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Do Participatory Watershed Management Projects Guarantee Sufficient Attention to Pro-Poor Concerns? - An Indian Case Study

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Abstract

In recent years decentralized development approaches have been encouraged to realize the goal of poverty reduction. In the agricultural sector Irrigation Management Transfer (IMT) and Joint Forest Management (JFM) projects have been promoted with a view to improve service provision in a watershed context. Improved service provision it is presumed would improve access of resource poor households to watershed services such as irrigation and Non Timber Forest Products (NTFP's). Improved access to watershed services it is argued would reduce poverty through increases in agricultural productivity and farm incomes. This paper draws on evidence from a post-project evaluation of a Ford Foundation supported watershed management project in northern India 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 in ensuring that water allocation, collection of Irrigation Service Fees (ISF) and routine maintenance of irrigation infrastructure was undertaken. Our analysis of benefit distribution from successful irrigation service provision, however, shows that wealthier land holding households benefited more than poorer households. Cropping intensity rates, farm productivity, acreage under dam assisted irrigation and farm incomes tended to favour wealthier households. Interestingly, although non-farm incomes reduced levels of income inequality they did not alter distribution of total incomes which continued to favour wealthier households. Further, landless households were facing increasing competition for non-farm jobs from marginal land owning households. Women, another traditionally marginalized group in the region were suffering from an increased workload since improved access to irrigation led to doubling of agricultural yields. We also noted that when it came to collecting fuelwood from catchment areas women from resource poor households bore greater drudgery when compared to their counterparts from wealthier households. In conclusion this paper highlights three issues that merit attention from policy makers: choice between policy support for public irrigation systems or private tubewell expansion and its implications for farmer participation in watershed management, expansion of non-farm employment as a way towards reducing inequality in income distribution and removal of institutional biases so that women may benefit from a process of agricultural development.

Key Words

Participatory Watershed Management/Pro-poor/Access to Natural Resources/India

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1. **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 State 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's groups or other private-sector entities (International Water Management Institute (IWMI) 1995:4). Donor supported JFM and IMT projects have encouraged co-management between State 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's 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 though a number of evaluations of watershed projects have pointed out that community participation in watershed management need not necessarily guarantee adequate attention to interests of poor rural households. Studies have documented how powerful land

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

holders 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 point out that land less 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, Beck and Nesmith, 2001). 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 and Mittal, 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 emphasises 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 (Krishna, 2004, Ravallion, 2000). Pro-poor growth is growth that enables the poor to actively participate in and significantly benefit from economic activity (Kakwani, 2000:3). Promoting pro-poor growth requires a strategy that is deliberately biased towards the poor so that the poor can benefit proportionately more than the rich. 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 paper is based on a study of a Ford Foundation supported watershed management project in the Haryana Shiwaliks. Three 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

[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 practiced in large parts of north- west India large land holders 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).

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 (ie. by private individuals or community organization) is more successful in ensuring that effective 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 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 favour of poorer households and sub-groups such as women when compared to wealthier groups?

The following sections of the paper are organized as follows. Section Two provides a profile of the research area and a description of the data base and methodology adopted for the study. Section Three 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. Section Four highlights the main conclusions and policy implications of the study.

2. **Data and Methods**

2.1. *Profile of 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 non-farm 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). Access to non-farm 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. 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.

[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 Ramana, 1996).

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

2.2 *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 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 acknowledgement 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 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 three 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 use of water and thereby increase efficiency 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 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 labourers. Such a provision would enable use of public funds for maintenance of economic and social infrastructure in the village.

2.3. *Rapid Survey of Management of Earthen Dams in Post-project Phase*

Thirty five HRMS were established in Morni-Pinjore Forest Division of Panchkula District in Haryana. These thirty five HRMS were responsible for managing fifty four earthen dams. 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 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 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 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 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% of all dams that were constructed silted up within five years of construction and 33% within ten years of construction *(Table 1*). Interestingly 20% 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 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 five 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 five years increased by fifty percent. Further, the proportion of dams silting up within five years of construction fell from 50% in the previous phase to 21.4%. 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

[5] The eight functioning dams were under the management of 8 HRMS

years from construction. This we argue is because of the failure to ensure catchment stabilization prior to dam construction.

2.4. *Case Study*

Two of the 8 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 review of secondary data on non-farm 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. Socio-economic data was collected using structured interviews, focused interviews and group discussions.

2.5. *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 twenty five households (*Figure 2).* Bharauli HRMS is composed of four different caste groups compared to Thadion HRMS that is composed on only 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 labour 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 labour 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 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, 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 (*Table 2).*

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% 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

[6] Open scrub refers to degraded land in need of rehabilitation through soil and water conservation measures
[7] Tubewell density in Thadion is 2.8- ie., 7 tubewells in a command area of 20 ha.

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 three 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 land holders.

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 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. 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].

[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, 2004a).

[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.

3. **Discussion of Study Findings**

3.1. *Group Composition, Service Provision and Effectiveness of Water Management*

We hypothesized earlier on that an institutional contract that fosters accountability and transparency may facilitate private sector participation in provision of watershed services. Our survey of 8 HRMS with functioning dams indicates that groups that were relatively heterogeneous in distribution of nature based endowments tended to facilitate 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 (*Table 3)* [11]. Our case study of Bharauli HRMS, under contractor based irrigation service provisioning highlights the underlying reasons for such success.

Group Composition and Mode of Service Provision

Our examination of co-efficient 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 4).*

- Group heterogeneity in Bharauli is greater than in Thadion at both points in time (1996 and 2000).

[10] Our survey found that of the 8 HRMS with functioning dams, only 5 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, 2003, Kurian and Dietz, 2004b)).

[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, 2004a, Pottete and Ostrom, 2003).

[12] For a detailed description of methodology for construction of household endowment scores see *Appendix 1*.

- 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 rainfed 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 5)*. 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 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 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.

[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.

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 Service Provision- 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% of dam users received water for four to five months during the *rabi* season (winter season) compared to only 28% 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 (*Table 6*). We observe that in 1995-96 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 1996-97 too both dams were under HRMS management and the trends with compliance with user charges were similar. In

[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).

