Can Participatory Watershed Management be Sustained? Evidence from Southern India

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Abstract

Watershed development is a very important rural development programme in India. This paper studies 60 community groups in 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 that watershed institutions in most cases become inactive once the project period is over. The analysis of factors that influence on-going maintenance of watershed structures indicates that collective action emerges when user groups are small and homogenous and communities are dependent on a large number of wells. Wealthy user groups are likely to be more active when a project is on-going. The results suggest that watershed development should be given more emphasis where wells are the predominant source of irrigation. Further, greater success is likely where user groups have more knowledge and control over funds available for maintenance activities after the state withdraws.

Key words: Watershed management, collective action, user groups, rich-poor differences.

Can Participatory Watershed Management be Sustained ? Evidence from Southern India

D Suresh Kumar

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). Recognising the significance of local-level institutions in managing natural resources, many developing countries are increasingly adopting participatory approaches to forests, irrigation and fisheries management. 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 rain-fed 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 (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) 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 examines how collective action institutions emerge and function to manage watersheds in India.

In India, watershed management is an important rural development strategy, particularly in rain-fed 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 common point, and where soil and moisture is conserved ***in situ***. While watershed development has been implemented since before independence, interest in this area has grown in recent years. Millions of people depend on fragile agriculture and natural resources and there is a huge demand for techniques that can lead to sustainable management of land and water. In such a context, watershed development has become quite necessary (Palanisami, *et al.,* 2002).

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 become key. 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.

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 has not produced the desired results and watershed management programmes, in particular, 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.

In watershed management, it is essential that we understand when and where collective participation is required, and with what type of watershed development technologies collective action is sustained. To address this issue, we undertake the following: (i) we look at different collective efforts undertaken in watersheds during and after implementation. We assess who is responsible for these tasks in both situations and who undertakes such tasks. We then evaluate if the incentives for undertaking these tasks have changed; (ii) Since a variety of socio-economic and environmental factors can influence farmer participation in collective action, we try to understand what factors are strongly associated with collective efforts in our study area. We are also interested in knowing whether the same factors motivate collective action during programme implementation and post-implementation or whether they change. Through this exercise, the study attempts to offer practical recommendations that can be incorporated into watershed planning and development by local communities and state agencies. This study is based on quantitative and qualitative data collected from 12 watershed villages in the Coimbatore district of Tamil Nadu, India.

2. Watershed Management 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] In general, 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).

Most watershed projects are implemented within a well-defined institutional framework. Figure 1 depicts this framework. A state-level committee called the State Watershed Development

[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.

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 in selecting a Project Implementation Agency and members of a Watershed Development Team (WDT). The Project Implementing Agency (PIA) is responsible for implementation of watershed activities and supervises the 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 community organizations. The community-based organizations (CBOs) involved in managing watersheds are the Watershed Association (WA), 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 watershed association is the chairman of the Watershed Committee, 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 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 take over 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. 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%) is meant for development/treatment and construction activities.[5] The WC opens a bank account and directly uses these funds.

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.

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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.

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

3. Study Area and Data

Our study was conducted in the Coimbatore district of Tamil Nadu, India. In this rural district, 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. However, due to the vagaries of the monsoons, the river systems, which are the main sources of surface water irrigation, fail to cater to the needs of farmers in this area. Hence, the chief source of irrigation in the district is through wells. The district is also supplied water through some 66 irrigation tanks.
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 and 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. Roughly, 1285 micro-watersheds have been identified in the district, out of which 89 micro-watersheds now have investment operations. Of the total 89 watersheds, investments in 41 micro-watersheds have already been completed (DRDA, 2004).

Different types of watershed treatment activities are carried out Coimbatore. 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). Training in 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 re-charge.

A problem in many of these watersheds, however, is community participation. A recent 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% (Sikka, *et al*, 2000). The community participation rate was 55% at the planning stage, 44% at the implementation and 27% 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). Of course, in some cases, there are significant positive impacts.

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 Project Implementing Agency had withdrawn its support and 30 User Groups were selected from the additional 6 watersheds where the programme is ongoing.

Data were collected during the period March 2005 to June 2005. 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. Appendix 1 includes the questionnaire used for user groups.

As records are maintained by Watershed Committees, additional information was collected from committee secretaries. Details at the watershed level were collected from the Watershed Committee, Project Implementing Agency, and village *panchayats*. 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. In general, percolation ponds are mainly constructed for groundwater recharge. Check dams are usually constructed across gullies to prevent soil and water erosion. In addition, check dams help groundwater recharge in nearby wells. The renovation of village tank activities facilitates irrigation. Recently, however, most small rain fed tanks act as only recharge structures rather than irrigation tanks. Generally, these structures are expected to produce benefits in terms of ground water recharge, prevention of soil and water erosion and provision of irrigation water.

4. Methods

This study is fundamentally interested in the ability of state supported programs to motivate and sustain collective action in order to improve local ground water resources. 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? b) What factors are important for collective action in watershed programs being implemented in Coimbatore district? and, c) how do these factors differently affect collective action during and post-implementation.

4.1 Assessing watershed functions during and post-implementation

User groups are formed to undertake specific tasks. However, they do not operate in isolation. Thus, in this paper we assess activities undertaken by user groups in relation to the roles and responsibilities of the other organizations involved.

The Watershed Committee plays a crucial role in the implementation period. The Committee with the help of the User Group organises meetings, mobilises contributions, constructs structures, and engages in monitoring and maintenance activities. Most importantly, the WC operates the watershed project funds account. There is a solution devised to provide support to watersheds in the post-implementation period. It is mandatory for these funds to be created. Programme beneficiaries have to contribute 10% of the amount investment on private lands and 5 % of the

investment on common lands into this fund. This fund is to be utilized for maintenance of watershed structures after the project is closed.[6]

The role of the Project Implementing Agency (PIA) and the Watershed Development Team too is also significant in the implementation stage. In the post project period the PIA and the WDT no longer exist and the onus of motivating maintenance and monitoring falls entirely on the WC and UGs.

To understand why and how groups contribute to collective efforts, we study key functions of user groups and other higher-level agencies during implementation and post-implementation of watershed management. We focus then on those tasks that are essential in both stages. Once we isolate these tasks, we move on to assess if the same groups are undertaking these tasks or not, if the incentives in terms of benefits from undertaking these tasks have changed, and whether the costs have changed.

4.2 Examining the role of local factors

When resources are abundant, the question of managing by collective action does not arise. It is only when the resources are available in limited quantity that collective action is likely to emerge. And in times of extreme scarcity of resources, local institutions and organizations governing common pool resources break down. It is generally accepted that for cooperation to occur there must be some minimum benefits. Thus, one issue at hand is what factors influence these benefits and thereby induce successful collective action. A second issue is how households or individuals view their own net benefits of cooperation relative to what others obtain, and, how this may influence collective behavior.

