanisami, D Suresh Kumar and B Chandrasekaran, New Delhi: Associated Publishing Company.

Palanisami, K, D Suresh Kumar and P Balaji (2003), "Evaluation of Watershed Development Projects: Approaches and Experiences," Coimbatore: Tamil Nadu Agricultural University.

Palanisami, K, S Devarajan, M Chellamuthu and D Suresh Kumar (2002), *Mid-term Evaluation of IWDP Watersheds in Pongalur Block of Coimbatore District,* Technical Report, Tamil Nadu Agricultural University, Coimbatore, India.

Palanisami, K. D.Suresh Kumar and P.Balaji, "Evaluation of Watershed Development Projects:Approaches and Experiences", (Coimbatore: Tamil Nadu Agricultural University), 2003.

Pearce, U. (1990). Sustainable Development:Economic and Envrironment in the Third World (London:Earthscan).

Pender, J and S J Scherr (1999), "Organisational Development and Natural Resource Management: Evidence from Central Honduras," EPTD Discussion Paper No.49, Washington D C: International Food Policy Research Institute.

Priya Shyamsundar, Eduardo Araral and Suranjan Weeraratne. (2005). Devolution of Resource Rights, Poverty, and Natural Resource Management : A Review, Environmental Economics Series, Paper No.104, World Bank, Washington.D.C., U.S.A.

Ramasamy, C, K Palanisami, K Lokanadhan and M Anjugam (2000), "Coping Behaviour to Growing Groundwater Scarcity in Tamil Nadu," Coimbatore: Tamil Nadu Agricultural University.
Rao Hanumantha, C H (2000), "Watershed Development in India: Recent Experiences and Emerging Issues," *Economic and Political Weekly,* 35 (45): 3943-3947.

Rasmussen, L N and Ruth Meinzen-Dick (1995), "Local Organisations for Natural Resource Management: Lessons from Theoretical and Empirical Literature," EPTD Discussion Paper, No.11, Washington D C: International Food Policy Research Institute.

Reddy, V Ratna (2000), "Sustainable Watershed Management: Institutional Approach," *Economic and Political Weekly,* September 16: 3435-3444.

Ribot, J. 2002. Democratic Decentralization of Natural Resources. Institutionalizing PopularParticipation. Washington, D.C.: World Resources Institute.

Sakurai, T (2002), "Quantitative Analysis of Collective Action: Methodology and Challenges," Paper Presented at CAPRI Workshop on Collective Action in Nairobi, Kenya, 25-28, February, 2002.

Sharma, B.R. and C.A.Scott. (2005). Watershed Management Challenges: Introduction and Overview, In Watershed Management Challenges:Improving Productivity, Resources and Livelihoods" (ed.) B.R.Sharma, J.S.Samra, C.A.Scott and S.P.Wani, International Water Management Institute (IWMI) and International Crop Research Institute for Semiarid tropics (ICRISAT) publication, (New Delhi:Malhotra Publishing House). PP: 245-257.

Sikka, A K, Subhash Chand, M Madhu and J S Samra (2000), "Report on Evaluation Study of DPAP Watersheds in Coimbatore District," Central Soil and Water Conservation Research and Training Institute, Udagamandalam, India.

Tobin, J (1958), "Estimation of Relationship for Limited Dependent Variables," *Econometrica,* 26 (10): 24-36.

Vedeld, T..(1996).Enabling Local Institutions building:Reinventing or enclosing the Commons in the Sahel. In Improved Natural Resources Management:The role of Formal Organisations and Informal Networks and Institutions, (ed.) H.S.Marcussen, Occasional paper 17; 135-189, Rosklide University, (Norway:International Development Studies).

Vermillion, D. L. 1997. "Impacts of Irrigation Management Transfer: A Review of the Evidence.: Research Report 11. Colombo,Sri Lanka: IIMI.

White, T Anderson and C.Ford Runge. (1995). "The Emergence and Evolution of Collective Action: Lessons from Watershed Management in Haiti", World Development, 23 (10): 1683-1698.