1997-98 both HRMS adopted contractor based water provisioning. In Bharauli the contractor paid the lease amount of Rs. 3000 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 1998-99 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 lease 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. 7500. The same trend was repeated for 1999-2000 but in Thadion a history of non-compliance 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 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 7*). This finding indicates a higher

[15] Mean annual rainfall in the study area declined to 1188.5 mm in 1997 compared to 1395.8 mm and 1372.7 mm in 1995 and 1996 respectively (Central Soil and Water Conservation Research and Training Institute Research Centre, 2000).

[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.

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 monopolise 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 19.5 acres was brought under irrigation.

[17] Discussions in Thadion revealed that two households removed distribution pipes to level their fields and never replaced them. In response, Somnath, a large land holder, 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 1 acre of wheat crop from the dam. Mean land size among water users in Bharauli is 4.7 Acres. 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 5.8 acres. 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, the proliferation of tubewells lead dam water users to utilize water from the earthen dam to cultivate paddy[19] (*Table 8*). 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.

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 labour 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 labour 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 labour 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[20].

3. 2. *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. Relatively greater success in management of the dam in Bharuali could be explained by absence of alternative sources of irrigation like tubewells,

[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.

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

scattering of water contractor's plots at the tail end of the distribution channels and absence of factional conflicts among wealthy land holders. 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 Bharuali guarantee sufficient attention to pro-poor concerns? In other words did distribution of economy wide benefits from watershed management favour traditionally marginalized groups like the landless, marginal land holding households and women? In this section we attempt an answer to this question by stratifying the Bharauli water user group and examining the distribution of economy wide benefits from watershed management.

A. *Stratifying water user groups*

Stratification of groups is one approach to understanding distribution of benefits from watershed management. We used scatter diagrams to examine how households are distributed based on their ownership of endowments. Based on the scatter diagram we stratified groups into three endowment categories: low (0–9.9), medium (10–19.9) and high (20–40) (*Figure 3*).We observe 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[21]. On the basis of stratification we examine the distribution of benefits by focussing on three aspects:

- Agricultural Cropping Strategies
- Non-farm Income
- Access to Forest Resources in Catchment Areas

B. *Agricultural production strategies*

<u>Cropping patterns</u>

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

[21] In this context it is important to note that sharecropping does not exist among any of the water users in Bharauli and Thadion.

radishes, whose productivity depends on smaller doses of water at particular periods during the growth cycle (*Table 9*). We observe differences in cropping patterns across endowment clusters in Bharauli. For instance, we note that households in the lower and middle categories raise corn, wheat, paddy and radishes. Households in the high category in Bharauli raise corn, wheat and radishes but do not cultivate paddy.

Labour hiring

Farmers' cropping preferences influence their patterns of labour hiring. For instance, peasants in the high endowment category in Bharauli hire labour 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 labour alone would be unable to perform the harvesting operations.

There is also an interesting difference in the type of labour hired in Bharauli. In Bharauli we find a greater reliance on female labour, especially during the harvesting of paddy. Interestingly, though, most of the labour for on-farm operations comes from outside the village. Interviews reveal that labourers from the state of Bihar arrive during the harvesting period and accept lower wages than village residents (*Table 10*). Landless households in Bharauli, on the other hand, find it more remunerative to take daily wage jobs in nearby towns.

Crop productivity

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. Large aggregate area under irrigation by dams was reflected in higher cropping intensity, per acre application of fertilizers and use of hired labour (*Table 11*).

Agricultural returns

Total returns to agricultural activity are a function of price, per acre productivity and acreage. In 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[22] were consistently higher for peasants in the high endowment cluster for all crops with the exception of returns to the radish crop *(Figure 4*).

In the case of radish, despite the fact that households in the high endowment cluster devoted larger percentage of their land to cultivate radishes (*Table 12*), their returns from this activity were lower. 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 labour hiring for farm operations during the busy month of April when both wheat and radishes are harvested. One may speculate that lower labour productivity associated with the use of hired labour instead of family labour is responsible for the lower per acre productivity of radishes on farms of peasants in high endowment category[23].

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 (*Figure 5*). Livestock incomes constitute 7.1%, 15.8% and 27% 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 climate based risks associated with reliance on small holder agriculture (Ellis, 1998).

C. *Do Non-farm Incomes Favour the Rural Poor?*

Our analysis indicates that farm based incomes tended to favour wealthier land holding households. In the ensuing discussion we ask if non-farm incomes discriminate in favour of poorer households to compensate for the bias that farm based incomes have towards wealthier land holding households. Our analysis indicates that non-farm employment exhibits great variety. The main types of non-farm jobs in the area are stone quarrying, truck driving and employment in government departments like water supply, electricity and public works. Other non-farm sources of income include family transport business and pensions for aged persons and

[22] 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).
[23] We acknowledge this to be a weakness of the study design as a result of which it is difficult to assert a that family labour has potential to increase per acre productivity in contrast to hired labour.

retired army personal. In Bharauli 44% of non-farm jobs involved employment in government departments like water supply or the electricity department. Stone quarrying accounted for a further 33% of non-farm 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% of government sector jobs were captured by households in the low endowment category. Similarly, 88% of 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 category. It is important to note in this context that most of the non-farm jobs involved low-level skills and training and therefore posed few entry barriers for households. Our analysis indicates that non-farm incomes contribute immensely to household income, especially for low and medium category households in Bharauli. In fact, non-farm income constitutes 28.9% of income for high endowment category households, 44.4% for medium category households and 60% for low endowment category households (*Table 13*).

Considering the importance of non-farm income in sustaining livelihoods of rural households it is pertinent to ask "To what extent does non-farm income influence patterns of rural income inequality?" Our analysis indicates that non-agricultural incomes can potentially reduce inequalities in the distribution of household incomes. The inequality-reducing potential of non-agricultural income is reflected in the transformations shown in the box plot of farm-based income (*Figure 6)*. 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 we consider non-farm incomes. However, we must concede that despite the inequality-reducing impact of non-farm incomes, the overall distribution of total income still favours households in the high endowment category.