As Bardhan (2000) discusses in an earlier paper the *'history of local community-level cooperation in water management in South India is mixed*.' While there are many cases of successful and often informal cooperation it is still very unclear what empirical factors may contribute to success. There is some game-theoretic literature that can help identify factors that are important for successful cooperation. However much of this literature is not sufficiently nuanced to help with real-world applications (Bardhan, 1993). In the mean time queries regarding failure of cooperation in the post-implementation stages of watershed development are increasingly asked in policy circles. It is in this context that we seek to more formally examine the factors that may or may not contribute to successful cooperation in watersheds in Coimbatore.

There are various forms of cooperative behavior that take place in the watersheds of Coimbatore. However, for analytical purposes we focus on two main indicators: money contributed by group members towards creation of group assets or maintenance of these assets and meetings attended by members of user group. Thus, our first set of indicators of collective action are amount of money contributed by group members in rupees per year during the project period (CONTBN) and the average participation rate per meeting attended during the project period (MEETING).

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[6] The DRDA, under the guidance of the State government, is supposed to develop an exit protocol for watershed projects, as well as guidelines to clarify how the *panchayats* take over and manage the assets created in completed watersheds. If no clear post-project institutional arrangement is defined by the DRDA, the Chairman and Secretary, WC, operate the account jointly.

CONTBN is a direct indicator of farmers' willingness to pay for collective efforts while MEETING is a more indirect indicator of interest and participation in collective decision-making. These indicators of collective behavior are regressed on a number of factors that are hypothesized to influence collective action.

In order to identify these factors, we rely on a large theoretical and empirical literature on the conditions that determine successful co-operation (Rasmussen and Meinzen-Dick, 1995; White and Runge, 1995; Bardhan, 2000; Lise, 2000; Heltberg, 2001; Meinzen-Dick, *et al.,* 2002; Sakurai, 2002; Gebremedhin, *et al.,* 2003; McCarthy, *et al.,* 2004). Unfortunately, there is no clear underlying theory that can be used to identify the functional form of the relationships between determinants of cooperation and indicators of cooperation. We seek to estimate the following reduced form equations of collective action and its correlates.

The following model estimates the factors that influence user group contribution and meeting participation:

$$CA_i = a_0 + b_1 UG + b_6 E + b_{12}$$

$$PIAEXP = c_0 + d + d_6 ED$$

.....(1)

where i refers to user group contribution (CNTBN) and meeting participation (MEETING). The variables are defined in Table 2.

Collective action is influenced by the size of the group that needs to cooperate. When group size is small, problems of free riding and conflict among the members can be easily overcome and the benefits to group members are obvious (Rasmussen and Meinzen-Dick, 1995; Baland and Platteau, 1996; Gebremedhin, *et al.,* 2003). *A priori* it is expected that the variable UGSIZE will have an inverse relationship with collective action.

Another important factor is the type of watershed technology constructed or maintained. The benefits from watershed development technology critically depend on the functions performed by the structure or technology put in place. And of course benefits affect the behavior of the beneficiaries. There are three types of watershed structures that are built or repaired in the study area: percolation ponds, check dams, and tanks that are renovated. Thus, the variables PERCOLATION and CHECKDAM are included in the model as dummy variables to study the influence of the type of watershed structure. These two constructed structures are expected to be perceived as more beneficial than pre-existing tanks.

Dependence on ground water is another important factor that affects collective action. To capture the effect of resource dependence, the variable WELLS, or the number of wells in the zone of influence, is included. The greater the number of wells, the more important it is for these wells to be re-invigorated and this may lead people to participate in watershed management. It would also be useful to have an indicator of water level in each well but unfortunately, we do not have this data.

WEALTH and EDUCATION can have two different types of effects on collective action. Wealth is measured as the average size of the land holding within the user group and education is the average number of years of education. Both wealth and education offer exit options and this is likely to reduce participation (Lise, 2000). However, user groups that are wealthy and have educated leaders can be influential in the community and can motivate members to work together. They may also be able to supplement collective resources with their own. If this happens, then collective action is positively influenced by wealth and education. Thus, a priori, the direction of influence of these two variables is ambiguous.

The presence of other formal or informal organizations (FARMORG) such as Farmers' Association and Tank Water Users' Association may increase social interactions and the possibility of enforcing agreement (Baland and Platteau, 1996; White and Runge, 1995; Pender and Scherr, 1999). The presence of such organizations is likely to influence participation in watershed management when those organizations provide complimentary inputs (Pender and Scherr, 1999).

It is a common phenomenon in rural India that persons belonging to the same caste come together for any collective tasks when compared to a socially heterogeneous group. Social homogeneity, represented by caste, is expected to influence participation in collective tasks positively (Bardhan, 2000). The variable CASTE is included in the model as a dummy variable (=1 if more than 75 per cent of UG members belong to the same caste, 0, otherwise).

The variable ZONE represents the area benefited by the rainwater harvesting structure. This variable is included mainly to capture the effect of scale. A larger zone may require a large contribution by the user group but may also mean less participation by members. The variable WPHASE is a dummy variable included to capture differences in contribution between the UGs that are in completed watersheds and in on-going watersheds.

Another important variable is the type of Project Implementing Agency (PIA) that actually implements the watershed programmes. Though the implementation of watershed development programme follows a participatory mode, many crucial decisions such as number and size of different rainwater harvesting structures are made by the PIA. Thus, participation by the UGs critically depends on the type of PIA that implements the programme. Three PIAs are active in the study area. The District Rural Development Agency (DRDA) ran the majority of the watershed programs. The Central Soil and Water Conservation Research and Training Research Centre (SWC) was responsible for four user groups, and an non-government organization (NGO) was responsible for four other user groups. Two structural dummy variables, SWC and NGO, are included to examine whether these organizations are able to mobilize collective action better than the DRDA.

The variable PIAEXP, which is the total amount of expenditure made by the Project Implementing Agency in each user group, is expected to influence collective action positively. User Groups are expected to contribute 5% of the total expenditure of the development of any structure in the common lands. However, in reality, UGs do not satisfy the 5% norm and this amount varies across watersheds.

An issue that we need to consider is that PIAEXP may be endogenous. This is because before the Project Implementing Agency decides how much money to allocate to each structure or user group,

it holds discussions with villagers and local stakeholders who thereby influence budgetary allocations. Thus, in examining the determinants of collective action, we treat PIAEXP as endogenous. We model this relationship as a simultaneous system using Two Stage Least Squares (2SLS).

PIAEXP is expected to influenced by different variables viz., size of the user group, type of rain water harvesting structures, wealth position of the UGs, number of wells in the zone of influence, educational level of the UG leader, presence of formal or informal organizations, social homogeneity, zone of influence, type of PIA, and number of user groups (NOUGS) in the watershed. This last variable is included for identification purposes.

