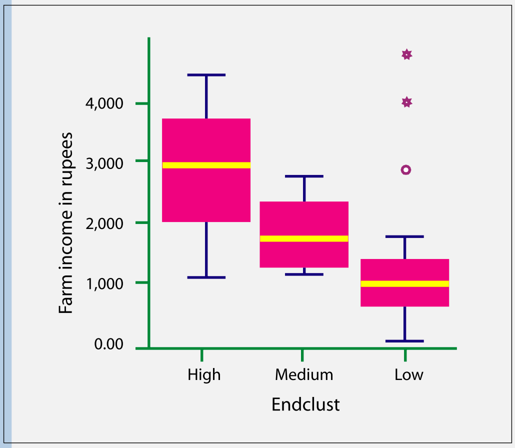
RESEARCH REPORT

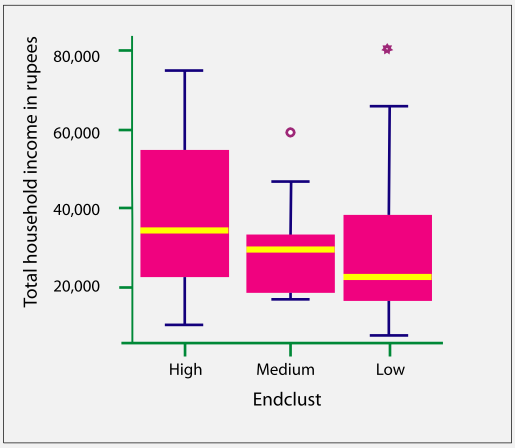
92

How Pro-Poor are Participatory Watershed Management Projects?

An Indian Case Study

Mathew Kurian and Ton Dietz





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Research Report 92

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Mathew Kurian and Ton Dietz

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Contents

Summary

In recent years Irrigation Management Transfer (IMT) and Joint Forest Management (JFM) projects have been promoted with a view to improve service provision in the agricultural sector. Improved service provision it is presumed would enhance access of resource poor households to watershed services such as irrigation and Non-Timber Forest Products (NTFPs). This report draws on a survey and case study evidence from 28 watershed management groups in Haryana to argue that participatory watershed management projects need not necessarily safeguard the interests of poorer rural households. We demonstrate that given a particular institutional contract as in Haryana, irrigation service provision by contractors proved to be more effective than provision by a community organization (HRMS) in ensuring that water allocation, collection of Irrigation Service Fees (ISF) and routine maintenance of irrigation infrastructure was undertaken. Our analysis of benefit distribution reveals that wealthier landholding households benefited more from management of irrigation and forest resources when compared to relatively poorer households. In conclusion this report points out that although no blueprints for promoting pro-poor community participation in watershed management may be readily available, certain principles are identifiable that may include: ensuring transparency of policy processes and predictability of institutional contract to promote private sector participation in irrigation service provision, ensuring fairness in benefit distribution to facilitate compliance with irrigation service rules and minimize potential for conflicts and promoting inter-sectoral policy coordination by targeting subsidies for private tubewells and addressing anomalies in the nonfarm labor market with a view to dovetailing watershed management projects within wider regional programs of poverty alleviation.

How Pro-Poor are Participatory Watershed Management Projects?—An Indian Case Study

Mathew Kurian and Ton Dietz

Introduction

In recent years decentralized development approaches have been promoted to realize the goal of poverty reduction. In the agriculture sector declining budgetary support and deteriorating quality of service provision by parastatals the world over has prompted an interest in Irrigation Management Transfer (IMT) and Joint Forest Management (JFM) policies. IMT and JFM policies typically refer to devolving management of previously publicly controlled forests or irrigation systems to farmer groups or other private-sector entities (International Water Management Institute (IWMI) 1995:4). Donor supported JFM and IMT projects have encouraged co-management between parastatals and farmer groups or the private sector to undertake tasks of catchment protection, water allocation, collection of Irrigation Service Fees (ISF's) and routine maintenance of irrigation infrastructure in a watershed context[1] (ADB 2001; IWMI 2003).

There are essentially three arguments that have been made in support of co-management in watershed management. First, an institutional contract that establishes accountable and transparent procedures for management of land and water resources could potentially encourage participation of farmer groups or the private sector in provision of rural services (ADB 1999; Alsop et. al. 2000). Second, enhanced service provision may improve access of marginal land- holding and landless households to irrigation, fuelwood, fibre and fodder grasses within watersheds (Kerr 2002; Ostrom 1996). Third, enhanced access of poor rural households to irrigation services in particular could potentially trigger off positive economy-wide improvements in income streams through increases in on-farm productivity and greater integration in factor or product markets (Bebbington 1999; Cox et. al. 2002).

In recent years through a number of evaluations of watershed projects have pointed out that co-management of watershed resources need not necessarily guarantee adequate attention to interests of poor rural households. Studies have documented how powerful landholders may collude to appropriate benefits of watershed management at the expense of poorer peasants[2] (Bandhopadyay and Eschen 1988; Platteau and Gaspart 2003). Second, studies

[1]A watershed refers to a geo-hydrological unit that drains at a common point (Brooks et. al. 1992).

[2]Most discussions of equity issues in participatory irrigation management assume that large landholders would have their plots located at the head end of an irrigation system while poor farmers would have their plots located at the tail end of a system. Similarly, discussions of watershed or river basin management also assume that downstream users would bear the externalities caused by land and water management practices of upstream resource users. While these assumptions may be true in specific instances it may prove to be futile to generalize. This is because as a result of a practice of land scattering in large parts of north- west India large landholders may have their farm plots distributed across different locations in an irrigation command. Similarly, it is not uncommon for upstream resource users to either rent or purchase arable land in lower reaches of a watershed and thereby incur the costs imposed by upstream resource use practices (see Kaul 1997).

point out that landless households that depend on public lands to meet a considerable portion of their subsistence needs for fuelwood, fodder or timber may suffer as a result of JFM-style conservation measures that regulate their access to such lands (Agarwal 1996). Third, studies of watershed management in South Asia highlight the fact that women may have to bear an increased workload from an improvement in access to irrigation due to doubling of agricultural yields. (Arya et al.1998; Sarin 1999).

Interest in the plight of the rural poor and their access to natural resources is reflected in the recent debate on pro-poor growth. The pro-poor growth debate emphasizes the fact that institutional mechanisms that influence how the benefits of economic growth are distributed are as important, if not more important, than growth itself (Ravallion 2000). Pro-poor growth is growth that enables the poor to actively participate in and significantly benefit from economic activity (Kakwani and Pernia 2000:3). Promoting pro-poor distribution of benefits of watershed management requires a strategy that is deliberately biased towards the poor so that the poor can benefit proportionately more than the rich (Reddy et. al. 2004, Kurian et. al. forthcoming). Such an outcome would rapidly reduce the incidence of poverty so that those at the bottom end of the distribution curve of consumption would have the resources to meet their basic needs. Therefore, to be effective a pro-poor strategy would entail removal of institutional and policy induced biases against the poor whether they are based on differences in gender, ethnicity or regional context (Agarwal 1997; Bebbington 1999).

This report is based on a study of a Ford Foundation supported watershed management project in the Haryana Shiwaliks. Three sets of questions guided the research:

- To what extent does the institutional contract for co-management of land and water resources ensure attention to issues of transparency and accountability in watershed management? How are pro-poor concerns as reflected in quotas for women in community organizations, water rights for landless households and management of community funds addressed?
- How does the institutional contract for co-management of watershed resources influence provision of irrigation services? Which mode of irrigation service provision (i.e., by private individuals or community organization) is more successful in ensuring that water allocation, collection of ISF's and routine maintenance of irrigation infrastructure is effectively undertaken?
- How does success with irrigation service provision influence distribution of benefits and costs within farmer groups? Do economy-wide benefits relating to farmer incomes, cropping intensity, and access to forest resources such as fibre and fodder grasses and fuelwood located in catchment areas discriminate in favor of poorer households and sub-groups such as women when compared to wealthier groups?