The landless labourer and non-farm employment

Our analysis of non-farm incomes reveals that non-farm income definitely reduces level of inequality in distribution of total household incomes. However, the overall distribution of total incomes still favours households in the high endowment category. In other words non-farm incomes do not discriminate in favour 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 14*). We noted earlier on that 66% of government jobs and 88% of stone quarrying jobs that were relatively higher paying were undertaken by low endowment category households. By contrast only 35% of landless households had access to stone quarrying jobs.

A second feature of livelihoods of landless households is the increasing competition they are facing from agricultural labourers. Two factors probably influence competition for farm jobs. First, employment is available for only a brief period during 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 labour from Bihar are prepared to work for lower wages than local labour, thus making them a more attractive proposition for households hiring in labour. Sheila Bhalla (1999) in reviewing changes in the workforce composition in rural Haryana makes the following points:

- The latest rural labour inquiry suggests that in 1987/88, 67% of rural labour in Haryana cultivated land. Similar figures ranged between 7% and 8% in the preceding decade. What has happened is that members of households that had previously stuck mainly to cultivation accepted jobs as hired agricultural labourers 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%. Simultaneously, the agricultural labour group grew by more than 4%.
- In Haryana the rapid expansion of demand for hired labourers that characterized the early years of the Green Revolution attracted a surge of workers from small farm households

> who entered the hired labour market. By 1972/73, it had become a major source of grievance for the landless, who complained that landed households "were taking their jobs" (Bhalla 1999: 47–48).

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D. *Irrigation Access and Status of Women*

Our analysis of livelihood strategies of relatively poorer landless households reveals increasing competition with landed households for non-farm jobs that have traditionally been the bastion of the landless. In other words, non-farm incomes do not discriminate in favour of poorer households to compensate for the bias that farm based incomes 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 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. Second, when decisions are made to increase cattle herd sizes to maximize returns from 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.

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 management of earthen dams. They are not invited to meetings of the HRMS and remain unclear of their membership status in community organizations. 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 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 repair of village school and provision of drinking water taps[24] (*Table 15*).

E. *Access to Forest Resources from 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.

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 (*Table 16a*). We find that the potential for fodder grass production was greater on fields with access to irrigation from the dam.[25] We followed up the regression with another (*Table 16b*) 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 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

[24] We acknowledge from the point of view of watershed management that attention by community organizations towards 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 watershed management 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.

[25] 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.

irrigation in the winter (rabi season) had higher production of dung, which is used as a substitute cooking fuel. This lowered fuelwood extraction from state forests.[26]

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 project assumption that greater access to irrigation would levels of fuelwood extraction from state forests we find 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 17*). 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%, 45% and 70%, respectively, for high, medium and low endowment category households.
- 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 18).*
- 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.[27]

Forest Dependence and Petty Capitalist Accumulation

Between 1995/96 and 1999/2000 an individual in Bharauli was responsible for leasing out fibre grass extraction rights from forest areas as part of the usufruct sharing arrangement under joint forest management. Rights to fibre grass are leased out at an auction held in May. The contractor

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

[27] 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 were not being compensated by higher area under irrigation from alternative sources like seasonal kuhls. Our analysis indicates that 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%, 60% and 88.2% for high, medium and low endowment categories of households.

then protects fibre grass stands in the forest areas until they are ready for harvest in October. During this period the contractor curbs open grazing in the area, because young fibre grass can be used as fodder grass. In mid October the contractor harvests the fibre grass and sells it to traders who resell it to paper mills.

The important point here is that the person leasing out fibre grass rights in Bharauli belongs to the high endowment category of households. Profits from sale of fibre grass accrue to the contractor after the lease amount has been deposited with the forest department. In recent years though, fibre grass contractors are beginning to sell fibre grass to the local Banjara community (that uses the grass to make rope) and not to paper mills (*Table 19).* This was primarily because in recent years paper mills were switching to use of imported raw materials due to liberalization policies of the government[28]. In Bharauli, the ability of the individual to lease out fibre grass rights is clearly aided by the relatively high level of surplus he commands from irrigated agriculture. We may recall that households in the high endowment category have the highest farm-based incomes.

Further, income from fibre grass sales is achieved by restricting other households' access to the resource. Although in principle the contractor is expected to supply every household desiring fibre grass with two headloads of the grass free of charge, discussions with villagers reveal that in practice this did not happen. Further, theoretically a portion of the sale proceeds go to the HRMS fund, which can be used to undertake development activities that would benefit the community such as construction of pucca roads or repair of school buildings. However, it is evident from inspection of HRMS records that most expenditure involves repairs of the earthen dam. Indeed, what becomes clear is that benefits from public domain forestlands are increasingly being appropriated by wealthy landed households.

<u>Gender, Class and Forest Access</u>

Our analysis of patterns of forest resource extraction reveals a close relationship between gender and class. In other words women from poorer households tend to bear greater drudgery of

[28] For a general discussion of trends in international prices of paper and supply of raw materials by forest departments see Kurian 1998.

fuelwood extraction from forest areas when compared to women from relatively wealthier households. 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 (*Table20*). One may recall that up to 80% of non-farm jobs in Bharauli were captured by households in the low category. Further, male members of landless households were drawn away to work as daily wage labourers in nearby towns. These employment patterns explain to a great degree why women in these households are called upon to shoulder domestic tasks like fuelwood collection.

4. **Conclusions**

In recent years decentralized development approaches have been promoted to realize the goal of poverty reduction. Towards achieving this goal co-management of watershed resources have been encouraged with a view to improving effectiveness of service provision. This paper draws on evidence from a Ford Foundation supported watershed management project in India to ask whether benefit distribution resulting from improved service provision actually favors poorer rural households? This paper concludes that transparent and accountable policy processes of State parastatals can go a long way in encouraging participation of farmer's groups or the private sector in provision of watershed resources. This was evident from our post-project analysis of earthen dams in Haryana; where attention was paid to issues of technical design of dams, community participation was forthcoming for their management.