4.3 Collective action in watershed programs that are completed

A key concern for policy makers is the fact that interest in maintaining watershed structures drops off after the watershed is completed. In the post-project period, most activities decline as key watershed institutions become inactive due to withdrawal of the Project Implementing Agency (PIA). The contribution made by the UGs is generally very low or almost nil. Although collective maintenance such as bund-strengthening, de-silting, repair of surplus weirs and sluices is required during the post-project period, only eight user groups in our sample undertook some maintenance activity. Thus, an important research question is why collective action fails in the post-implementation period.

In order to answer this question we look at the factors that determine collective action during and post-implementation and assess whether there is some difference in these factors during these two stages. Again, our two dependent variables are: amount of money contributed by group members in rupees per year pooled for both during project and post-project period (CONTBN1) and the participation rate per meeting pooled for during and post-project period (MEETING1).

An empirical issue that needs to be considered, however, is that many UGs did not participate in collective action during the post-project period. Thus, the dependent variables take the value zero for these UGs. Given that our dependent variables are 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:

$$CA1_i^* = X_j b + U$$
$$CA1_i = CA1_i^*$$
$$= 0$$

…. …(2)

Where,

$CA1_i$ = User Group contribution / participation in meetings in watershed development activities

X_j = Vector of independent variables such as UGSIZE, CHECKDAM, PERCOLATION, WELLS, WEALTH, EDUCATION, FARMORG, CASTE, ZONE, PROJECTD, DWEALTH, DEDUCATION, DFARMORG, DCASTE

b = Vector of unknown coefficients

where, i refers to user group contribution (CNTBN1) and meeting participation (MEETING1). The error term U_j is independently normally distributed with zero mean and constant covariance σ^2.

To identify the factors that determine the collective tasks performed by the user groups in two different periods, we estimate a model that includes a dummy variable (PROJECTD) to capture the effect of the PIA. Thus, PROJECTD takes the value 1 if the Project Implementing Agency is in place and 0 in the post-implementation stage of watershed development. We also introduce interaction variables where the PIA dummy is interacted with some explanatory variables to identify the differential impact of some explanatory variables during and post-implementation.

We expect the explanatory variables WEALTH, EDUCATION, FARMORG and CASTE are to have differential influence on the UG contribution and participation in meetings. Wealthy people may play a larger role in the presence of government power; while experience with other organizations and education may fill a leadership vacuum even in the absence of the PIA. Homogenous communities are more likely to work together even in the absence of any government agencies. Thus, these variables are interacted with the PROJECTD. The coefficient on the variable DWEALTH tells us the effect of WEALTH variable when the PIA is present i.e. during the project period. Similarly the other variables DEDUCATION, DFARMORG and DCASTE explain the effect of these variables when the PIA is active in the watershed.

The other independent variables hypothesized to influence collective action remain the same: group size, type of watershed development technology, wealth, number of wells, education of the group leader and experience with another organization, caste homogeneity and zone of influence. The coefficients tell us the effect of these variables on the UG contribution and participation in meeting in the absence of PIA's influence.

We estimate robust standard errors for the coefficients of (2). We need to do this because if there are significant unobservable factors that affect contribution and meeting participation by the UG members, then the error terms for the same UG for pre and post implementation observations would be correlated. To solve this problem, we estimate the heteroskedasticity adjusted, i.e. the robust standard errors for the Tobit model.

Descriptive statistics of the variables used in estimating the determinants of collective action are presented in Table 2. As the Table shows the contribution by user groups to watershed management during the project period is Rs.1512.81 per year. This includes the UGs contribution towards construction and maintenance during the project implementation period. The average participation rate per meeting ranged between 60 % and 95 % during the project period. The average size of land holding in the UGs is 2.18 hectares and the size of user group is approximately 8 members.

5. Results

5.1 Watershed Management during and post-implementation

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.

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.

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 re-charge 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.

A more interesting issue is the differences in collective action during and post-implementation of watershed projects. Table 3 presents a summary picture of various indicators of participation in collective action by user group members during and post project implementation. There is a significant reduction in meetings held and attended by UGs over the two periods. For instance, UGs participated in 3.76 meetings per year during the programme period but only 0.33 meetings per year in the post-project period. Similarly, the average meetings participation rate (% of members attending per meeting) fell dramatically during the post-project period from 78 per cent to 17 per cent. We expect the number of meetings to decline in the post-project period since few construction activities are undertaken at this stage. Some drop in participation is also to be anticipated, however, discussions are required for on-going maintenance. This kind of dramatic decline in participation suggests that post-implementation maintenance may suffer.

User Groups actively contribute to watershed development activities during the project period. The total contribution per UGs during construction was Rs 1211 per year in completed watersheds and Rs 1590 in on-going watersheds. The amounts spent on maintenance during the implementation phase were approximately 128 per year and Rs 96 per year respectively in completed and on-going watersheds. These contributions are in terms of cash, labour, machinery, water and materials, which we have monetized.

After the programme was over, average maintenance expenditure per UGs decreased by about 40%. Furthermore, maintenance activity is a rare phenomenon -- out of 30 User Groups only eight (27 per cent) continued to undertake some form of maintenance activities after the project was over. This was mainly because of the interest of members who derived direct benefits from rainwater harvesting. Though, watershed development structures produce benefits, generally farmers think that maintenance is the mandate of the state and they show less inclination towards further maintenance.

To better understand the activities undertaken by the User Groups, Table 4 classifies user group contribution by types of tasks undertaken. Common tasks include construction, de-silting of pond/tank, reconstruction/repairing of surplus weir, bund strengthening, and cleaning of weeds. Table 4 shows that contribution towards maintenance of percolation ponds fell by 42% in the post-project period. However, some types of action, such as bund strengthening, increased in the post-project period. No maintenance activities were performed for check dams in the post-project. In the case of renovation of tanks, contribution to maintenance declined by 83 % in the post-project period.

It is possible that some maintenance activities are not needed regularly and are undertaken where and when necessary. To understand the role of post-project maintenance, we held discussions with the officials from the State government Department of Agricultural Engineering who are involved in watershed development. They indicated that check dams and percolation ponds need to be de-silted after three years. However this depends on the rainfall, quality of construction, and location of the structures. Our subjective evaluation of the structures suggested that about 75% of percolation ponds in completed watersheds were in good condition relative to 88% of percolation ponds in on-going watersheds. While almost all the check dams in the study watersheds were in good condition, there were weeds, bushes and silt depositions that were creeping up in many. Similarly, in many tanks the supply channels had bushes and weeds that prevent free flow of water into tanks, and silt and breached bunds in some cases were commonly noticed. Based on a physical inspection of the watershed structures our sense is that there was a need for collective action to maintain these structures. But, perhaps things were just not bad enough to motivate farmers.

The beneficiaries of User Groups (with help of the Watershed Association, Watershed Committee and the Project Implementing Agency) often share the costs of any activities or infrastructure that is created with the government. User groups are expected to contribute 5% to the costs of structures created. However, the extent to which user group members are willing to cost share depends on the quantum of expected benefits and economic status of group members and varies according to the structure that is created.[7] Table 5 shows that the average contribution by user groups varied from 1.81 per cent of total costs for check dams to 3.68 per cent of costs for percolation ponds in completed watersheds. In on-going watersheds, the contribution by User Groups was highest for check dams and least for percolation ponds. An important question we try to address in the next section is what factors influence this contribution.

