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# Protection & Regeneration of Common Pool Resources

*Estimating the Economic Value*

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# Protection and Regeneration of Common Pool Resources: Estimating the Economic Value

Annexure to Document 21
"Common Land Development and Poor Livestock Keepers: Experiences from Common Land Development in the States of Rajasthan and Madhya Pradesh in India"


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# Content

# 1. Introduction

## 1.1 CONTEXT

Constituting nearly one fifth of the total landmass, common pool resources assume significant importance not only from the view point of resource management but also in terms of their potential for providing livelihood support for the landless and poor across various agro-ecological systems in India. Common pool land resources represent a larger set of non-exclusive resources with varying degree of access and multiple and often multiple patterns of rights [Chopra and Dasgupta, 2002]. A sub-set within this, having specified property regime, referred to as common property land resources (CPLRs). While much of the common pool/property land resources consists of degraded land within and outside forest area, there is little by way of gauging the actual size of CPLRs as there is no systematic data base on the status, ownership as well as property rights regimes governing the land that are generally in the domain of common property [Iyengar, 2003]. The issue is particularly important as absence of an appropriate data-base may lead to perpetuation of the 'residual' character, often associated with the official nomenclature viz; 'waste land', used for representing the common land in the Indian context. This in turn may result in continued degradation and/or mis-use of the commons.

Assessing the status and valuation of the benefits from resource management systems could be an important source of information for gauging the outcomes of some of the important interventions in the field of CPR-management. This may not only help in getting the broad idea of the potential benefits from otherwise a fairly degraded resource under the open access-regime, it may also unravel the profile of benefits-sources, extent, and distribution. In turn, these aspects may play significant role in the nature and sustenance of collective action and community organization.

This is particularly important at a time when common lands are increasingly being treated as a resource with least productivity (almost a 'waste' in literal sense) hence

receiving the lowest priority in the context of planning for land use and their allocation across different sectors. Revenue wasteland is often the first claim for diversion of land under the industrial/infrastructural/mining project. This obviously, has two grave consequences: First, it overlooks the ecological functions rendered by particular use that the CPLRs has been put under each agro-ecological system; and second, it bypasses the critical dependence that poor households have on the commons, how so ever degraded they might be.

New market opportunities that tend to treat common lands as 'wastelands' could serve the interests of ascending economic groups within the villages. However, they tend to 'commoditise' and 'privatise' the natural resources that were otherwise accessible to the poor, dispossessing them further. A recent analysis reinstates the fact that diverting CPLRs for implementing projects to ensure Clean Development Mechanisms' (CDMs) in India may run a high risk of increased impoverisation among rural communities hence lead to conflicts [Gundimeda, 2005]. In such situations, it is imperative to ensure tenure security for the poor, evolving institutional arrangements that safeguard their entitlements and searching for ecologically sound and economically rewarding livelihood opportunities. Though it is not clear whether improved natural resources really offer a long-term economic route out of poverty, it is known that they do provide a safety net for the poorest and are vital to their health. As the well being of ecological surroundings benefits the poor and not so poor, it is important to work towards safeguarding the natural resources, the backbone of the rural economy. This is particularly important in a situation like in South Asian countries where the extent of livelihood dependence on natural resources accounts for 15-29 per cent [Ghate, et.al; 2007].

The present study tries to assess the value of resource regeneration through a special variant of CPR-management under initiative of Foundation for Ecological Security (FES), in India Central-Western parts of and highlights good practices thereof. The FES-approach aims at realizing the above vision of sustainable development through their multifarious interventions in the field of natural resource management especially, the commons.

The study has been carried out jointly by the team-members of GIDR and FES. At times, data have been collected independently by each team and shared for the analysis through a fairly interactive process. FES-team members were present during most of the data collection activities in the study villages.

## 1.2 CPLRS: CONSERVATION, LIVESTOCK ECONOMY, AND LIVELIHOOD

An important development in the recent past pertains to the use of common land for compliance under the various environmental protocols such as Clean Development Mechanism (CDM) and Carbon trade etc. Hence projects for afforestation, plantation of bio-fuel, or corporate farming etc. may become attractive for alternative uses of common land. The issue once again is-diversion of CPLRs from their primary stake holders i.e. the local communities and their dependence for basic needs such as fuel and fodder to a different type of land-use and management of the commons.