We also conclude that an institutional contract that is based on transparency and accountability may encourage participation of the private sector in provision of irrigation services in a watershed context. Our case study reveals that factors like presence of a substantial sub-set of water users with an interest in water use, caste-based labour exchange and absence of factional conflict among powerful land holders may result in effective service provisioning by private individuals. Effective water provisioning may be reflected in orderly water allocation, collection of irrigation services and routine maintenance of irrigation infrastructure. However, success with service provision need not always ensure pro-poor benefit distribution. This assertion is supported by our analysis of agricultural production strategies. Here we found that cropping intensity, agricultural incomes, productivity increases and acreage under irrigation from earthen dams- all tended to favour weathier households when compared to poorer households.

We found that although non-farm incomes reduced levels of inequality in distribution of total incomes, they were not sufficient to change overall income distribution in favour of poorer households. Here we pointed to underlying institutional concerns- poor returns on non-farm jobs like stone quarrying, lower agricultural wages for women and increasing competition for non-farm jobs traditionally performed by landless households. We also found that although greater acreage under dam assisted irrigation resulted in greater fodder production in aggregate terms, wealthier households were actually using catchment areas more for fuelwood collection. This we argued was because large land holding households had the smallest irrigated areas as a percentage of total land owned compared to low and medium endowment category households. We also found that women’s workload increased when improved access to irrigation led to doubling of agricultural yields. This was especially the case with collection, transport and threshing of fodder grass from private fields. In the case of fuelwood collection from catchment areas we found that it was women from poorer households who were called upon to perform this task since male members of households were engaged in low paying non-farm jobs in nearby towns.

This paper highlights a number of institutional issues that are merit attention by policy makers. First, policy makers should make an informed choice between encouraging proliferation of private tubewells (through for example, subsidies for kerosene) and promoting co-management of public irrigation systems. Unbridled proliferation of private tubewells could potentially reduce participation of farmer’s groups or private sector in provision of irrigation services from public systems. This could leave resource poor households at the mercy of market forces- characterized by rising costs of tubewell installation and unscrupulous water contractors engaged in water sales. Second, how can access to non-farm income be expanded to reduce levels of income inequality associated that stems from over-reliance on agriculture for a livelihood? Finally, how can deep rooted institutional biases against women, as reflected, for example, in lower agricultural wage rates, be overcome to ensure that the benefits of agricultural development favour traditionally marginalized groups in rural societies?

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Figure 1:The Sukhomajiri Watershed Model