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[7] Our survey suggests that in completed projects cost-sharing was based almost equally on economic ability and proximity to the structure created. For instance, in completed watersheds, 57% of the UGs follow cost sharing based on the economic status of the UG members. Wealthy people come forward to contribute more when compare to the poorer households.

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 6 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.

In the post-implementation stage, the Watershed Association and its Watershed Committee 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 become inactive during post-implementation.

Government guidelines recommend that the Watershed Association 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 Watershed Committee 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 Watershed Committee is jeopardized.

An additional problem relates to lack of continuity in overall leadership. In most cases, the President of the village *panchayat* is the Watershed Association President. If the same *panchayat* President is not re-elected, then the Watershed Association falters. 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 user groups 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 watershed committee 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.

Table 7 shows that 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 funds, and few of the most directly involved beneficiaries – members of user groups -- 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.

5.2 Local factors that matter

One of our main objectives was to identify factors that influence the collective tasks performed by the UGs during the project period. Estimation of the factors that determine a) UG contribution towards construction and maintenance of structures and b) participation in meetings, are presented in Table 8. The sample includes all 60 User Groups and the adjusted R^2 obtained is 0.68 for the first estimation and 0.51 for the second. Given the significance of the coefficients obtained for the different variables hypothesized to determine collective action, we have greater confidence in our results from the user group contribution regression relative to the meeting participation regression.

The number of farmers in the user group (UGSIZE) significantly and negatively influences UG contribution. This shows that as group size increases the collective action exerted by the UGs decreases. These results are in accordance with the received literature (Rasmussen and Meinzen-Dick, 1995; Baland and Platteau, 1996; Gebremedhin, *et al.,* 2003).

The type of watershed development technology is expected to positively influence collective action. 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. Table 8 shows that CHECKDAM and PERCOLATION positively and significantly influence UG contribution but not participation.

The number of wells in the zone of influence (WELLS) significantly and positively influences the contribution made by UGs. This confirms theoretical assertions that resource dependence is a major factor determining collective action.

User group contributions are also dependent on the size of the watershed structure that is built and larger structures will cost more and have a greater zone of influence. Therefore, we control for zone of influence and PIA expenditure in our analyses. We also control for whether or not the watershed is already completed or if work is still on-going with a WPHASE dummy variable. All three variables, as expected, have a positive influence on the contribution made by the UGs. Note, that in our 2SLS equation we jointly estimate PIA expenditure along with our two dependent variable. It is interesting that PIA expenditure has no influence on participation.

Social homogeneity among the user groups is expected to have a positive influence on collective action (Bardhan, 2000). Our results show that the extent of social homogeneity as represented by caste (CASTE) significantly influences UGs participation in meeting during the project period but not member contribution. It appears that caste homogeneity plays a role at least in bringing people together for meetings but may not lead to actual increases in monetary contributions.

The educational level of the User Group leader (EDUCATION) has a positive and significant impact on participation in meetings. Education improves awareness about the positive externalities generated by watershed development and motivates leaders to initiate action. The Watershed Committee usually organizes all meetings. However, in times of need, the User Group leader can request the Chairman/Secretary of the concerned Watershed Committee to organize meetings to discuss specific issues. Apparently, as with caste homogeneity, education matters for meetings but does not for contributions.

The presence of other organizations (FARMORG) such as Farmers' Associations and Tank Water Users' Associations influences user group contribution. As noted by other scholars, prior experience with other organizations and a history of co-operation and social interactions usually helps with new collective action efforts – our results reinforce this general finding (Baland and Platteau, 1996; White and Runge, 1995; Pender and Scherr, 1999).

The type of Project Implementing Agency has a strong bearing on the motivation of the local villagers to actively participate in the watershed development programmes. Our analyses suggest that both NGOs and SWC may be more effective relative to the DRDA in motivating members to contribute money towards collective management and participation in meetings.

5.3 The changing influence of all things local

Our second objective was to know whether the same factors were responsible or different factors influence collective tasks during the project and post-project periods. We estimate a pooled model that includes only the *completed* watersheds but uses data from *before* and *after* completion. The results are presented in Table 9.

Table 9 shows that wealth is a significant factor associated with user group contribution during the project period. Percolation ponds, number of wells in the zone of influence as well as wealth significantly influence UG contribution in the absence of the PIA. The participation regression offers even more interesting results. Check dams, percolation ponds, presence of formal or informal organizations and caste significantly and positively influence UG participation in meetings in the absence of the PIA. Thus, it appears that rainwater harvesting structures and, as to be expected, social networks are important for getting people to come together in the absence of PIA. However, these same social networks don't have much influence on getting people to actually put in money and labor effort (UG contribution).

It is interesting to find that wealth differently affects collective tasks during the project and post-project periods. We find that wealth exerts a significant and positive influence on contributions during project implementation but becomes less significant (10% level) and negative in the absence of PIA i.e. during the post-project period. The reason for this may have to do with the fact that whenever an external agency enters a rural area and offers services, the wealthy are the first to show interest. Often the Watershed Development Team members or the PIA give the leaders and wealth preferential treatment. Most local people and organizations show respect to wealthy people and give cognizance to issues raised by them. However, once the state withdraws from the project area, the wealthy may reduce their role for three reasons: (i) perceived benefits from the continuing collective action are seen to be low compared to the costs of collective action; (ii) being members of a higher economic class, their opportunity costs are greater; and (iii) they

no longer have access to government officials and external agencies who may provide the wealthy with opportunities that are beyond or un-related to watershed benefits.

The impact of membership in other organizations on collective efforts is also interesting in terms of participation in meetings. Membership in alternative organizations has a positive effect in the post-project period. This suggests that experience with other organizations, at a minimum, increases participation in meetings during the post project period. Caste homogeneity has a similar effect – thus, the glue of social networks appears to be important once the PIA removes itself.

6. Case study

In order to further examine what determines the interest of user groups to continue collective action after the project period is over, three cases of successful user groups in the K. Ayyampalayam watershed were studied. K. Ayyampalayam is a drought-affected village in the Palladam Block of Coimbatore District and was selected for watershed development under DPAP programme. Different watershed treatment activities such as soil and moisture conservation, drainage line treatments and water resources development were taken up. More specifically, the construction of percolation ponds, check dams and renovation of tank was undertaken. These activities appear to have helped augment the storage capacity in the watershed. They have helped decrease excess run-off from surface water and increased ground water recharge. In addition to ground water recharge, farmers perceived that there is sufficient water available for domestic use and for cattle after implementation of the project.