The following sections of the report are organized as follows. The section on “Overview of the Study Area and Project Descriptions” provides a profile of the study area and description of the Haryana Ford Foundation watershed management project. The section on “Data and Methods” provides a description of the data base and methodology adopted for the study. The section on “Discussion on Study Findings” discusses the main findings of the study focussing on a discussion of performance of institutional mechanisms for co-management of watershed resources and distribution of benefits from dam management and other economy-wide benefits related to engagement in factor and product markets. This section examines whether benefits arising from co-management of watershed resources have been pro-poor in their distribution in the case of a Ford Foundation watershed management project in the Shiwalik hills, Haryana. The section on “ Conclusions” highlights the main conclusions and policy implications of the study.

Overview of the Study Area and Project Description

The Study Area

In recent years Haryana has emerged as one of the most prosperous states in India. Driven by irrigation expansion and large-scale adoption of High Yielding Varieties (HYV) of green revolution crops like paddy, cotton and sunflower, Haryana has achieved impressive agricultural growth. Impressive gains in farm wage rates have been partly responsible for increases in per-capita income (Narayanamoorthy 2001). However, on the flip side Haryana has seen widening income disparities between those mainly dependent on casual agricultural work and those occupied in the rural nonfarm sector (Bhalla 1999). Widening income disparities probably explain why poverty rates have increased in Haryana despite increases in per-capita income. To add to this Haryana has a poor record of land reforms as a result of which land distribution is skewed (Narayanamoorthy 2001; Sharma 1994). Access to nonfarm jobs, a potential way to escape poverty is, however, curtailed for certain groups like women in rural communities (Agarwal 1997).

Panchkula district has the largest proportion of land under forests in Haryana (HCFP 2000). As a result the district has been a particularly important focus of participatory forestry projects. Since the early 1980s a spate of community forestry initiatives have been undertaken: social forestry, joint forest management and the Haryana community forestry project. The Haryana Joint Forest Management (JFM) Project was responsible for developing an integrated model of watershed management based on experiments that were undertaken in the village of Sukhomajiri between 1975 and 1985 (Arya and Samra 1995). From the Haryana Forest Department's (HFD) point of view the Sukhomajiri watershed management intervention was crucial to reduce siltation of the Sukhna reservoir located further downstream in the state capital of Chandigarh.

The Sukhomajiri model was premised on the idea that a linear relationship exists between the condition of forests located in the Shiwalik hills and agricultural productivity in low lying plains (see figure 1). As a result fodder production on private fields was encouraged through provision of irrigation from earthen dams in the expectation that greater fodder and dung[3] production from irrigated fields would obviate the need to use state-owned forests for fodder and fuelwood extraction (Sarin 1996). Between 1984 and 1989 an attempt was made to scale up or replicate the Sukhomajiri watershed model to about 35 micro-watersheds located in Morni-Pinjore Forest Division[4] of Panchkula District in Haryana. An important feature of the scaling up phase of the project was the creation of institutional mechanisms for sharing revenue from state forests with local communities to promote conservation of watershed resources.

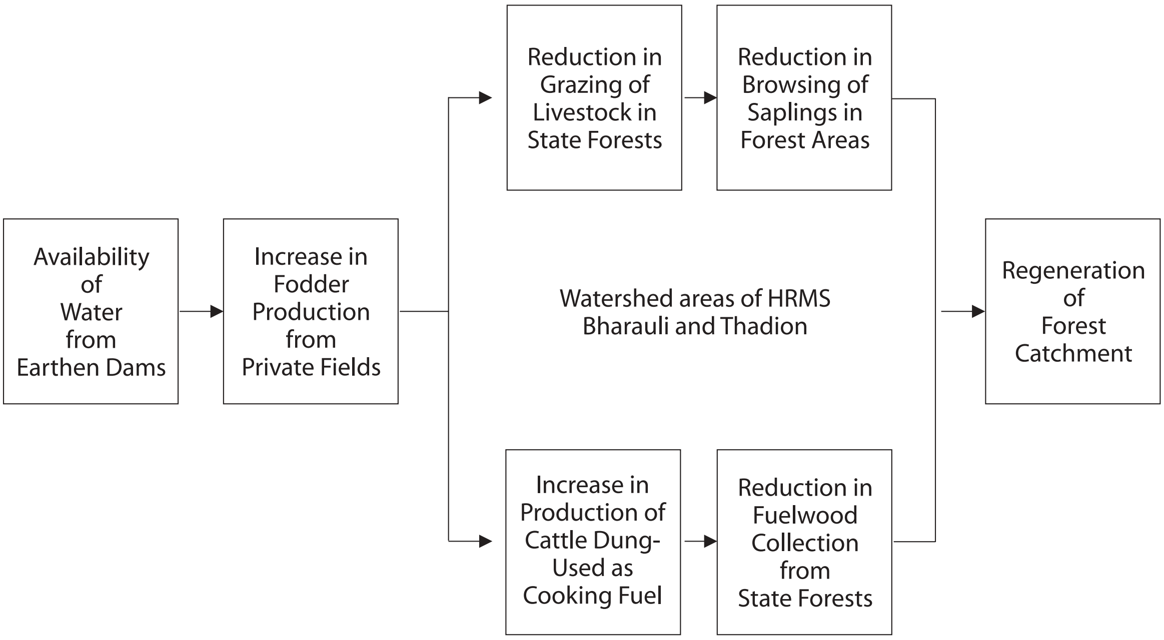
The Haryana Joint Forest Management Project—Pro-poor Features of the Co-management Contract

In June of 1990, Haryana became one of the earliest states of the Indian Union to adopt the Central Government's circular on JFM. There was an explicit attempt to encourage participation of rural communities in rehabilitation of degraded public forests. Earthen dams that were

[3]Cattle dung is used extensively as a cooking fuel in the Shiwalik region. Increased production of cattle dung it was assumed would reduce pressure on state forests for supply of fuelwood for cooking purposes. An alternative approach to reducing pressure on forests for fuelwood collection has been to facilitate greater adoption of non- biomass fuels like Liquefied Petroleum Gas (LPG) technology for cooking purposes by rural populations. This strategy has been attempted at an all India scale by the Indian Ministry of Non-Conventional Energy Sources (see Ramana1996).

[4]For administrative purposes Morni-Pinjore Forest Division is further subdivided into three forest ranges—Pinjore, Panchkula and Raipur Rani.

FIGURE 1.
The Sukhomajiri Watershed Model.



constructed acknowledged the intricate relationship between access to irrigation in downstream agricultural fields and patterns of fuelwood collection from forests in upstream areas. There was also an acknowledgment that access of traditionally marginalized groups such as the landless and women needed to be safeguarded. Five features of the institutional contract with an explicit focus on pro-poor concerns may be outlined as follows: (TERI 1998):

- *Tenure Reform:* Water user associations were constituted as Hill Resource Management Societies (HRMS) under the Registration of Societies Act, 1900. HRMS were given the opportunity once a year to lease out rights to harvest fibre grass from state-owned forests located in the catchment area of earthen dams. The lease price was fixed at the average of the previous 3 years revenue of the HFD from designated forest area. Previously only paper mills had the right to harvest fibre grass from such forests.
- *Tradable Water Rights:* Landless households were given a share of water from dams provided they were members of the HRMS. Attempts were made to institute a system of tradable water shares so that landless households could sell their share of water to other households. Tradable water rights, it was reasoned, would place an economic value on the use of water and thereby increase the effectiveness of water use.
- *Modalities for Private Sector Participation in Watershed Management:* We pointed out earlier that HRMS could lease out rights to harvest forest products on public forest lands from the HFD annually. In the case of water from earthen dams (built on public forest land) water allocation rights purchased by the HRMS could be further sublet to private contractors at auctions held annually. In the case of fibre grass private contractors were to ensure that every household in the HRMS received two head loads of fibre grass free to meet subsistence requirements before

deciding on its sale. In the case of water, profits from the sale of water from earthen dams were to be shared on a 50:50 percent basis between the private contractor and the HRMS.

- *Access of Poor to Decision Making Forums:* The HFD was to facilitate annual elections of the HRMS managing committee. At least a third of positions in the managing committee of the HRMS are to be reserved for women, who form a traditionally marginalized group in the Shiwalik region. Every woman in a household was entitled to membership distinct from membership of the male head of household in the general body of HRMS. Further, in cases where a HRMS comprised of two villages, one relatively small and powerless than the other, attention was paid to issues like how revenue raised from sale of water (and fibre and fodder grasses) could be spent in a manner that benefited both villages.
- *Management of Community Funds:* An important principle followed regarding the use of HRMS funds was that a proportion of profits derived by the water contractor from the sale of water from dams (and fibre and fodder grasses) were to be deposited in the HRMS common fund. A proportion of these funds could then be used for community development activities such as construction of village roads, repair of school buildings or construction of rest areas for laborers. Such a provision would enable the use of public funds for maintenance of economic and social infrastructure in the village.