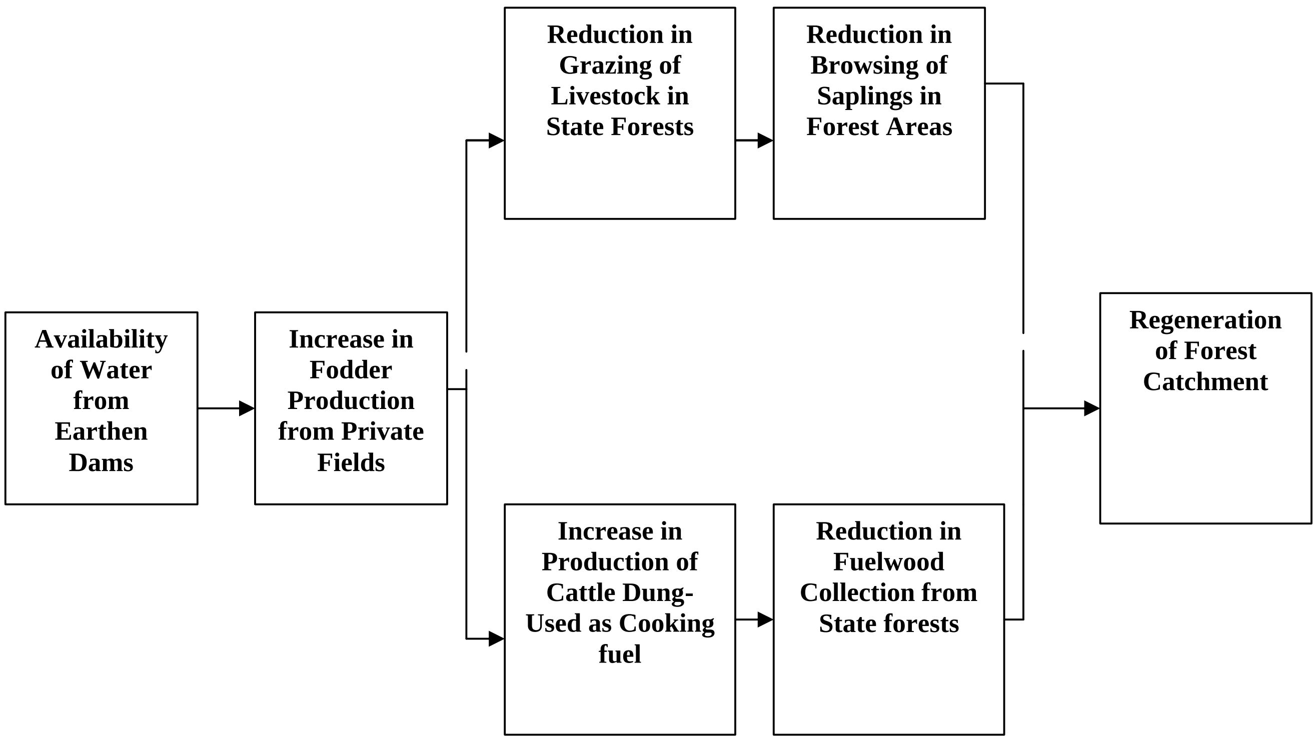


Figure 2: Watershed Areas of HRMS Bharauli and Thadion

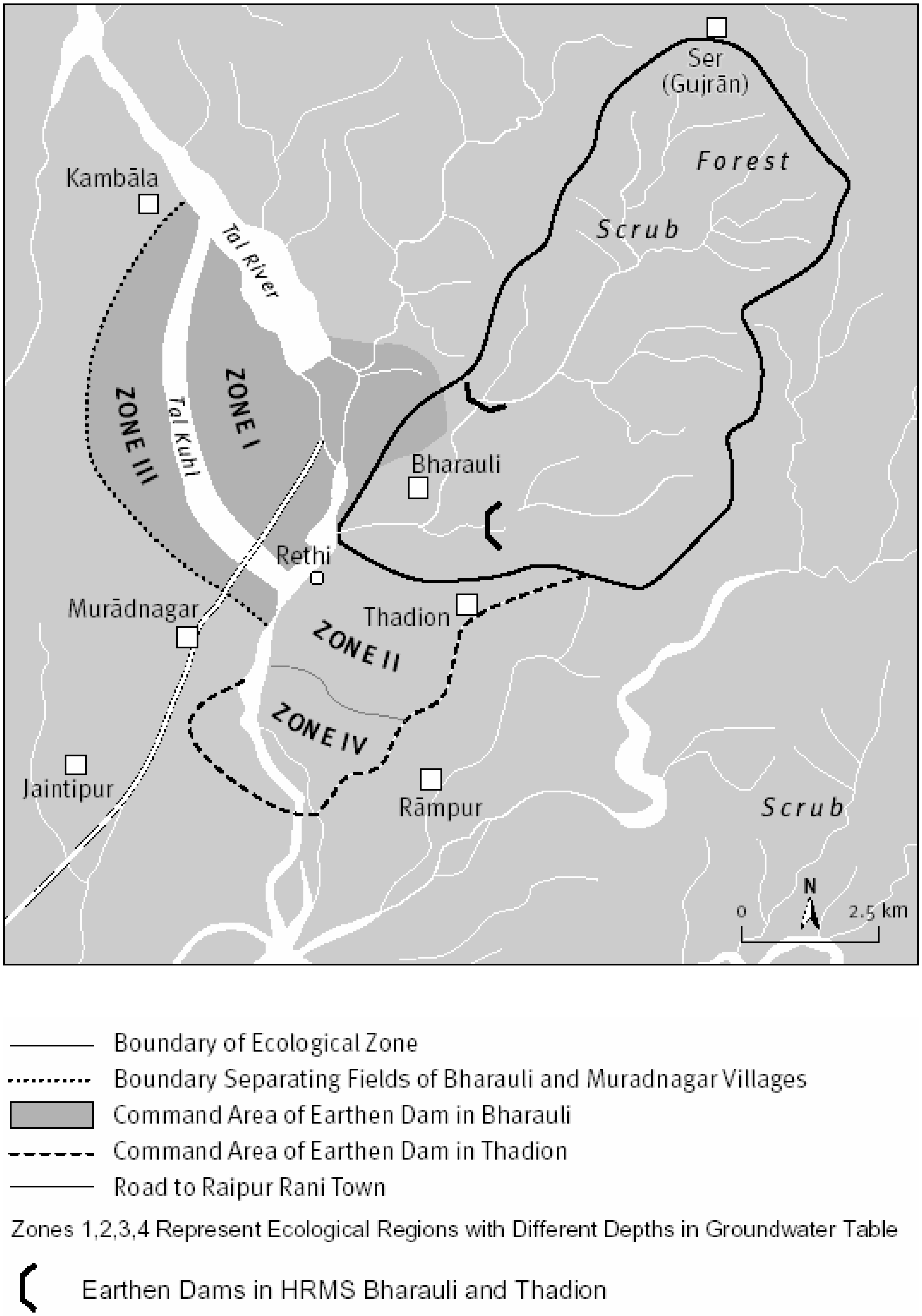


Figure 3: Distribution of Water-Using Households by Endowment Category

Bharauli

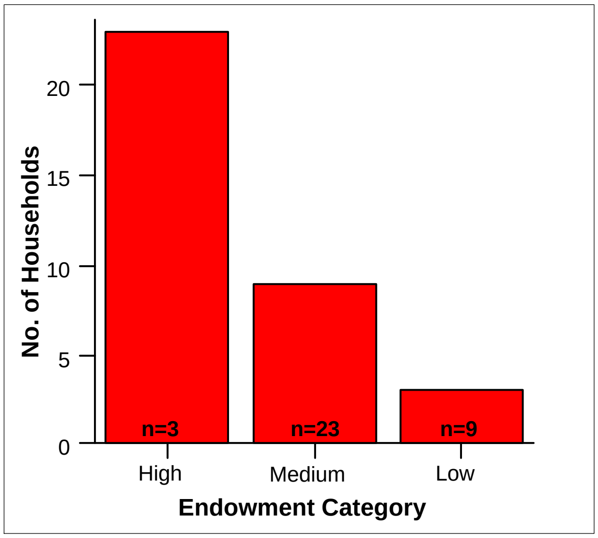


Figure 4: Gross Returns for Major Agricultural Crops by Endowment Category in Bharauli