There is essentially an inherent dilemma of balancing between the objectives of conservation (including environmental protocols) or developmental initiatives (such as corporatisation) and that of sustaining livelihood needs of the local communities. The dilemma is fairly complex as the aims or aspirations of the state, corporate sector, or communities are neither singular nor homogenous and static. It is likely that conservation and commercialization may also create alternative livelihood options that the local communities may aspire for. This is particularly so if the benefits from resource regeneration and management is not adequate and/or well distributed among different segments of the society.

The issue of adequate benefits and incentives assume special significance in the context where revival and strengthening of livestock economy, especially among the poor and the small livestock keepers, is at the centre stage. This raises an important issue of choosing a right kind of management strategy that involves identifying appropriate mix of technologies, institutional arrangements, and preferences over use and users of the commons. While natural regeneration is undoubtedly the best approach for combining ecological and livelihood objectives, the actual operationalisation may not be so strait forward. It may involve a lot of negotiations within the community over the critical choices depending on the core (ecological) characteristics of the resources and challenges posed by the changing economic-socio-cultural context within a region.

Recognizing that livestock economy has the closest link with the extent, status and the changing use-pattern of the common lands in most parts of the country, mainly as a source of fodder, may assume central thrust in regeneration and management of CPLRs in an ecologically sustainable manner. However, availability of additional fodder though, a necessary but not sufficient condition for promoting livestock economy in a manner which is both-ecologically sustainable and socially equitable. Three aspects, emerging from the past experience, deserve special attention in this

context: (i) Whereas livestock in India is owned mainly by the underprivileged households [Kurup, 2004], the ownership is increasingly being influenced by access to land and irrigation [Shah, 2007], owing mainly to the lopsided policies focusing mainly on dairy products; (ii) Given the ownership pattern, resource poor farmers need additional support for overcoming technical, economic, and social constraints in order to benefit from the growing demand for livestock products [Thomas and Rangnekar, 2004]; and (iii) With increasing economic compulsion for occupational diversification especially among the landless and poor, reinstating their economic stakes in livestock sector may necessitate a quantum jump in the incentives (benefits) realized from the regeneration process.

It is pertinent that in absence of the last two conditions, the transition form CPLR-management, growth in livestock economy, and enhanced economic welfare of the poor and/or small livestock keepers may not be automatic, smooth, and long lasting.

## 1.3 MANAGEMENT OF COMMON LANDS: IMPERATIVES AND POLICY INITIATIVES

Apart from being highly degraded and having multiple stakeholders as well as users, three important features of common lands deserve special attention while evolving systems for their management. First, there is a continuum between common land and crop/forest land since the communities and the households within that look at the entire basket of land (and water) resources for optimizing their welfare. Second, the common land is an integral part of an ecosystem; at times management of water rather than the land *per se*, assumes special significance in regenerating the land and mobilizing collective action around the resource. And third, asymmetry in households dependence on common land; generally the poor depend more on these resources as compared to the rich. Whereas the first two features call for an integrated approach for resource development and management, the third suggests need for a special emphasis on equity in decision-making and benefit-sharing.

Conceptually, watershed development is the most suitable approach for managing the commons by building on the two special features noted above. Similarly, the third feature underlines the importance of positive discrimination in favour of those having relatively limited resource-base hence, greater dependence on the common land.

A number of policy initiatives have been initiated over time for managing common land resources under various schemes for development of degraded/wastelands.

While these initiatives have helped creating a fair amount concerns among different stakeholders, most of these are found to have adopted top-down and compartmentalized approaches [Jodha, 2000]. Both these are serious limitations in so far as collective action and ecological sustainability assumes special significance in managing the commons.

The recent upsurge in participatory approaches for natural resource management especially, Integrated watershed Development Projects (WDPs) and Joint Forest Management (JFM) could be treated as steps in the right direction, much needs to be done for attaining the desired results in so far as the common land are concerned. Despite adopting an integrated approach WDPs, in most cases, are found to have neglected the common land such as village pastures and forests within the watershed boundary, owing to factors like legal hitch, encroachment, and presence of intra-community conflicts over these resources [Shah, 2000]. The JFM-experience refers mainly to the iniquitous participation in decision-making and benefit sharing; the issues noted earlier [Lele, et.al; 2003]. The outcomes are: absence of appropriate management practices and inequitable distribution of benefits, despite collective action.