Data and Methods

Rapid Survey of Management of Earthen Dams in Post-project Phase

Thirty-five HRMS were established in the Morni-Pinjore Forest Division of Panchkula District in Haryana. These 35 HRMS were responsible for managing 54 earthen dams. The goal of the survey was to visit all HRMS with earthen dams in Morni-Pinjore Forest Division. However, due to logistical constraints (roads being washed away in the monsoon rains) we could visit only 28 HRMS. This reduced our sample to 28 HRMS responsible for managing 45 earthen dams. Our rapid survey of the 28 HRMS in the Morni-Pinjore Forest Division was undertaken over a period of one month in the year 2000, during which information was collected on variables like sources of fuel for domestic household purposes and participation in management of earthen dams.

The issue of participation in management of earthen dams needs to be examined in the context of the number of dams that were functioning when this survey was undertaken. Our survey revealed that only 8 of the 45 earthen dams that were constructed in the Morni Pinjore Forest Division were functioning in 2000 (Kurian 2003).[5] We find that in cases where the catchment stabilization principle was followed earthen dams continued to function. The catchment stabilization principle basically emphasizes the need to form village forest management organizations prior to dam construction. Village-based organizations were to institute rules regulating access to state forests for fuelwood, fodder and fibre grass. In response to regulated use of forest areas, earthen dams

[5]The eight functioning dams were under the management of eight HRMS.

could be built. The assumption was that the regulated forest use would have stabilized rates of soil erosion and, as a result, increased the lifespan of the dams (Arya and Samra 1995).

We undertook an assessment of earthen dams in the Morni-Pinjore Forest Division by examining three aspects: (a) Physical condition of headworks, (b) physical condition of spillway and (c) physical condition of distribution channels. Our assessment revealed that approximately 31 percent of all dams that were constructed silted up within 5 years of construction and 33 percent within 10 years of construction (Kurian 2003). Interestingly, 20 percent of dams constructed functioned for less than a year. We notice there are two clear periods of dam construction in which it is possible to discern a relationship between watershed institutions and the lifespan of dams. The first period covering the Panchkula Forest Range extended from 1984 to 1989. This was a period in which scant attention was paid to institutional issues related to setting up water user groups. Instead emphasis was purely on constructing earthen dams. As a result half of the dams silted up within 5 years of construction.

During the second phase of dam construction, which extended from 1990 to 1998, we note a gradual movement towards Raipur Rani forest range. During this phase new dams were constructed and community-based organizations were also established. The various stakeholders— Ford Foundation, Tata Energy Research Institute (TERI) and the HFD closely monitored the process. As a result of closer monitoring and greater transparency, dams surviving beyond 5 years increased by 50 percent. Further, the proportion of dams silting up within 5 years of construction fell from 50 percent in the previous phase to 21.4 percent. Nevertheless, we must emphasize that when compared to the Sukhomajiri pilot phase, dam performance had undergone a marked decline in Raipur Rani. This is evident from figures on numbers of dams surviving beyond 10 years from construction. This we argue is because of the failure to ensure catchment stabilization prior to dam construction.

Case Study

Two of the eight HRMS with functioning dams-Bharuali and Thadion were selected for a comparative case study. We used five criteria to arrive at the choice of Bharuali and Thadion HRMS for a detailed case study. First, water harvesting dams must be operational. Second, HRMS must be functional. Third, one HRMS (heterogeneous in endowment distribution) must function relatively better than the other (homogeneous in endowment distribution) with regard to dam management. Fourth, HRMS must be situated in close proximity to each other to reduce differences in contextual factors like distance from markets, slope, elevation and forest type. Fifth, HMRS must be situated in Raipur Rani forest range, where it was clear based on the review of secondary data on nonfarm employment that rural livelihoods depend to a greater extent on agriculture and animal husbandry. Two rounds of household surveys were undertaken to cover all households in the study sites of the Bharauli and Thadion HRMS. The household surveys collected information on household demography, cropping patterns, asset ownership and participation in management of earthen dams. Socioeconomic data was collected using structured interviews, focused interviews and group discussions.

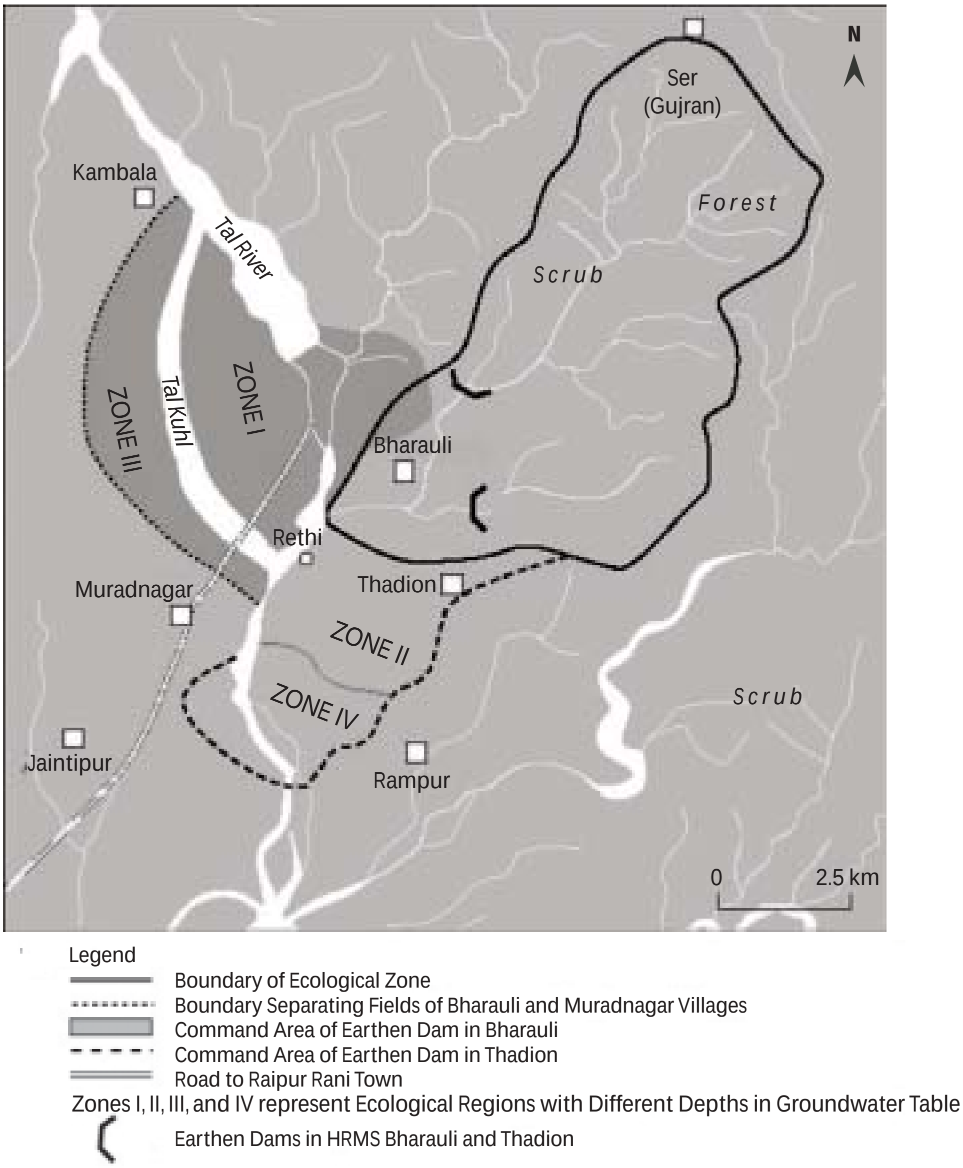
Description of Case Study Sites—Bharauli and Thadion HRMS Demographic Features

Bharauli HRMS is composed of two settlements; Bharauli, a relatively large village with 80 households and Sher Gujran with about 25 households. Sher Gujran village is located in the catchment of the earthen dam while Bharauli lies downstream of the dam. On the other hand Thadion HRMS is composed of two villages—Thadion with 50 households and Rethi village with 25 households (figure 2). Bharauli HRMS is composed of four different caste groups compared to Thadion HRMS that is composed of only one caste group. Given the greater diversity of castes in Bharauli, some occupational specialization based on caste identity is evident. For instance, the Tarkhans or blacksmiths undertake iron works for other caste groups. In return for their services they are usually paid in grain. Likewise, the Harijans have traditionally worked as hired labor on other people's fields or as domestic helpers in the homes of large landholders. In recent years Harijan households have provided a source of labor for water contractors to undertake routine repairs of earthen dams. No such caste-based pattern of occupational specialization exists in Thadion.