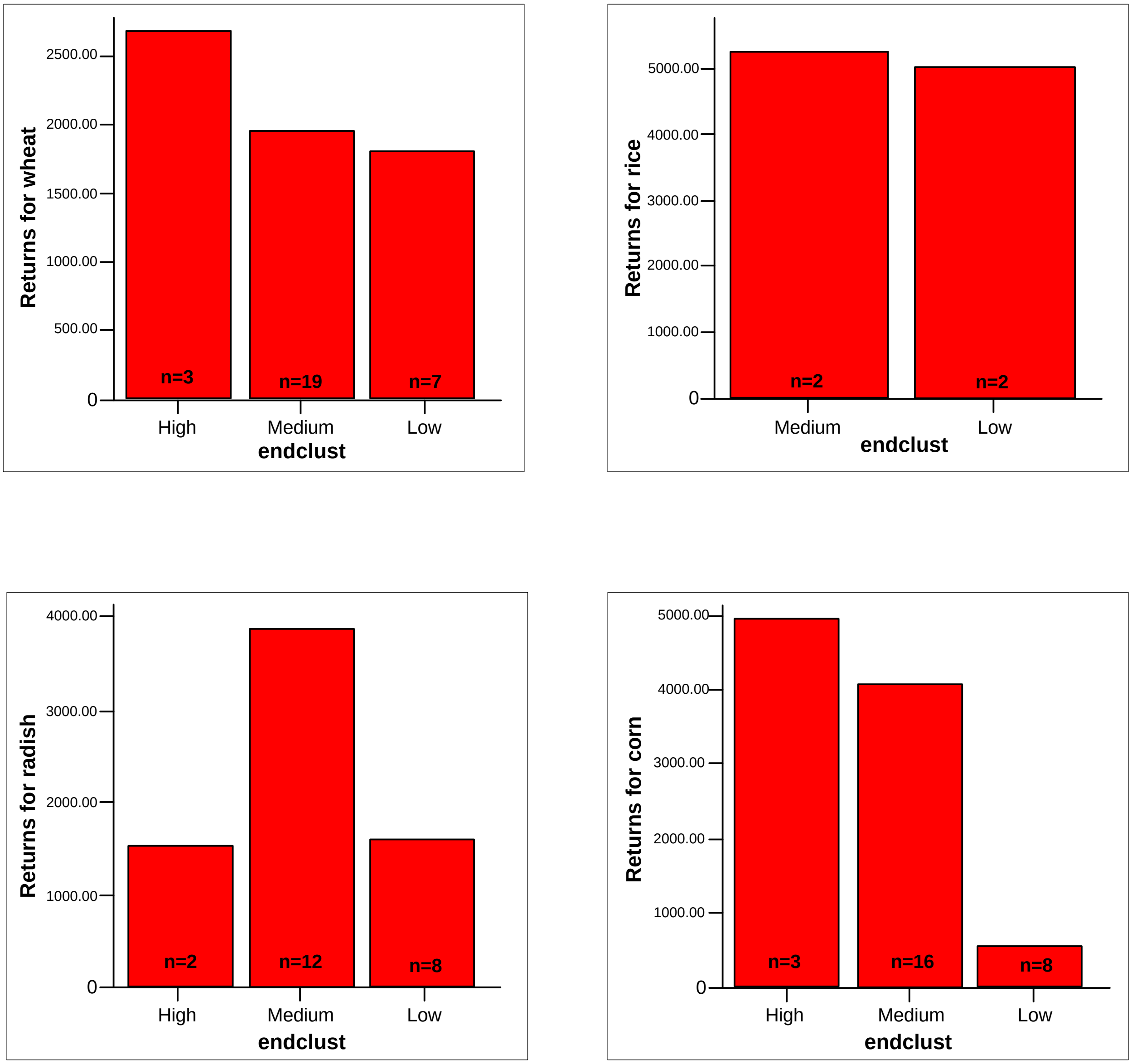


Figure 5: Household Farm-Based Incomes by Endowment Categories, Bharauli HRMS

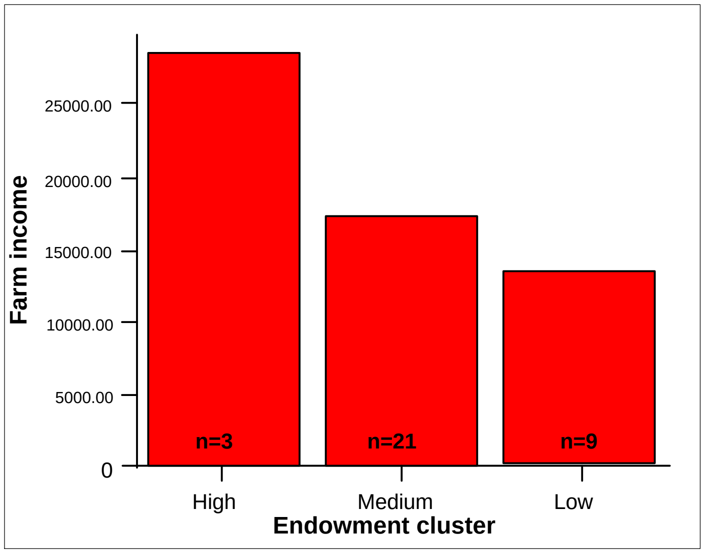
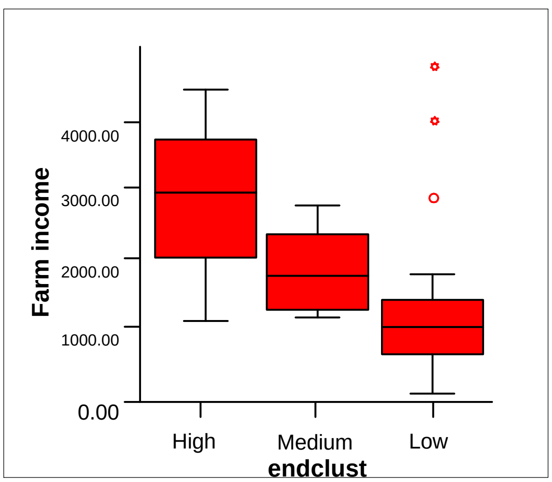


Figure 6: Non-Farm Income and Rural Inequality in Bharauli HRMS



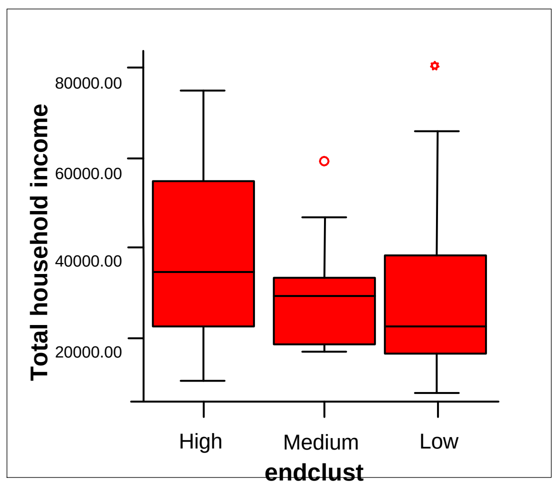


Table 1: Post-Project Analysis of Earthen Dams in Morni-Pinjore Forest Division

Indicator	**Dams for Entire Forest Division**	**Pinjore Forest Range** *(1975-83)*	**Dams for Range**	**Panchkula Forest Range** *(1984-1989)*	**Dams for Range**	**Raipur Rani Forest Range (***1990-98)*	**Dams for Range**
Number of Dams Silted within 5 Years of Construction	(45) 31.3%	4	(18) 22.2%	7	(14) 50%	3	(14) 21.4%
Number of Dams Silted within 10 Years of Construction	33.3%	5	27.7%	3	21.4%	7	50%
Number of Dams Functioning for less than 1 Year	20%	6	33.3%	1	7.1%	1	7.1%
Number of Dams Functioning in 2000	17.7%	4	22.2%	2	14.2%	2	14.2%