Evidence from a number of initiatives for managing common land, including large number of WDPs and JFM-projects, suggest that improving the resource management system is relatively easier as compared to addressing the issue of equity. It is quite likely that the former is contingent upon the community to accept inequitable sharing of benefits from a particular management system. This reinstates the basic feature that collective action, by itself, does not guarantee equitable distribution [Dasgupta, 2008-sandee book], not to talk about positive discrimination favouring the resource-poor within the community. This is likely to be true more in the case where the negotiations between the unequal stockholders (viz; the state vs. community; rich vs. poor; farmer vs. pastorals; and large vs. small land/livestock owners) take place in absence of mediation from an external agency for upholding the equity concerns. The same may hold true of sustainability issue for resource conservation.

Involvement of an external agency however, is a double-edged razor. This may help bringing together different stakeholders-the resourceful and the resource poor-on a common platform of negotiations, and that it may also help upholding the concerns over equity and sustainability as compared to a situation where the processes are left completely to the community, with the hierarchies and stratifications kept intact.

Nevertheless, the risk involved in a third party mediation-is that the consensus once arrived at may not be long lasting and is likely to get reverted back once the external agency withdraws the intervention. There are two possible mechanisms to avert an eventuality like this: (i) accept, as conscious choice, certain elements of inequity tilting more in favour of the resourceful and the powerful within the community; and (ii) ensure long term presence in the post-project period. In absence of either of these two the sustenance of the benefits and their equitable distribution may come under serious challenge.

Given this backdrop, the present study looks into the experiences from interventions by Foundation for Ecological Security (FES) and Bharatiya Agro-Industries Foundation (BAIF) in two out of the 17 major states in India viz; Madhya Pradesh (M.P.) and Rajasthan. The initiatives by FES and BAIF represent an important variant of the externally mediated processes of resource development and management by mobilizing community action. In doing so, it tries to focus on the issues of resource sustainability; productivity; and equity besides promoting community organizations and market linkages. The approach envisages facilitating role for ensuring sustainability of the community organizations thereby resource management by way of continued presence in the field over a longer period of time. In that sense the approached adopted by FES and BAIF tend to, at least partly, avert of the risk of non-sustainability of institutions created during the project interventions, thereby ensure CPLRs-management in the post-intervention scenarios.

## 1.4 MAIN OBJECTIVES

The main objectives of the study are:

a) To assess the change in vegetation, livestock, and crop productivity at the village/ community level, and estimate the direct as well as indirect benefits accruing of different categories of households within the community;
b) To examine the major sources of direct benefits and their distribution among households, especially the poor and the small livestock keepers; and
c) To document good practices of institution building and resource management and draw implications for promoting equitability and sustainability of benefits by simultaneously improving resource regeneration and ecology.

More specifically, the study addresses two sets of questions: (i) What is the nature and extent of benefits? Who have been benefited from the initiative? What is the likely

impact on poor livestock owners? And (ii) what works better for generating the desired flow of benefits on a sustained basis?

The analysis is divided into two parts. First part focuses on the benefits from CPLRs and the second part presents documentation of good practices for CPLR-management in the study area. The first part consists of seven sections. The next section presents a brief description of the management practices, highlighting some important features of the FES-approach. This is followed by presentation of the macro as well micro scenarios on land-use, CPRLs, and livestock population so as to provide a backdrop within which the benefits-assessment could be placed. Sections 4 and 5 present estimates of biomass and the monetary value thereof. Section 6 presents estimated benefits from water harvesting structures (WHS)-a major source of direct benefits to the village communities. This is followed by analysis of the perceived benefits especially, on livestock economy in the light of the primary data collected from a sample of 1053 households from 11 villages in the two states. The last section 7 highlights major findings from the analysis in the part 1.

## 1.5 DATA AND METHODOLOGY

The study is confined mainly to ascertaining the first round impact of CPLR-management on The valuation exercise is based on ascertaining changes in: i) vegetation; ii) water table and irrigation; iii) cropping pattern and crop productivity; iv) ownership of livestock; and v) use of CPLRs. As a result, it does not capture the entire flow of second round effects on households' income and employment on the one hand, and environmental services on the other. The limitations, by and large, emanate from two important considerations: First, whereas the impact of improved availability of water/irrigation on household's income is quite certain, substantial and immediate, that from the increased vegetation may not be the same; especially, increased availability of fodder from CPLRs may not necessarily lead to positive changes in the size, composition, and quality of livestock especially in region facing frequent drought conditions and having to diversify economic activities out of the farming system. Also, some of the impacts, especially on livestock, is also variable over time. Capturing these may require fairly comprehensive and extended enquiries among households representing different socio-economic categories within village communities; this was not possible to attain given the larger canvass of villages to be covered within the limited time frame of the study. The second consideration pertains to difficulty in undertaking an inter-disciplinary study requiring detailed assessment

of changes on bio-physical indicators such as bio-diversity; soil-moisture and land productivity; and ground water and hydrology.