HRMS Designated Forest Area?

Shiwalik forests in the vicinity of Bharauli and Thadion HRMS have been classified as "open scrub"[6] according to Survey of India topography

FIGURE 2.
Watershed areas of HRMS Bharauli and Thadion.



[6]Open scrub refers to degraded land in need of rehabilitation through soil and water conservation measures.

maps (Survey of India 1965). With the introduction of joint forest management in the Shiwalik hills a total of 712 ha of forest area was allotted to Bharauli HRMS. This area comprises five forest compartments. On the other hand, Thadion HRMS was allotted a forest area of 354 ha, which includes three forest compartments. Both Bharauli and Thadion have one forest guard who is appointed by the HFD and responsible for monitoring forest use by local villagers.

Earthen Dams

There are two earthen dams in the study area, each constructed by the state forest department. In both cases the Shiwalik forests serve as their catchment. The earthen dam at Bharauli was constructed in 1990 at a cost of Rs 578,000 (US$1=Indian rupees 40), while the dam at Thadion was constructed in 1993 at a cost of Rs 653,000. Although the dam in Bharauli was built in 1990 the dam became functional only in 1995/96 after repairs had been made to it. The catchment area of the dam at Bharauli is 39 ha, while the area of the dam at Thadion is 15 ha. Further, the command area of the dam at Bharauli is 40 ha compared to 20 ha at Thadion. Thirty-five households benefit from irrigation from the dam in Bharauli, while fifteen households benefit from dam assisted irrigation in Thadion.

Alternative Irrigation on Dam-irrigated Land

None of the water-using households in Bharauli have access to private tubewells as an alternative source of irrigation for dam-irrigated land. In Thadion, by contrast, there are seven tubewells and 53 percent of water users have access to them.[7] From figure 2 it is possible to discern that there are four distinct ecological zones: zone 1 groundwater can be tapped at a depth of between 200 to 300 feet compared to Zone II, where the depth is approximately 50 feet. In Zone III groundwater depth is in the range of 150-200 feet while in Zone IV groundwater can be struck in the range of between 25-30 feet. Drilling costs which are a major factor in farmer's decisions to establish tubewells vary between Rs 18,000 to reach a depth of 25 feet and Rs 50,000 to reach a depth of 100 feet. It is not surprising, therefore, that all seven tubewells in Thadion are located in Zone IV.

Water Transport

Water is transported by plastic pipe from earthen dams. The pipes are buried about 3 feet in the ground. At strategic locations in the command area, vertical exit valves are placed. At the ends of the plastic pipeline, farmers dig artificial water courses to transport water to their fields. Water transport is dependent on gravity flow and usually has to crisscross several fields. As a result, water transport in some cases involves negotiations between farmers to facilitate the digging of channels to divert water towards their fields. Here, locally embedded notions of a fair allocation are critical to avoiding conflicts. Large farmers with plots located at different points in the dam command have to balance their interests for water with those of small landholders.

Water Use Rules

Water in earthen dams is harvested during the monsoon period (June to September). Harvested water is then used during the *rabi* season primarily for the wheat crop. Water users in Bharauli are charged Rs 20 per hour of water used from the dam compared to Rs 10 per hour in Thadion.[8] Three to four rounds of watering are possible in both Bharauli and Thadion. Rules stipulate that water allocation should take place on a rotational (hourly) basis for the wheat crop.

[7]Tubewell density in Thadion is 2.8—i.e., seven tubewells in a command area of 20 ha.

[8]In another paper we argue that a higher water rate in Bharuali reflects a higher economic value that farmer's place on supply of water from earthen dams in the absence of private alternatives like tubewells (Kurian and Dietz 2004).

During each round farmers whose lands are situated closer to the dam are supplied water first, after which water is released for use by farmers farther down the distribution channel.[9]

Discussion of Study Findings

This study posed three sets of research questions. First, to what extent does the institutional contract for co-management of land and water resources ensure attention to issues of transparency and accountability in watershed management. Second, how does the institutional contract for co-management of watershed resources influence provision of irrigation services and third, how does success with irrigation service provision influence distribution of benefits and costs within the farmer groups. The discussion in sections on “Overview of the Study Area and Project Descriptions” and “Data and Methods,” respectively, addressed the first research question. In this section we address the second and third research questions.

Group Composition, Service Provision and Effectiveness of Water Management

Our discussion in the section on “Overview of the Study Area and Project Description” highlighted the pro-poor features of a co-management contract in Haryana. An important feature of the co-management contract included modalities for private sector participation in watershed management. In this section we examine how modalities for private sector participation influence provision of irrigation services in a watershed context. In subsequent subsections we examine to what extent economy-wide benefits of success with water provisioning are pro-poor in their distribution.

Our survey of eight HRMS with functioning dams indicates that groups that were relatively heterogeneous in distribution of nature-based endowments tended to facilitate the emergence of water contractors.[10] Further, evidence suggests that provision of irrigation services tended to be more effective in terms of water allocation, collection of ISF’s and routine maintenance when under contractor management than when under HRMS management.[11] Our case study of Bharauli HRMS, under contractor-based irrigation service provisioning highlights the underlying reasons for such success.

[9]We may recall from earlier in the discussion that a system of tradable water shares was introduced by the JFM project. This meant that landless households in particular who did not have a need for irrigation water could sell their share of water to other households. But our study indicates that the system of tradable water shares was not being implemented in Bharauli.

[10]Our survey found that of the eight HRMS with functioning dams, only five showed evidence of service provision. Four of these groups were heterogeneous and three of them were under contractor-based service provision. Of the three groups that failed in service provisioning two were homogeneous groups and both of them were under HRMS provisioning (for a detailed discussion see Kurian et al. 2003; Kurian et.al. 2004).

[11]In another paper we point out that in the absence of a sufficient number of cases (only 8) it is impossible to statistically test the relationship between group composition and service provision. We also caution that in the absence of an individual with leadership qualities, even group heterogeneity may have been insufficient to provide effective water provisioning. Therefore, specificity of local conditions means that is difficult to generate blueprints for collective action (see Kurian and Dietz, 2004; Pottete and Ostrom, 2004).

Group Composition and Mode of Service Provision

Our examination of coefficient of variation of variables used in construction of a composite household endowment score[12] for two data sets from 1996 and 2000 in Bharauli supports our contention regarding group composition and service provision. Two factors merit particular attention (table 1).

- Group heterogeneity in Bharauli is greater than in Thadion at both points in time (1996 and 2000)
- Bharuali appears to be becoming more heterogeneous over time while Thadion is becoming more homogeneous

A useful way to understand reasons behind such trends in group heterogeneity is to examine each of the four variables that went into calculations of household endowment scores. We estimated the coefficient of variation of each of the following variables: average land irrigated, average size of rain-fed land owned, livestock composition and average family size.We observe that patterns of variance are comparable for all variables except for average irrigated land (table 2). We, therefore, argue that the land area irrigated by the earthen dam in Bharauli had the greatest explanatory power for understanding trends captured in the movement of endowment scores for both water user groups.[13]

An important observation may be made in this context: the level of group heterogeneity in Bharauli was increasing because although a greater proportion of water users (compared to Thadion) were receiving water from the dam, not all their plots were being irrigated. In such a situation, factors like location of plots in relation to the earthen dam play a crucial role in determining what proportion of a farmer's total plots may be irrigated. By contrast, in Thadion proliferation of tubewells offered water users an alternative source of irrigation. As a result

TABLE 1.
Changes in Household Endowment Scores in HRMS.