The major indicators of collective action and characteristics of the user groups are presented in Table 10. The case-study user groups are concerned with the construction and development of percolation ponds. All the three user groups are to some extent successful in terms of amount of contribution and meetings attended. On average, above five meetings were attended by UGs during the project period with a relatively high participation rate by the members. The contribution at the time of construction satisfied the mandate of 5 per cent of costs among two of the three groups.

Once the state withdraws, it is essential that the members of user groups be convinced about expected benefits from the watershed structures. In this context, it appears that the user groups do perceive benefits as they continue to maintain their rainwater harvesting structures. A subjective evaluation of the structures revealed that all are in good condition. During, the post-project period, user groups undertook maintenance activities and spent an amount of Rs 334 to Rs 402 per year, an amount that is significantly higher than what we find for the overall sample.

The success of these user groups can be attributed to the crucial role played by the PIA in terms of institutional and technical support in forming community organizations, running meetings and organizing trainings. In this watershed, the Project Implementing Agency conducted Participatory Rural Appraisal exercises to assess the resource availability and needs of the community and organized awareness campaigns and user group trainings. These activities motivated local villagers to play an active role during project implementation. This also contributed to a better understanding of roles and responsibilities of user groups in the post-project period. Also, the village panchayat president is very keen on watershed development and motivated UGs to take some activities in

the post-project period. As the PIA imparted adequate training, the members were very aware of the Watershed Development Fund and its importance and this might be one of the reasons for good contribution.

In addition, the characteristics of these user groups may also have played a role. The size of user groups in terms of the number of farmers in each user group ranged from 9 to 12, which was adequate to mobilize funds and to initiate actions collectively. The Gini ratio on land holdings shows that these groups are almost homogeneous in terms of economic strength. They are also socially homogeneous in terms of caste.

In summary, in successful watersheds we see a confluence of conditions that help them to continue and operate at a higher level. These include good PIA leadership and efforts during the project period, awareness and training programs, groups with enough members to take on maintenance activities and good leadership at the *panchayat* level in the post-implementation stage.

7. 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. User groups and their members participate in meetings and PRA exercises and share the costs of construction and maintenance of watershed development structures. In the study sample, user groups contributed 2.48 per cent to 4.36 per cent of total costs of investments made in common lands. Though monetary contributions of villagers are less than the mandated 5% of construction costs, they indicate that villagers recognize the need for these structures and are willing to take some of the required action.

An analysis of factors that influence collective action indicates that cooperation emerges in areas where there is greater resource dependence (i.e., a greater number of wells that need to be replenished) and where there are homogeneous social groups involved. The results suggest that watershed development should be given more emphasis where well-irrigation is the predominant source of irrigation.

The issue of optimal group size has been debated for a long time among development personnel and policy makers. As expected, our study finds that the possibility of collective action decreases as group size increases. Further, the case study analysis suggests that collective action is ensured and sustained to some extent when group size ranges from 9 to 12 members. This allows for monitoring of individual actions but also makes it possible to have enough members to undertake different maintenance activities.

Another interesting result is that NGO managed projects appear to do better in motivating collective action relative to projects managed by the DRDA. However, we do not want to over-emphasize this result because we had a small selection of such projects in our sample.

The link between wealth and collective action presents some important policy dilemmas. Our analysis indicates that wealthy user groups are likely to contribute to increased collective action during the project period when the state agency is present. In other words, the wealthier the user group, in terms of average land-holding, greater contribution towards construction. However, this relationship may be reversed when we consider post project maintenance i.e. when the state agency withdraws its support. Thus, we can speculate that when the project implementation agency withdraws access to power and panchayat or district level leadership may also decline. Wealthier user groups also have a higher opportunity cost of time. For these reasons, it is likely that post-implementation activities are more likely to be undertaken by poorer user groups. This suggests that during the implementation stage, it is important to ensure that poorer groups and less influential groups are given the required training.

In addition, the presence of other formal or informal organizations also seems to contribute toward motivating collective efforts. This is an interesting result and suggests that there are complementary skills being developed where multiple organizations exist. There is a debate in policy circles about whether there are too many issue specific collective action institutions in rural areas. At least this study seems to suggest that membership in alternate organizations helps rather than hinders efforts in watershed management. Social networks matter – caste and experience with other organizations are the factors that contribute to user group participation in meetings in the post implementation period.

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) 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.

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.

Unlike in the case of the forest or water user groups, the user groups in watershed development projects, whose members both benefit and bear the costs of collective action, are not vested with power to make decisions or control finances. If the UGs are given these powers, then there is a possibility that the devolutionary process could become more successful.

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 user groups, village *panchayats* and the District Rural Development Agency (DRDA)/ District *panchayats*. 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.

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APPENDIX A

TAMIL NADU AGRICULTURAL UNIVERSITY

Department of agricultural economics,coimbatore-641 003.

Economic Inquiry into Peoples Participation, Collective Action and Farm Household Behaviour as Watershed Management Changes from State Control to Panchayats and Community Control

Funded by

South Asian Network for Development and Environmental Economics (SANDEE)

Project Leader: Dr. D.Suresh Kumar, Associate Professor (Agrl.Economics)

Interview schedule for user group

Date: ……..…..Interviewer: ……....…… Village Name: ……....……

Watershed Name: ……....…… Block: ……....….. District: ……....……..

Name of the User Group.……....……....……....……....…

Persons contacted: Name ……...…… Position ……...……....……...…

Watershed Code : Watershed programme Ongoing / Post project period

Implementation period : From ……....……....…… To ……....……..

1. Year and date of start :
2. Name of the leader :
   a. Educational level of the leader :
3. How the leader is selected/elected? : Election/Nomination by Project Implementing Agency/Nomination by Watershed Association President
4. Zone of influence/area benefited : ……Hectares
   a. Number of wells in the zone of influence :
5. a. Total members in the UG
      at the time of formation : ….…..…
      No.of upstream farmers : ….…..…
      No.of downstream farmers : ….…..…
   b. Total members in the UG
      at present : ….…..…
      No.of upstream farmers : ….…..…
      No.of downstream farmers : ….…..…
6. What structure(s) is managed/maintained by you?. Put tick mark and get how many numbers of structures managed and maintained by the User Group.

Percolation pond ……	How many ?	……..……
Minor Check dam ……	How many ?	……..……
Major Check dam ……	How many ?	……..……
Looseboulder Check dam……	How many ?	……..……
Tree plantations……	How many ?	……..……
Others (specify)		
1 ……..……	How many ?	……..……
2. ……..……	How many ?	……..……

Note : Tree plantations may be in number of trees or area in hectares.

Activities :

A. Percolation pond / Farm pond/cattle pond

1. *Desilting of pond*
2. *Reconstruction/repairing of surplus weir*
3. *Bund strengthening*
4. *Removal of weeds*
5. *Others (specify)*

B. Minor / Major check dam

1. *Desilting*
2. *Reconstruction/repairing of surplus weir*
3. *Removal of weeds*
4. *Others (specify)*

C. Tree plantations / Fodder plantations

1. *Gap filling*
2. *Watering*
3. *Weeding*
4. *Watch and ward*
5. *Manuring*
6. *Others (specify)*

Frequency : 1 :Once a month; 2: When needed; 3 : Once a year; 4: Irregularly; 5 : Never
Participation by members : 1 : Never; 2 :Least common; 3 : Sometimes; 4 : Most common

10. Have the members contributed any labour /water/ money towards the maintenance of structures / activities in common lands during implementation of the programme?