Table 2: Group Composition and Effectiveness of Irrigation Service Provisioning

HRMS	Land Ownership Pattern	Caste Composition	Evidence of Compliance with rules relating to water allocation, payment of ISF's and contributions towards routine maintenance	Land Area Irrigated by Earthen Dam	Number of Beneficiaries of Irrigation from Dam	Mode of Irrigation Service Provisioning for Dam
Sukhomajiri	Even	Single	No	24	12	HRMS
Dhamala	Skewed	Multi	Yes	16	30	Contractor
Lohgarh	Skewed	Multi	Yes	18	15	Contractor
Nada	Skewed	Multi	Yes	12	60	Contractor
Bharuali	Skewed	Multi	Yes	16	35	Contractor
Thadion	Even	Single	No	15	15	HRMS
Govindpur Mandpa	Even	Single	Yes	26	23	Contractor
Kiratpur	Skewed	Multi	No	6	15	HRMS

Table 3: Features of Earthen Dams in Bharuali and Thadion HRMS

HRMS	Year of Construction	Cost of Construction (in Indian Rupees)	Year Dam became Operational	Catchment Area (in ha)	Command Area (in ha)
Bharuali	1990	5,78,000	1993	39	40
Thadion	1993	6,53,000	1993	15	20

Table 4: 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 5: 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

Table 6: Rule Compliance in Earthen Dam Management: Comparison of HRMS Groups

a): HRMS Bharauli

Head	1995/96	1996/97	1997/98	1998/99	1999/2000
Lease amount pledged by contractor (in rupees)	N/A (under HRMS provision)	N/A (under HRMS provision)	3,000	2,500	5,000
Amount actually deposited in HRMS account by contractor	Nil		3,000	2,500	5,000
Hourly user charge (in rupees)	25/hr	25/hr	25/hr	25/hr	25/hr
Profit from water leasing (i.e., difference between lease amount and total dues collected by contractor on hourly basis)	N/A (under HRMS provision)	N/A (under HRMS provision)	no profit	7,500	5,000

Table 6: cont.

b: HRMS Thadion

Head	**1995/96**	**1996/97**	**1997/98**	**1998/99**	**1999/2000**
Lease amount pledged by contractor (in rupees)	N/A (under HRMS provision)	N/A (under HRMS provision)	850	6,800	N/A (under HRMS provision)
Amount actually deposited in HRMS account by contractor	Nil	Nil	Nil	1,500 (represents only 22% of lease amount pledged)	Zero compliance with irrigation service fees
Hourly user charge (in rupees)	N/A (no charges levied)	N/A (no charges levied)	10/hr	10/hr	10/hr
Profit from water leasing (i.e., difference between lease amount and total dues collected by contractor on hourly basis)	N/A	N/A	Nil	Nil	N/A

Table 7: 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

Table 8: Extent of Rice Cultivation- HRMS Comparison

HRMS	Percentage of Water-Using Households Growing Rice	Mean Gross Cropped Area Under Rice (in acres)
Bharauli	9	8.3
Thadion	46.6	30.9

Table 9: Seasonality and Cropping Practices in Bharauli and Thadion HRMS

Crop	Sowing Season	Harvesting Season	Irrigation Requirement
Corn	June	September	One rain 15 days after sowing
Wheat	November	April	Two irrigation rounds over a four-month period
Radishes	November	April	One to two irrigation rounds over a four-month period
Paddy	June	October	Standing water up to 15 days before harvest

Table 10: Differences in Wage Structure for Paddy Production in Bharauli and Thadion HRMS

Farm Operation	**Local Labourer**		**Labourer from Outside**	
	Male	Female	Male	Female
Sowing	60	50	50	35
Weeding	60	50	50	35
Harvesting	60	50	50	35

Table 11: 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 Labour**	**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

Table 12: Acreage under Radish Cultivation in Bharuali HRMS

Endowment Category	**Percentage of Gross Cropped Area Under Radish Cultivation**
High	21.5 (12.5)
Medium	17.9 (4.6)
Low	11.5 (8.4)

Note: Figures in parentheses are standard deviation.

Table 13: Sources of Household Income in Bharauli HRMS

Endowment Category	Non-farm Income In Indian Rupees (mean)	Net Farm Based Income in Indian Rupees (mean)	Non-Farm Income as a Percentage of Total Income in Indian Rupees (mean)
High	Rs 10,000	Rs 28,666	28.9
Medium	Rs 13,933	Rs 17,405	44.4
Low	Rs 17,158	Rs 13,381	60.0

Table 14: Annual Returns on Non-farm Jobs in Study Area

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

Table 15: **Women's Participation in Watershed Management in Bharauli HRMS**

HRMS	Women Represented in Managing Committee	Women Attending Managing Committee Meetings	Women Represented in General Body	Women Attending General Body Meetings	Main HRMS Expenditure (1995–2000)
Sukhomajiri	3/12	Nil	50%	Nil	Repair of earthen dam
Dhamala	3/12	–	22%	–	Purchase of diesel engine to pump water from dam pondage area
Lohgarh	3/11	–	18%	–	Repair of earthen dam
Thadion	2/11	–	50%	–	Construction of *dharamshala* (men's meeting place)
Bharauli	2/11	–	40%	–	Repair of earthen dam
Nada	2/11	–	1%	–	Repair of earthen dam
Kiratpur	3/11	–	67%	–	No records available