HRMS	Distribution of household endowments in 1996	Distribution of household endowments in 2000
Bharauli	61.4	69.1
Thadion	46.6	33.6

TABLE 2.
Co-efficient of Variation for Variables Used in Calculation of Endowment Scores.

Variable	Co-efficient of Variation (Bharuali)	Co-efficient of Variation (Thadion)
Average Irrigated Land	83.3	64.1
Average size of Land Owned	51	55.1
Average Number of Livestock	82.6	86.6
Average Family Size	40	45.7

[12]For a detailed description of methodology for construction of household endowment scores see Kurian and Dietz, 2004.

[13]In the absence of alternative sources of irrigation in Bharauli the relationship between total land area under irrigation and that which benefits from supply of water from the dam can be examined in a relatively straight forward manner. To test the explanatory power of dam-assisted irrigation we ran a regression using total land area irrigated (Dependent Variable) and area irrigated by dam (Independent Variable). We found a robust relationship between both variables.

water user's plots situated at a distance from the dam distribution network could still receive irrigation from tubewells. This explains why with an expansion of tubewell irrigation, the level of group heterogeneity was declining over time in Thadion.

Increasing group heterogeneity in Bharauli in the absence of access to tubewell irrigation has made certain farmers relatively well endowed in comparison to others in the water user group there. In particular, we found that household No. 54 had a particular interest in ensuring effective water provisioning. This was because all his farm plots were scattered at the end of each of the three distribution channels of the dam. His emergence as a water contractor in Bharauli was facilitated by the absence of other farmers of comparative wealth and power[14] (Vedeld 2000).

Effectiveness of Water Management—A Comparison of Bharauli and Thadion HRMS

A. *Collection of Irrigation Service Fees*

In the previous section we pointed out that relatively heterogeneous groups had the potential to facilitate contractor-based irrigation service provision. In this section we turn to examine how water management from earthen dams under contractor-based service provision fared when compared to provisioning under a community organization (HRMS). To do this we examined three aspects of water management: Collection of ISF's, water allocation and contributions towards routine maintenance of earthen dams.

Household surveys in Bharauli revealed that 91 percent of dam users received water for 4–5 months during the *rabi* season (winter season) compared to only 28 percent of water users in Thadion. Therefore, one may argue that due to the assured supply of water from the earthen dam and a sense of fairness associated with water distribution water users in Bharuali adhered to rules of payment of water fees to the contractor. We observe that in 1995–1996 the HRMS monitored water distribution from dams in Bharauli and Thadion. In Bharauli water users complied with payment of hourly water charges of Rs 20 while in Thadion compliance was nil although water user charges were lower at Rs 10 per hour. In the 1996–1997 too, both dams were under HRMS management and the trends with compliance with user charges were similar. In 1997–1998 both HRMS adopted contractor-based water provisioning. In Bharauli the contractor paid the lease amount of Rs 3,000 to the HRMS, whereas in Thadion the contractor failed to do so. However, due to poor rains that year the contractor could not net a profit from water sales in 1997.[15]

In 1998–1999 both water user groups adopted contractor-based provisioning once more. In Bharauli the contractor paid up the lease amount to the HRMS while in Thadion three individuals who combined to bid for the purchase of lease rights could only pay 22 percent of the lease amount pledged to the HRMS. That same year higher levels of compliance with payment of water user fees enabled the contractor in Bharauli to net a profit of Rs 7,500. The same trend was repeated for 1999–2000, but in Thadion a history of noncompliance with water user charges resulted in reversion to HRMS water provisioning. But by 1999–2000 repeated failure of the institutional mechanism for managing the dam in Thadion led to siltation of the dam in the village.

B. *Water Allocation Rules*

We adapted Ostrom's use of "water availability difference" to examine predictability in availability of water among peasants at the head-end and tail-end of the dam distribution network (Ostrom

[14]Our analysis also indicates that historically the water contractor has enjoyed an influential position in the village power structure—being a source of credit and representing Bharuali in the *panchayat* (or local government) (for a discussion see Kurian et. al. 2003).

[15]Mean annual rainfall in the study area declined to 1,188.5 mm in 1997 compared to 1,395.8 mm and 1,372.7 mm in 1995 and 1996, respectively (Central Soil and Water Conservation Research and Training Institute Research Centre 2000).

1994: 552).[16] The difference in predictability of water supply between head-end and tail-end peasants was lower in Bharauli than in Thadion (table 3). This finding indicates a higher level of effectiveness associated with lower level of conflict among farmers and greater clarity about water use rules.[17]

Another indication of the effectiveness of the water distribution system is the difference between average water requirement and water availability. Based on rule of thumb calculations of water requirements during the *rabi* season and mean land sizes we arrived at the difference between water requirements and water availability.[18] In Bharauli relatively more effective water management rules guaranteed water access to a relatively large number of households from the dam. This is reflected in the fact that both head and tail-end water users enjoyed more or less similar levels of confidence that they would receive their share of water from the dam. In Thadion, by contrast, because head-end households tended to monopolize use of water, the difference between water availability and requirement is double. Greater effectiveness of water use of the water-harvesting dam is also reflected in the expansion of the Bharauli distribution network. In response to higher profits from water sales, the water contractor responsible for water distribution expanded the distribution network in 1999/2000 to provide irrigation to 15 additional households. As a result, a total of 7.9 hectares was brought under irrigation.

TABLE 3.
Level of Predictability in Access to Water from Earthen Dams.

HRMS	Water Predictability among Users at Head of Distribution Network	Water Predictability among Users at Tail of Distribution Network	Difference in Water Predictability Between Head-End and Tail-End Users
Bharauli	1.8	1.3	0.5
Thadion	1.7	0.1	1.6

[16]We allotted weights to qualitative assessments of how predictable farmer's access to water from earthen dams was in Bharauli and Thadion. By predictable we refer to how confident a farmer was that the dam water user with a plot adjacent to his would release water to him for his use. Accordingly, we allocated weights depending on whether a farmer's access to water was high (2), medium (1) or low (0). The values that we arrived at for Bharauli and Thadion HRMS represent an aggregation of individual farmer responses to our query on level of predictability in access to water from earthen dams.

[17]Discussions in Thadion revealed that two households removed distribution pipes to level their fields and never replaced them. In response, Somnath, a large landholder, installed a siphon and pumped water out from the dam to his field using a circuitous route. Pumping water using a siphon can silt the dam, and so other farmers rejected this idea. As a result, Amarjeet, Somnath's uncle pledged to siphon water and desilt the dam regularly using his own funds. Amarjeet began charging farmers a fee to siphon water to their fields on the pretext of recovering his investment for dam de-silting works that he planned to undertake. However, in reality he did not undertake de-silting work on the dam as he had promised. Somnath rejected this practice and began a parallel scheme of water siphoning. Somnath pledged that he would stop a parallel scheme of water siphoning only if his uncle began de-silting work on the dam. The continuing conflict between these two individuals led to eventual silting of the dam in March, 2001. As a result access of the other 13 households to water from the dam was compromised.

[18]During a period of normal rainfall three waterings are required for a wheat crop.Four hours are required to water 0.405 hectares of wheat crop from the dam.Mean land size among water users in Bharauli is 1.9 hectares. Therefore, mean per-capita water requirement for wheat for water users in Bharauli is 18.8 hours (4.7 x 4).But in 1999-2000 a total of 555 hours of water was supplied in Bharauli at a mean per-capita rate of 16.1 hours.In Thadion mean land size is 2.3 hectares.Therefore, mean per- capita water requirement for water users is 23.2 hours (5.8 x 4).But in 1999-2000 a total of 479 hours of water was supplied in Thadion at a mean per capita rate of 32 hours. This leads us to conclude: 1. that per-capita use of water from the dam in Thadion was higher largely due to greater demand for irrigation to augment supply from private tubewells for paddy cultivation in the wet season and 2. That a larger number of farmers in Thadion could potentially benefit from dam-assisted irrigation for wheat cultivation in the dry season if water is not used to irrigate paddy during the wet season.