YES / NO

If YES, give the following details.

Activities	Year	Labour (days)	Cash (Rs.)	Water *	Bullock power (days)	Tractor (Hours)	Materials (Rs.)	Machinery (Hours)	Total value (Rs.)
1.									
2.									
3.									
4.									
5.									

Activities :

A. Percolation pond / Farm pond/cattle pond

1. *Desilting of pond*
2. *Reconstruction/repairing of surplus weir*
3. *Bund strengthening*
4. *Removal of weeds*
5. *Others (specify)*

B. Minor / Major check dam

1. *Desilting*
2. *Reconstruction/repairing of surplus weir*
3. *Removal of weeds*
4. *Others (specify)*

C. Tree plantations / Fodder plantations

1. *Gap filling*
2. *Watering*
3. *Weeding*
4. *Watch and ward*
5. *Others (specify)*

** Quantity of water : Collect in Hours of pumping with discharge (li/sec) or number of cart loads/tankers with capacity (litres)*

10. a. Price details of inputs used

Price of labour (Rs./manday) : ……

Price of water (Rs./ unit) : ……

Price of bullock (Rs./day) : ……

Price of tractor/machine (Rs./day) : ……

Price of machine (Rs./day) : ……

11. Has your User Group undertaken any maintenance activities after closing the programme?

YES / NO

If YES, give details of maintenance activities performed by your User Group?

Activities	Year	Frequency (use code)	Total number of times undertaken	Participation by members (use code)	
				Voluntary	Forced
1.					
2.					
3.					
4.					
5.					
6.					

Activities :

A. Percolation pond / Farm pond/cattle pond

1. Desilting of pond
2. Reconstruction/repairing of surplus weir
3. Bund strengthening
4. Removal of weeds
5. Others (specify)

B. Minor / Major check dam

1. Desilting
2. Reconstruction/repairing of surplus weir
3. Removal of weeds
4. Others (specify)

C. Tree plantations / Fodder plantations

1. Gap filling
2. Watering
3. Weeding
4. Watch and ward
5. Others (specify)

Frequency : 1 :Once a month; 2: When needed; 3 : Once a year; 4: Irregularly; 5 : Never
Participation by members : 1 : Never; 2 :Least common; 3 : Sometimes; 4 : Most common

12. Have the members contributed any labour /water/ money towards the maintenance of structures / activities in common lands after closing the programme?

YES / NO

If YES, give the following details.

Activities	Year	Labour (days)	Cash (Rs.)	Water *	Bullock power (days)	Tractor (Hours)	Materials (Rs.)	Machinery (Hours)	Total value (Rs.)
1.									
2.									
3.									
4.									
5.									
6.									

Activities :

A. Percolation pond / Farm pond/cattle pond

1. *Desilting of pond*
2. *Reconstruction/repairing of surplus weir*
3. *Bund strengthening*
4. *Removal of weeds*
5. *Others (specify)*

B. Minor / Major check dam

1. *Desilting*
2. *Reconstruction/repairing of surplus weir*
3. *Removal of weeds*
4. *Others (specify)*

C. Tree plantations / Fodder plantations

1. *Gap filling*
2. *Watering*
3. *Weeding*
4. *Watch and ward*
5. *Others (specify)*

** Quantity of water : Collect in Hours of pumping with discharge (li/sec) or number of cart loads/tankers with capacity (litres)*

12.a. Price details of inputs used

Price of labour (Rs./manday) : ……

Price of water (Rs./ unit) : ……

Price of bullock (Rs./day) : ……

Price of tractor/machine (Rs./day) : ……

Price of machine (Rs./day) : ……

13. Details of meetings organized/attended by the User Group.

i). Has any meeting been organized/attended by your User Group? YES / NO

If Yes, give details of meetings organized/attended by your User Group.

Particulars	Frequency of meetings	Number of meetingsor ganised	Year of conduct	Average meetings participation rate (%)
During project period				
Post project period				

14. Does your user Group have any cost sharing mechanism? YES / NO

If YES, How the costs are shared by the members?. Please put tick mark.

Cost is shared by

Nearness to the rainwater harvesting structure ……..

Based on economic status/ability of the farmers ……..

All members share equally ……..

Decision taken by the User Group ……..

As suggested by Project Implementing Agency ……..

As suggested by the Watershed Association President ……..

15. Do you have any idea about Watershed Development Fund? YES / NO

16. If YES, did you receive any amount for maintenance of structures? YES / NO

17. If YES, please give details of activities and amount of money received for maintenance activities.

Activities	Amount (Rs.)
1 ……..	1 ……..
2 ……..	2 ……..
3 ……..	3 ……..

18. What is your opinion about the present norms of 5 per cent cost borne by the beneficiaries for the structures constructed in common lands? (Put tick mark)

Acceptable ….…..…. Should be increased ….…..….
Should be decreased ….…..…. Should not be collected ….…..….

19. If it 'Should be increased', what could be the percent share borne by the beneficiaries?
…….. (0 – 100 %)

20. If it 'Should be decreased', what could be the percent share borne by the beneficiaries?
…….. (0 – 100 %)

21. Have you shared any usufructs produced/obtained from the common resource maintained by your User Group? YES / NO

If YES, give the details of usufructs you received during the project/ since the inception of the watershed development programme.

Products	**Year in which received the usufructs**	**Number of times per year**	**Quantity / time (Kgs.)**	**Total Value (Rs.)**	**Method of sharing**
Fodder					
Fuelwood					
Fruits					
Timber					
Silt					
Grass					
Green leaf manures					

Method of sharing :
1 : All User Group members share equally;
2 : Share is based on the contributions made by the User Group members;
3 : Other farmers in the watershed also shared

22. Details of conditions of watershed structures

Name of the structure	Numbers/area	Condition of structures (No.of structures)		
		Good	Moderate	Poor
Major check dams				
Minor check dams				
Percolation pond				
Loose boulder check dams				
Cattle ponds				
Retaining walls				
Avenue plantation				
Horticulture plantation				
Fodder plots				
Fuelwood plantation				
Grass plantation				

23. Water level in the pond/check dams (June2003 – May 2004)

(feet)

Name of the structure	Jun	Jul	Aug	Sep	Oct	Nov	*Dec*	Jan	Feb	Mar	Apr	*May*
1.												
2.												
3.												