Table 16: Fodder Grass Production in Bharauli HRMS

a: **Influence of irrigation on fodder grass production**

Independent Variable	Coefficient	Level of Significance
Area irrigated by earthen dam	1161 (2)	5%

Notes: Dependent variable is fodder grass grown on private fields (in kilos). Number of observations is 35. Figure in parentheses indicates t value.

b: **Influence of fodder grass production on dung production**

Independent Variable	Coefficient	Level of Significance
Fodder grass grown on private fields	1.25 (2.5)	5%

<u>*Notes:*</u> *Dependent variable is dung production (in no. of cakes per day). Number of observations is 35. Figure in parentheses indicates t value.*

Table 17: Irrigation Intensity and Use of State Forests in Bharauli HRMS

Endowment Category	Arable Land Irrigated by Earthen Dam (as a % of 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		sum-mer	mon-soon	win-ter
High	36	11.6	15.4	13.9	1450	8.6	10	21.3
Medium	45	26	3.1	12	1202	7.5	9.4	18
Low	70	14	6.5	12.9	1410	5.4	9	15.6

Table 18: 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	1450	3500	55
Medium	1202	3843	527
Low	1410	3671	173
Landless households	831	875	13

Note: 1. One quintal 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.

Table 19: Extraction of Fibre Grass by Private Contractor in Bharauli

Year	Lease Amount Deposited to Forest Department (in rupees)	Net Profit from Leasing out Fibre Grass Extraction Rights (in rupees)	Destination of Harvested Fibre Grass
1995/96	29,500	5000	Pawmi Paper Mills, Himachal Pradesh
1999/2000	20,400	Nil	Local rope-making community (banjaras)

Table 20: Gender, Class and Access to Forest Resources from Catchment Areas

Endowment Category	Percentage of Households Where Women are Responsible for Fuelwood Collection from State Forests
High	-
Medium	-
Low	25
Landless	44

Appendix 1

Method for Computation of Household Endowment Scores

1. Variables

In the process of constructing household endowment scores we considered four variables: (i) total rainfed land owned, (ii) total irrigated land owned, (iii) type of livestock owned and (iv) size of household. Total irrigated land owned refers to land irrigated by tubewells, earthen dams and kuhls (seasonal water channels). The principal livestock types considered in constructing the endowment scores are adult cows, buffaloes, bullocks, goats and camels. Household size refers to total number of members in a household.

2. Weights

In constructing household endowment scores we devised weights for each of the assets outlined above. The weights were decided based on food productivity assessments undertaken in Shiwalik villages. Four criteria guided the allocation of weights for variables:

per-acre productivity of corn/rice and wheat under non-irrigated conditions

per-acre productivity of corn/rice and wheat under irrigated conditions

average milk production by buffaloes in summer, monsoon and winter months

average milk production by cows in summer, monsoon and winter months

3. Assumptions

In devising weights for caloric value of cereal crops and average milk production we made five assumptions:

Each adult requires a minimum of 2,300 kilocalories per day.

The annual average kilocalorie requirement for an individual would therefore be some 850,000 kilocalories.

A kilo of a cereal like corn, wheat or rice contains on average 3,500 kilocalories.

Cow’s milk contains 700 kilocalories per litre.

Buffalo milk contains 900 kilocalories per litre.

4. Cereal crops caloric equivalent

Household-level assessments of crop and milk production were undertaken for which the following measures based on production under irrigated and non-irrigated conditions were used:

One acre of rice or corn in kharif season under non-irrigated conditions yields 1,200 kilos per acre on average.

One acre of wheat in rabi season under non-irrigated conditions yields 500 kilos per acre.

Therefore, under non-irrigated conditions annual average yields per acre are approximately 1,700 kilos (i.e. 1,200 + 500).

A yield of 1,700 kilos per acre under non-irrigated conditions is equivalent to some six million kilocalories per acre per year (i.e. 1,700 * 3,500 kilocalories per kilo).

Following from our earlier assumption regarding a minimum calorie requirement per individual of 850,000 kilocalories per year, six million kilo calories would sustain seven members of a family.

Under irrigated conditions one acre of corn in kharif season yields 1,800 kilos per acre.

Under irrigated conditions one acre of wheat in rabi season yields 1,600 kilos per acre.
Therefore, under irrigated conditions total yield per acre is approximately 3,400 kilos (i.e. 1,800 + 1,600).
A yield of 3,400 kilos per acre under irrigated conditions yields a caloric equivalent of 11,900,000 kilocalories per year (i.e. 3,500 * 3,400).
Assuming a minimum annual calorie requirement of 850,000 per individual, 11,900,000 kilocalories would sustain 14 members of a family.

5. Milk production and calorie equivalent

Milk production in Shiwalik villages varies by season. In the summer months between March and May an adult buffalo produces about 5 litres of milk per day. During the monsoon period between June and October, milk production peaks at about 10 litres per day. In the winter, between November and February, average milk production per day is about 4 litres. However, as no milk is produced for a few weeks in a year we assume that average annual milk production is approximately 2,000 litres. Two thousand litres of milk produced by an adult buffalo translates into a caloric equivalent of 1.8 million kilocalories annually; thus the 1.8 million kilocalories contained in buffalo milk can sustain 2.5 persons annually.

On the other hand during the monsoon season, a cow produces some 750 litres of milk. During the summer season, milk production falls to approximately 450 litres. Therefore, total annual milk production by a cow would be in the range of 1,200 litres. This 1,200 litres of cows milk translates into a caloric equivalent of 840,000 kilocalories. This 840,000 kilocalories contained in cows milk could sustain one family member annually.

Based on average food productivity assessments for cereal crops and milk we calculated household endowment scores as follows:

$(7Lr + 14Li + 2.5B + 1C + 0.5C = 0.1G) / H.H. Size$

where Lr = acres of rainfed land, Li = acres of irrigated land, B = no. of adult buffaloes, C = no. of adult cows, Ca = no. of camels, G = no. of goats, H.H. Size = no. of members in a household.