In Thadion by contrast, proliferation of tubewells lead dam water users to utilize water from the earthen dam to cultivate paddy.[19] Farmers with access to tubewells tend to view earthen dams as a supplemental source of irrigation for rice cultivation. Households belonging to a single extended family (*gotra)* with farm plots located at the head end of the irrigation system monopolize water use thereby depriving other households of their share during the *rabi* season. Households without access to tubewells, as we pointed out earlier are adversely affected by conflicts at the head-end of the irrigation system because their ability to raise crops other than rice to meet household food requirements is curbed.[20]

C. *Participation in Repair and Maintenance of Earthen Dams*

We find that peasants in Bharauli cooperate with the contractor in undertaking routine maintenance activities. In Bharauli between 1995 and 2000 the mean number of labor days contributed towards maintenance of the distribution network was 3.7 compared to 2.3 in Thadion. Further, the mean monetary contribution towards maintaining the distribution network was Rs 377 compared to Rs 156 in Thadion. Greater success with routine maintenance of dams may be explained by a historically defined labor exchange system. We find that in many cases landless households who were recipients of credit and grain from the water contractor during periods of droughts in earlier years offered their labor to undertake repairs of dams. Very often their services are not paid for in cash but are adjusted in the form of credit or grain that they received during distress periods.[21]

Economy-Wide Benefits of Success with Contractor-Based Water Provisioning—What Evidence of a Pro-Poor Distribution?

We observed in the previous section that irrigation service provision was more effective in Bharauli when compared to Thadion. The relatively greater success in the management of the dam in Bharauli could be attributed to the absence of alternative sources of irrigation like tubewells, scattering of water contractor's plots at the tail end of the distribution channels and the absence of factional conflicts among wealthy landholders. Such a situation enabled a well endowed individual from among the water users to undertake a leadership role in monitoring water distribution, collection of service fees and undertaking of routine maintenance work. But did relatively greater success with watershed management in Bharauli guarantee sufficient attention to pro-poor concerns? In other words did the distribution of economy-wide benefits from watershed management favor traditionally marginalized groups like the landless, marginal landholding households and women? In this section we attempt to answer this question by stratifying the Bharauli water user group and examining the distribution of economy-wide benefits from watershed management.

[19]It must be noted that farmers who did not own a tubewell purchased water from those who owned tubewells, thereby effectively spreading the influence of tubewell irrigation to all households with farm plots located at the head end of the irrigation command of the earthen dam. Expansion of tubewell irrigation in Thadion was reflected in a higher percentage of households (46.6%) cultivating paddy compared to only (9%) of households in Bharauli.

[20]In addition to equity aspects studies in India have also highlighted the adverse environmental effects of unbridled tubewell expansion that has taken place in the context of state subsidies for purchase of inputs like diesel and hardware such as pump-sets (Shah1993). The negative equity and environmental effects of tubewell proliferation has the potential to undermine the collective action in watershed management.

[21]For a discussion on inter-locking factor markets in Haryana (see Bardhan 1984:61).

A. *Stratifying Water User Groups*

Stratification of groups is one way in which the distribution of benefits from watershed management can be understood. We used scatter diagrams to examine the distribution of households in terms of their ownership of endowments. Based on the scatter diagram we stratified water user groups into three endowment categories: low (0–9.9), medium (10–19.9) and high (20–40).We observed that in Bharauli 3 households are located in the high endowment category, 23 households in the medium endowment category and 9 households in the low endowment category.[22] On the basis of stratification we examined the distribution of benefits by focusing on four aspects:

- Agricultural Production Strategies
- Nonfarm Income
- Irrigation Access and Status of Women
- Access to Forest Resources in Catchment Areas

B. *Agricultural Production Strategies*

Cropping patterns. The main agricultural crops grown in Bharauli watershed are wheat, paddy, corn and radishes. Corn and paddy are grown during the kharif season, which extends from mid-June to October. Wheat and radishes are primarily grown during the rabi season, which extends from November to April. Paddy requires large quantities of standing water, in contrast to corn, wheat and radishes, all of which use smaller doses of water at particular periods during the growth cycle in order to retain productivity. We observed differences in cropping patterns across endowment clusters in Bharauli. For instance, we noted that households in the lower and middle categories raise corn, wheat, paddy and radishes. Households in the high category in Bharauli , however, raise corn, wheat and radishes, but do not cultivate paddy.

Labor hiring. Farmers' cropping preferences influence their patterns of labor hiring. For instance, peasants in the high endowment category in Bharauli hire labor during the winter season to harvest wheat and radishes. This is probably explained by the fact that peasant households in Bharauli cultivate both wheat and radishes, which must be harvested at the same time in the month of April. With relatively smaller families (average of four) family labor alone would be unable to perform the harvesting operations.

There is also an interesting difference in the type of labor hired in Bharauli. In Bharauli we find a greater reliance on female labor, especially during the harvesting of paddy. Interestingly though, most of the labor for on-farm operations comes from outside the village. Interviews revealed that laborers from the state of Bihar arrive during the harvesting period and accept lower wages than village residents. Landless households in Bharauli, on the other hand, find it more remunerative to take daily wage jobs in nearby towns.

Crop productivity. The per acre productivity of wheat is highest among households in the high endowment category in Bharauli. In fact, households in the high endowment category had the largest area under irrigation. A large aggregate area under irrigation by dams was identified by the higher cropping intensity, per acre application of fertilizers and use of hired labor (table 4).

Agricultural returns. The total returns to agricultural activity are a function of price, per acre productivity and acreage. In the Panchkula district, farmers receive similar prices for most major agricultural crops. Therefore, returns are primarily a function of per acre productivity and acreage. In Bharauli agricultural returns[23] were consistently higher for peasants in the high endowment cluster for all crops with the exception of returns to the radish crop.

[22]In this context it is important to note that water users in Bharauli and Thadion do not practice share-cropping.

[23]Higher agricultural returns have been aided by secular increases in agricultural terms of trade for wheat and maize, two principal crops grown in the region (GoH 2000).

TABLE 4.
Cropping Intensity and use of Inputs in Bharauli Micro-Watershed.

Endowment Category	Cropping Intensity Rate	Per Acre Fertilizer Application(kilos)	Percentage of Households Hiring in Labor	Area Irrigated by Earthen Dam(in acres)
High	196.0	216.6	100	3.0
Medium	175.4	211.1	66.6	2.1
Low	185.7	191.5	60.0	1.2

In the case of radish, despite the fact that households in the high endowment cluster devoteda larger percentage of their land to cultivate radishes, their returns from this activity were in comparison lower to other crops. This is probably explained by lower per acre productivity. We may recall from our earlier discussion that households in the high endowment category resorted to labor hiring for farm operations during the busy month of April when both wheat and radishes are harvested. One may speculate that lower labor productivity associated with the use of hired labor instead of family labor is responsible for the lower per acre productivity of radishes on farms of peasants in the high endowment category.[24]

Farm-based income. Income from the sale of agricultural crops and from animal husbandry may be included under farm-based income. In Bharauli, mean farm-based incomes are the highest for households in the high endowment cluster. Livestock incomes constitute 7.1 percent, 15.8 percent and 27 percent of farm-based incomes, respectively, for households in high, middle and low endowment clusters. This suggests that diversification into livestock rearing is a strategy adopted by relatively poorer households to guard against the climate-based risks associated with reliance on smallholder agriculture (Ellis 1998).

C. *Do Nonfarm Incomes Favor the Rural Poor?* Our analysis indicates that farm-based incomes tended to favor wealthier landholding households. In the ensuing discussion we ask if nonfarm incomes discriminate in favor of poorer households to compensate for the bias that farm-based incomes have towards wealthier land-holding households. Our analysis indicates that nonfarm employment exhibits great variety. The main types of nonfarm jobs in the area are stone quarrying, truck driving and employment in government departments like water supply, electricity and public works. Other nonfarm sources of income include family transport business and pensions for aged persons and retired army personal. In Bharauli 44 percent of nonfarm jobs involved employment in government departments like water supply or the electricity department. Stone quarrying accounted for a further 33 percent of nonfarm income in the village, while the rest was accounted for by government pensions, truck driving and daily wage employment in nearby towns.