24. Problems in managing and maintaining watershed development structures. Assign ranks.

PROBLEMS	**RANK**
Non-co-operation by members	( )
Lack of technical support from project Implementing Agency	( )
Political intervention	( )
Lack of proper cost and benefit sharing mechanism	( )
No financial support after closing the programme	( )
Lack of co-ordination by other Community Based organizations	( )
No rainfall	( )

25. Scio-economic characteristics of User Groups

a. Number of households :
Number of farm households :
Number of labour households :
Others :

b. Profile of households

Sl. No.	Name and address of the farmer/ household	Number of members in the family	Farm size (Hectares)	Caste
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

26. What type of institutional arrangements do you think you need for effective watershed management? Please list the options based on priority.

1.
2.
3.
4.
5.

TABLES

Table 1: Details of the Study Watersheds and User Groups

Name of Watershed	Name of the Block	Stage of Watershed	Project Period		Actual Completion	Number of User Groups
			From	To		
Paruvai	Sulur	Completed	1998	2002	March 05	4
Salaiyur	Annur	Completed	1998	2002	2002	4
Karegoundampalayam	Annur	Completed	1999	2003	March 05	4
V.Kallipalayam	Pongalur	Completed	1999	2003	March 05	3
K.Ayyampalayam	Palladam	Completed	1999	2003	March 04	5
Kallakinar	Pongalur	Completed	1999	2003	2003	10
Chettipalayam	Tirupur	On-going	2002	2007	..	4
Thulukkamuthur	Avinashi	On-going	2002	2007	..	7
Giddampalayam	Palladam	On-going	2002	2007	..	5
Pattanam	Sulur	On-going	2002	2007	..	7
Vadavalli	Annur	On-going	2003	2008	..	4
Pogalur	Annur	On-going	2002	2007	..	3

Source: Field Survey 2004-2005

Table 2: Descriptive Statistics of the Variables Studied

Variables	Description	Number of Observations	Mean	S.D	Min.	Max.
CONTBN	Contribution by the UGs during project period in Rs./Year	60	1512.81	897.67	391.66	4383.33
MEETING	Participation rate per meeting during the project period (%)	60	78.75	7.57	60.00	95.00
CONTBN1	Contribution by the UGs in Rs./ Year (pooled for during the project and post-project period)	60	708.13	862.72	0.00	4383.33
MEETING1	Participation rate per meeting (%) (pooled for during the project and post-project period)	60	48.33	38.06	0.00	95.00
UGSIZE	Number of farmers in the User Group (number)	60	7.93	3.26	3.00	15
CHECKDAM	Dummy for the type of watershed structure. 1 if Check Dam, 0, otherwise	60	0.13	0.34	0.00	1.00
PERCOLATION	Dummy for the type of watershed structure. 1 if Percolation pond, 0, otherwise	60	0.56	0.49	0.00	1.00
WELLS	Number of wells in the zone of influence	60	6.63	3.56	2	17
WEALTH	Average size of land holding in hectares	60	2.18	0.76	0.8	3.51
EDUCATION	Educational level of the UG Leader in years of schooling	60	7.06	1.92	5	10
FARMORG	Presence of formal or informal farmers' organisation other than watershed institutions (1 if present; 0, Otherwise)	60	0.4	0.49	0.00	1.00
CASTE	Social homogeneity; Dummy, 1 = if more than 75 per cent of UG members belong to the same caste, 0, Otherwise	60	0.53	0.50	0.00	1.00
SWC	Agency dummy (=1 if the PIA is Central Soil and Water Conservation Research and Training Research Centre (SWC), 0, otherwise)	60	0.13	0.34	0.0	1.00
NGO	Agency dummy (=1 if the PIA is NGO; 0, otherwise)	60	0.13	0.34	0.0	1.00
PIAEXP	Amount invested by the Project Implementing Agency in Rs/Year per user group	60	29144	21727	3936	127904
NOUGS	Number of UGs in the watersheds	60	8.25	4.06	4.00	16.00
PROJECTD	Dummy for the presence of Project Implementing Agency (1 if present; 0 Otherwise)	60	0.5	0.50	0.00	1.00
WPHASE	Dummy for the stage of watershed (=1 if completed, 0, on-going)	60	0.5	0.50	0.00	1.00
DWEALTH	Project dummy-wealth interaction (PROJECTD X WEALTH)	60	1.09	1.22	0.0	3.51
DEDUCATION	Project dummy-education interaction (PROJECTD X EDUCATION)	60	3.53	3.81	0.0	10.00
DFARMORG	Project dummy-other organization interaction (PROJECTD X FARMORG)	60	0.20	0.40	0.0	1.00
DCASTE	Project dummy-caste interaction (PROJECTD X CASTE)	60	.33	.47	0.0	1.00

Table 3: Indicators of Collective Action in Watershed Management

Particulars	Completed Watersheds		On-going Watersheds
	During Programme Implementation	Post-project Period	
A. Meetings			
Meetings participated (No./Year)	3.76	0.33 ***	3.53
Average meetings participation rate in year (%)	78.0	17.0 ***	79.2
B. Contribution by user group members			
During construction			
Cash contributions (Rs/Year)	1041.52	..	1385.83
Labour contribution (Rs/year)	30.62	..	115.0
Water (Rs/Year)	126.49	..	24.46
Materials value (Rs/year)	12.33	..	6.67
Machinery (Rs/year)	..	..	58.33
Total (Rs/year)	1210.96	..	1590.29
During maintenance			
Cash contributions (Rs/year)	2.81	5.00	23.33
Labour contribution (Rs/year)	25.66	16.66	47.51
Water (Rs/year)	0.94	..	..
Materials value (Rs/year)	4.58	0.67	..
Machinery (Rs/year)	94.0	55.00	25.56
Total (Rs/year)	127.98	77.32	96.40
C. Rules			
Presence of cost sharing mechanism	YES		YES
Nearness to the rainwater harvesting structure (%)	40.00		43.33
Based on the economic status (%)	57.00		53.33
Share equally (%)	0		3.33

Source: Field survey 2004-2005
*NOTE: *** significance at 1 % level; ** significance at 5 % level; * significance at 10 % level*

Table 4: User group contributions to different structures by tasks undertaken (Rupees /Year)

Particulars	Completed Watersheds		On-going Watersheds
	During Project Period	During Project Period	During Project Period
Percolation pond			
Construction of pond	1537.69	..	1500.63
Desilting of pond	112.12	66.94	65.75
Reconstruction/repairing of surplus weir	19.68	..	..
Bund strengthening	3.98	10.68	..
Total maintenance	135.78	77.62	65.75
Check dams			
Construction of check dam	689.58	..	1621.88
Desilting	..	..	35.00
Reconstruction/repairing of surplus weir	..	..	15.00
Total maintenance	..	..	50.00
Renovation of tanks			
Desilting of pond/tank	997.32	101.78	1870.00
Reconstruction/repairing of surplus weir	..	2.22	85.00
Bund strengthening	..	7.11	250.0
Planting trees	..	..	..
Total maintenance	997.32	111.11	2205

Source: Field survey 2004-2005
*NOTE: *** significance at 1 % level; ** significance at 5 % level; * significance at 10 % level*