In Bharauli, 66 percent of government sector jobs were captured by households in the low endowment category. Similarly, 88 percent of the stone quarrying jobs in the village were undertaken by households in the low category. The lone truck-driving job was undertaken by a household in the high endowment category. Two of the daily wage jobs, involving work in house construction in nearby towns, were undertaken by households in the low income category. It is important to note in this context that most of the nonfarm jobs involved low-level skills and training and, therefore, posed few entry barriers for

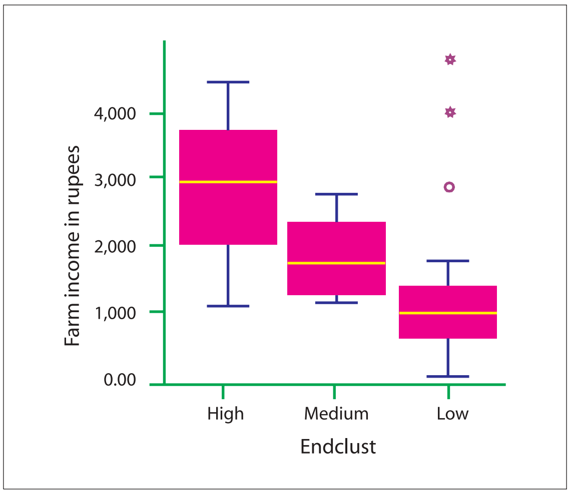
[24]We acknowledge this to be a weakness of the study design as a result of which it is difficult to assert that family labor has potential to increase per acre productivity in contrast to hired labor.

households. Our analysis indicates that nonfarm incomes contribute immensely to household income, especially for low and medium category households in Bharauli. In fact, nonfarm income constitutes 28.9 percent of income for high endowment category households, 44.4 percent for medium category households and 60 percent for low endowment category households.

Considering the importance of nonfarm income in sustaining the livelihoods of rural households it is pertinent to ask “To what extent does nonfarm income influence patterns of rural income inequality?” Our analysis indicates that nonagricultural incomes can potentially reduce inequalities in the distribution of household incomes. The inequality-reducing potential of nonagricultural income is reflected in the transformations shown in the box plot of farm-based income (figure 3). The mean of the distribution moves up marginally while the number of outliers decreases from three to two. Also noticeable is that the range of incomes increases among the low category households, although the mean income level drops marginally. In the medium category, the mean level of income actually increases. In the high endowment category, the mean level of income drops when nonfarm incomes were taken into consideration. However, we must concede that despite the inequality-reducing impact of nonfarm incomes, the overall distribution of total income still favors households in the high endowment category.

The landless laborer and nonfarm employment. Our analysis of nonfarm incomes reveals that nonfarm income definitely reduces level of inequality in the distribution of total household incomes. However, the overall distribution of total incomes still favors households in the high endowment category. In other words nonfarm incomes do not discriminate in favor of poorer households to the extent that they can compensate for the bias that farm incomes have towards wealthier households. There are two striking features of livelihoods of landless households. First, a larger proportion of landless households (about 45%) rely on daily wage jobs, which are low paying when compared to jobs engaged in by low endowment category households (table 5). We noted earlier on that 66 percent of government jobs and 88 percent of stone quarrying jobs, both of which were relatively high paying were undertaken by low endowment category households. By contrast only 35 percent of landless households had access to stone quarrying jobs.

FIGURE 3.
Nonfarm income and rural inequality in Bharauli HRMS.



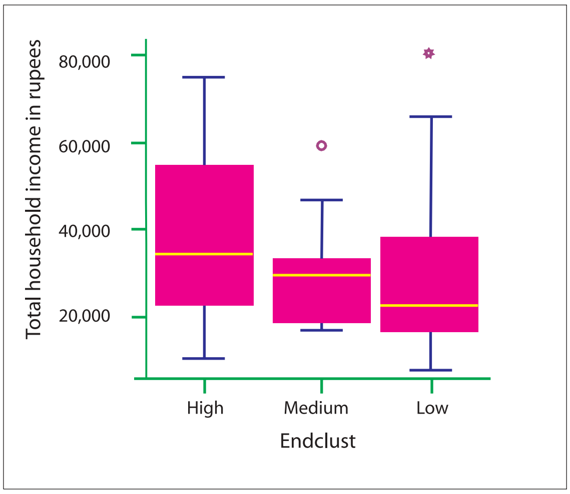


TABLE 5.
Annual Returns on Nonfarm Jobs in Study Area.

Job Type	Availability of Employment	Annual Returns in rupees
Stone quarrying	8 months, for 20 days in a month, at a wage of Rs 75 per day	18,000
Government service	12 months at Rs 2,000 per month	24,000
State pension	12 months at Rs 200 per month	2,400
Daily wage	8 months, for 20 days in a month, at a wage of Rs 60 per day	9,600
Truck driving	12 months at Rs 100 per day for 30 days in a month	36,000

A second feature in the livelihoods of landless households is the increasing competition they are facing from agricultural laborers. Two factors probably influence competition for farm jobs. First, employment is available for only a brief period during the harvest. The number of days that employment is available throughout the year does not exceed 40. As a result, landless households prefer to work outside the village rather than take up agricultural jobs during the harvest season. Second, as noted earlier, migrant labor from Bihar are prepared to work for lower wages than local labor, thus making them a more attractive proposition for households hiring in labor. Sheila Bhalla (1999) in reviewing changes in the workforce composition in rural Haryana makes the following points:

- The latest rural labor inquiry suggests that in 1987/1988, 67 percent of rural labor in Haryana cultivated land. Similar figures ranged between 7 percent and 8 percent in the preceding decade. What has happened is that members of households that had previously stuck mainly to cultivation accepted jobs as hired agricultural laborers in large numbers.

- In the decade ending in 1991, demographic pressure reduced the number of men who reported their main work as cultivation by some 6 percent. Simultaneously, the agricultural labor group grew by more than 4 percent.

- In Haryana the rapid expansion of demand for hired laborers that characterized the early years of the Green Revolution, attracted a surge of workers from small farm households who had entered the hired labor market. By 1972/1973, this trend had become a major source of grievance for the landless, who complained thatlanded households “were taking their jobs” (Bhalla 1999: 47–48).

D*. Irrigation Access and Status of Women*

Our analysis of the livelihood strategies of relatively poorer landless households reveals increasing competition with landed households for nonfarm jobs that have traditionally been the bastion of the landless. In other words, nonfarm incomes do not discriminate in favor of poorer households in a manner that compensates for the bias that farm-based incomes inherently have towards wealthier households. Our analysis indicates that women, another traditionally marginalized group, especially drawn from poorer households, suffer from higher workloads as a result of the higher agricultural productivity associated with improved access to irrigation from earthen dams. Focused group discussions indicate that women make more trips transporting fodder grass from fields to their homes when compared to men. Second, when decisions are made to increase cattle herd sizes to maximize returns from the sale of milk, women end up spending more time feeding and bathing cattle. Third, unlike grass from forest areas, fodder grass from agricultural fields has to be threshed in a machine before it is fed to livestock. Women's involvement has increased in this task and will rise with an increase in fodder grass production from agricultural fields.[25]

Notwithstanding the increased workload of women there are limited avenues open to them to renegotiate a redistribution of benefits and costs arising from participatory watershed management. This is because women are effectively excluded from participation in decision making forums relating to the management of earthen dams. They are not invited to meetings of the HRMS and their membership status in community organizations remains unclear. Even if they do attend meetings organized by the HRMS, cultural norms that prescribe that it is improper for women to speak up in front of men effectively relegate their views on natural resource management priorities to the back burner. This was reflected in the expenditure patterns of HRMS that predominantly reflected male priorities (construction of temples and meeting halls for elders from which women are excluded) as against women's priorities like the repair of village school and the provision of drinking water on taps.[26]

E. *Access to Forest Resources in Catchment Areas*

Irrigation and Fodder Grass Production on Private Fields. Earlier on in the discussion we emphasized that one of the core assumptions guiding the Haryana Forest Department's decision to construct earthen dams was that it would facilitate increased fodder grass production on private fields. Increased fodder production could facilitate greater dung production by facilitating livestock rearing. Greater dung production presumably would reduce fuelwood collection from state forests for cooking purposes.

In order to understand whether irrigation provided by earthen dams induces peasants to grow fodder grass on their agricultural fields during the rabi period, we ran a linear regression. We found that the potential for fodder grass production was greater on fields with access to irrigation from the dam.[27] We followed up the regression with another to examine the relationship between fodder grass production on private fields and dung production in the winter season. The tables show a positive relationship that suggests that when dam-assisted irrigation is available during the winter period, dung production is also at its all-year high.

To conclude this line of examination, we ran one more regression to explore whether higher levels of dung production had any influence on the intensity of fuelwood extraction during the winter. We found a negative relationship between the level of dung production and intensity of fuelwood extraction from state forests. This implies that households with better access to irrigation in the winter (rabi season) had higher production of dung, which is used as a substitute for cooking fuel. This lowered fuelwood extraction from state forests.[28]

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[25]In the case of fodder grass collection from forest areas as well we found a clear relationship between gender and class. For instance, in the high and medium category of households fuelwood collection is primarily undertaken by male members of the household. However, low and landless categories of households rely on women and young girls to a greater extent to undertake fuelwood collection. This is primarily because male members from approximately 80 percent of landless category households were engaged in low paying nonfarm jobs in nearby towns.

[26]We acknowledge from the point of view of watershed management that attention by community organizations towards the routine maintenance activity may be considered favorably. However, our intention here is to highlight the fact that when women are not adequately involved in decision making when it comes to watershed management and interventions may offer them limited benefits when compared to men. From the perspective of empowering traditionally marginalized groups like women therefore, such interventions may fare less favorably.

[27]Fodder production refers to both fodder raised as a crop as well as fodder as agricultural residue. In the case of the latter we acknowledge that higher levels of agricultural productivity may result in higher fodder production. Implicit in this assumption is the fact that households in the high endowment category (with demonstrated levels of agricultural productivity) had the potential to achieve higher rates of fodder production on a per acre basis.

[28]Discussions revealed that fuelwood collection from state forests is highest during winter when compared to summer and monsoon seasons.

Irrigation Intensity and Fodder Grass Production on Private Fields. We pointed out earlier in the discussion that household's in the high endowment category had the largest acreage under dam assisted irrigation. However, contrary to the project assumption, that greater access to irrigation would decrease levels of fuelwood extraction from state forests, we found that households in the high endowment group with largest acreage under dam-assisted irrigation were actually extracting greater amounts of fuelwood from state forests compared to households in the medium and low categories (table 6). This finding is explained by three factors:

- Arable land irrigated by earthen dams as a percentage of total irrigated land was the lowest for households in the high endowment category. The percentage of land irrigated by earthen dams as a proportion of total irrigated land was 36 percent, 45 percent and 70 percent, respectively, for high, medium and low endowment category households.
- A relatively larger area irrigated by earthen dams as a percentage of total land irrigated among medium and low endowment households resulted in higher levels of fodder grass production on private fields compared to that on the fields of high endowment households (table 7).
- Larger areas of land irrigated by earthen dams as a proportion of total irrigated land among low and medium categories of households led to comparable increases in dung production between the summer and winter.[29]

TABLE 6.
Irrigation Intensity and Use of State Forests in Bharauli HRMS.

Endowment category	Arable land Irrigated by earthen dam (as a % total land Irrigated	Fuelwood extraction from state forests by season (in kilos per month)			Annual fodder extraction from state forests (in kilos per month)	Dung production by season (summer/monsoon/winter) in kilos per month)		
		Summer	Monsoon	Winter		Summer	Monsoon	Winter
High	36	11.6	15.4	13.9	1,450	8.6	10	21.3
Medium	45	26	3.1	12	1,202	7.5	9.4	18
Low	70	14	6.5	12.9	1,410	5.4	9	15.6

TABLE 7.
Fodder Production on Private Fields Relative to other Sources.

Endowment Category	State Forests (in kilos per month)	Private Fields (in kilos per month)	Local Markets (in kilos per month)[1]
High	1,450	3,500	55
Medium	1,202	3,843	527
Low	1,410	3,671	173
Landless households	831	875	13

Note: 1. Onequintal of dry fodder in local market cost Rs 200 in 2001. Between 1995 and 2001 the price of a quintal of dry fodder increased by Rs 100.

[29]One must remember that in the case of high endowment household's relatively lower percentage of land irrigated (as a percentage of total land irrigated) by earthen dams was not being compensated by higher area under irrigation from alternative sources like seasonal kuhls. Our analysis indicates that the percentage of land irrigated by kuhls as a percentage of total land irrigated was highest for households in the low endowment category. The percentage of land irrigated by kuhls as a percentage of total area irrigated was 63 percent, 60 percent and 88.2 percent for high, medium and low endowment categories of households, respectively.

Conclusions

This report posed three sets of questions. First, to what extent does the institutional contract for co-management of land and water resources ensure attention to issues of transparency and accountability in watershed management? Second, how does the institutional contract for co-management of watershed resources influence the provision of irrigation services? And third, how does success with irrigation service provision influence the distribution of benefits and costs within farmer groups? To answer these questions, a survey of watershed management groups known as HRMS was undertaken in the Shiwalik hills of Haryana.

It was found that the institutional contract for the co-management of land and water resources paid limited attention to issues of transparency and accountability in the initial stages of a Ford Foundation watershed management project in Haryana. The lack of accountable and transparent policy processes was seen in the technical measures relating to design of earthen dams. As a result of poor emphasis on transparent and accountable policy processes, the constructed earthen dams functioned poorly in the post-project phase. This was evident from the fact that 31 percent of all dams constructed silted up within 5 years of construction and another 33 percent within 10 years of their construction. Interestingly, 20 percent of dams that were constructed functioned for less than a year.However, when institutional issues relating to benefit sharing and community consultation inthe construction of earthen dams were emphasized at later stages of the project the lifespan of earthen dams showed a tendency to increase.

Our first conclusion confirms the broadly held view that transparent and accountable policy processes increase the potential for rural communities to participate in the operation and maintenance of physical infrastructure such as irrigation head works, forest catchments and distribution channels. The participation of rural community groups in different aspects of irrigation management may improve the effectiveness of watershed management interventions. This report also concludes that an institutional contract that facilitates transparent and accountable policy processes may potentially increase the number of beneficiaries of irrigation projects. A substantial sub-set of water users with an interest in water use may serve as an incentive for relatively well endowed individuals to participate in provision of irrigation services.

The second conclusion this report draws is that given an institutional contract that promotes co-management relatively heterogeneous community groups were more effective at provision of irrigation services. Effective service provisioning in heterogeneous groups becomes possible through the presence of water contractors and is reflected in orderly water allocation, collection of irrigation service fees and routine maintenance of irrigation infrastructure. By contrast a relatively homogeneous community in Thadion failed to provide irrigation services but instead became embroiled in factional conflict. This finding goes against the grain of findings of previous studies which suggest that heterogeneous groups may not be as adept at cooperation in natural resource management when compared to relatively homogeneous groups.[30]

The third conclusion of this report is that success with service provision need not always ensure a pro-poor distribution of benefits and costs within rural communities. This assertion is supported by the fact that cropping intensity rates, agricultural incomes and productivity increases and acreage under irrigation from earthen dams- all tended to favor wealthier households when compared to poorer households. Although nonfarm incomes tended to reduce levels of inequality in distribution of total incomes, this reduction was not sufficient to

[30]For a review see Poteete and Ostrom 2004; Kurian and Dietz 2004.

change overall income distribution in favor of poorer households. Here, we emphasized the underlying institutional concerns—poor returns on nonfarm jobs, lower agricultural wage rates for women and increasing competition for nonfarm jobs that were traditionally performed by landless households. From the point of view of analysis of distribution of costs arising from watershed management, we found that the workload for women was greater than that of men as a result of the doubling of agricultural yields under irrigated conditions.

Our second and third conclusions cast doubts over assumptions that blue prints for promoting pro-poor community participation in natural resources management are readily available. Our case study reveals that ecological conditions, local leadership and community-based norms of social exchange can all play a role in facilitating community participation. Although blueprints for pro-poor community participation may not be readily available, we may highlight certain principles on such participation based on our analysis of watershed management in Haryana:

- Ensure transparency of policy processes and predictability of institutional contract to foster private sector participation in provision of irrigation services.
- Ensure fairness in benefit distribution to facilitate farmer compliance with irrigation service rules and minimize potential for conflicts over resource use.
- Foster inter-sectoral policy coordination to re-examine the need for state support for private tubewell expansion (*through subsidies*) and to address anomalies in the nonfarm labor market with a view to dovetailing watershed management projects within wider regional programs of poverty alleviation.

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