Table 5: Financing of construction and maintenance during project implementation and contribution by User Groups

Name of the Structures	Completed Watersheds				On-going Watersheds			
	Number	Average Amount borne by the Project (Rs.)	Average Amount contributed by the UG (Rs.)	Percentage of people's contribution (%)	Number	Average Amount borne by the Project (Rs.)	Average Amount contributed by the UG (Rs.)	Percentage of people's contribution (%)
Percolation Ponds	17	176490.00	6489.88	3.68	16	184373.00	3329.38	1.81
Check Dams	4	114378.00	2068.75	1.81	10	65337.20	3243.75	4.96
Renovation of Tanks	9	136007.00	4373.22	3.22	4	114496.00	3740.00	3.27

Source: Field Survey 2004-2005

Table 6: Collective Tasks Performed in Watershed Management

Activities	What is required?		Who undertakes?		Incentives change?
	Project period	Post period	Project period	Post period	Post period
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	VPWC –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	VPWC –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 Dev Team; WA: Watershed Association; WC: Watershed Committee;
UG: User Group; VP: Village panchayat ; TC: Transaction costs;
IMP: Inadequate man power. WDF: Watershed Development Fund,

Table 7: Details of the Watershed Development Fund

Name of the Watershed	Amount Available (Rs)	Amount Spent (Rs)
Paruvai	60000	NIL
Salaiyur	194000	NIL
Karegoundampalayam	53343	NIL
V.Kallipalayam	60000	NIL
K.Ayyampalayam	56000	NIL
Kallakinar	126965	NIL

Source: Field Survey 2004-2005

Table 8: 2SLS estimation of factors influencing collective action during the project period

VARIABLES	PIA expenditure Rs./year	User Group contribution in Rs/year	Average participation rate per meeting (%)
CONSTANT	1184.5726	-155.4888	70.9550
	(0.064)	(-0.322)	(14.107)
UGSIZE	-1588.6495*	-359.0825***	0.0528
	(-1.934)	(-4.297)	(0.061)
CHECKDAM	22203.0206*	4043.3890***	1.4130
	(1.799)	(3.746)	(0.126)
PERCOLATION	19434.6900**	3647.1524***	1.7582
	(2.510)	(3.661)	(0.169)
WELLS	1279.6760	333.0213***	0.3595
	(1.329)	(3.978)	(0.412)
WEALTH	1164.3955	188.5097	-0.5297
	(0.342)	(1.563)	(-0.422)
EDUCATION	-722.0410	-9.3721	0.4668**
	(-0.458)	(-0.171)	(2.217)
FARMORG	22274.7373***	4409.0678***	0.3637
	(2.966)	(3.813)	(0.030)
CASTE	-1674.2575	-20.9943	9.9135***
	(-0.264)	(-0.102)	(4.631)
ZONE	1103.3486***	210.5259***	0.0893
	(3.292)	(3.569)	(0.145)
SWC	-5938.3627	607.7690*	3.0775**
	(-0.499)	(1.648)	(2.269)
NGO	-6290.0478	933.5316**	1.6354***
	(-0.455)	(2.150)	(3.129)
WPHASE	..	534.0722**	2.4870
		(2.971)	(1.328)
NOUGS	-481.9779	..	..
	(-0.569)		
PIAEXP	..	0.1879***	-0.1458
		(3.480)	(-0.259)
Adj.R-squared	0.28	0.68	0.51
F statistics	2.95***	10.55***	5.69***
Number of observations	60	60	60
Dependent variable	PIAEXP	CONTBN	MEETING
Model	2SLS	2SLS	2SLS

Source: Field Survey 2004-2005
*NOTE: *** significance at 1 % level; ** significance at 5 % level; * significance at 10 % level*
Figures in parentheses indicate estimated 't' ratios

Table 9: Factors Influencing Collective Action during the Project Period and Post-project Period in Completed Watersheds

VARIABLES	User Group contribution in Rs/year		Average participation rate per meeting (%)	
	Coefficients	Robust Std. Errors	Coefficients	Robust Std. Errors
CONSTANT	112.2603 (0.103)	1087.417	28.9071 (0.6376)	45.3331
UGSIZE	-46.9191 (-0.756)	61.992	-0.5668 (-0.175)	3.236
CHECKDAM	378.9868 (0.953)	397.774	37.500*** (2.648)	14.161
PERCOLATION	626.5262* (1.632)	383.704	22.011** (2.147)	10.251
WELLS	94.7323* (1.811)	52.293	0.3262 (0.136)	2.393
WEALTH	-726.4729* (-1.790)	405.668	10.7670 (0.728)	14.787
EDUCATION	2.3100 (0.015)	153.277	-2.6573 (-0.523)	5.073
FARMORG	722.7308 (1.577)	458.021	33.844** (2.424)	13.957
CASTE	-139.6737 (-0.326)	428.118	45.617** (2.071)	22.023
ZONE	-11.0689 (-0.371)	29.819	-1.8165 (-1.348)	1.346
PROJECTD	-437.3817 (-0.351)	1244.308	62.6191* (1.877)	33.360
DWEALTH	862.1378** (2.087)	412.940	2.7546 (0.252)	10.927
DEDUCATION	111.5896 (0.794)	140.443	3.435 (0.790)	4.344
DFARMORG	-153.3934 (-0.335)	457.357	17.820 (1.088)	16.378
DCASTE	-99.0737 (-0.237)	417.267	-29.9785 (-1.302)	23.017
Log likelihood fun	-291.39	-180.51		
Number of observations	60	60		
Dependent variable	CONTBN1	MEETING1		
Model	TOBIT	TOBIT		

Source: Field Survey 2004-2005
*NOTE: ***: significance at 1 % level; **: significance at 5 % level; *: significance at 10 % level*
Figures in parentheses indicate estimated 'z' ratios

Table10: Case-study Analysis of Successful User Groups in K. Ayyampalayam Watershed, Coimbatore District of Tamil Nadu, India

Particulars	User Groups		
	Kovilkuttai	**Ramanthottam kuttai**	**Kaikalakuttai**
Type of structure	**Percolation pond**	**Percolation pond**	**Percolation pond**
Number of meetings attended during project period (Number/year)	8	6	5
Average meetings participation rate during project period (%)	70.0	60.0	80.0
Number of meetings attended during post-project period (Number/year)	1	1	2
Average meetings participation rate during post-project period (%)	50.0	50.0	50.0
Total contribution at the time of construction (Rupees)	12500	8220	6150
Percentage of UG contribution (%)	5.0	5.07	2.28
Gini ratio on land holding	0.38	0.13	0.007
Social homogeneity reflected by caste (%)	100	89	92
Total members in the user group (Number)	11	9	12
Having knowledge about Watershed Development Fund	YES	YES	YES
Condition of rainwater harvesting structures	GOOD	GOOD	GOOD

FIGURE

Fig.1: Instiutional Structure of the Watershed Development Programme