The analysis therefore has focused mainly on capturing the direct impact on the variables indicated above. This has been supplemented through select case studies of households that may have experienced/not experienced changes in their household economy especially, on livestock, owing to the management of CPLRs in these villages.

Chart 1 depicts main features of the methods and tools used for data collection at for capturing different aspects of the analysis.

The analysis is based on both secondary as well as primary data collected from 17 villages; 6 in Madhya Pradesh and 11 in Rajasthan. The changes have been captured mainly by comparing 'with-without' and 'before-after' situations depending on the data-availability. The former pertains to comparison with a control village. For the later the comparison is based on secondary data for the pre-project period as well as on recall during the primary survey.

## Sample Selection: Villages and Households

The study is located in selected villages in Madhya Pradesh and Rajasthan where FES and BAIF have their project-interventions since the nineties. The selection of study villages was guided mainly by the fact that (a) CPLR-management should have been undertaken at least five years back; and (b) the villages should have at least average level of success in CPLR-management. Both these criteria were necessary for capturing a reasonable impact on vegetation and other indicators presented in Chart 1.

Subsequently, three additional aspects have been considered for selecting the villages especially, in Rajasthan. These are: geographical spread, clustering of villages, and the approach/agency involved in project intervention. Given these considerations, villages have been selected by adopting a purposive sampling in consultation with the FES/BAIF functionaries.

In all, 17 villages have been selected for the study-six in Madhya Pradesh and 11 in Rajasthan. These consist of two control villages. Of the 15 villages, two villages in Rajasthan have intervention by BAIF, the rest have been covered by FES-intervention. The consideration of cluster of villages also pertains to the FES-villages where a distinction is made between the villages that constitute a part of the cluster of

## Chart 1: Methods and Tools

| Ascertaining Changes in | Analytical Frame | Data Source/s | Method/ Tools | Variables Covered | Remarks |
|---|---|---|---|---|---|
| 1. Vegetation | Comparison across plots under different management practices and with a control situation | Primary Vegetation survey, RS data and Ground truthing | Vegetation mapping | Biomass estimation for tree, shrub, fodder and species diversity | Estimations made by FES-team during 2007-08 |
| 2. Water Table and Irrigation | Supplementary survey of the households owning wells expected to have benefited from Water Harvesting Structures (WHS) created by FES and other agencies | Primary data collected from households (87 in 8 villages in M.P. and 33 in 3 villages in Rajasthan). The survey include control villages in both states. | Survey of selected wells in the vicinity of WHS in project and control villages; selection of wells was done with the help of the informed persons | Status of water table, crop-area, irrigated area, yield for the two period-before and after the project (for Rajasthan) | Data based on well-monitoring available for a sub-set of study villages (only in Rajasthan) |
| 3. Land-Use and Crop Production | Comparing Before-After situations by considering comparability of rainfall conditions | Secondary data | | Change in cropped area; area sown during Rabi; irrigated area; No. of wells etc. | Official data lack systematic recording of land use each year |
| 4. Livestock Ownership | As above | Secondary data plus survey conducted by Village Community in MP and Rajasthan. Also data collected through the sample survey | | No. by type (not on age and quality) | The number of livestock is generally quite variable during and over the years owing to a number of factors |
| 5. Resources from CPLRs | Comparison between project and control village sin the light of the vegetation mapping | Primary data | Sample survey of Households | Season wise use of CPLRs for grazing (no. of animals), fodder collection, fuel and NTFPs | Quantification is difficult |
| 6. Other Benefits | Direct-Indirect | As above plus Focus Group Discussions (FGDs) in selected villages | | Impact on reduced indebtedness, migration, income from / consumption of milk etc. | FGDs were conducted in few villages as part of the Documentation of Good Practices by FES-team |
| 7. Perception about Livestock as Livelihood Option for Future | Change in the size and composition of livestock, and Impact of Fodder Availability thereof | Primary data | Livestock Census Conducted by FES; and Sample survey of households | Ownership pattern across different categories of livestock; Preference for livestock as future occupation, plan to buy more livestock, constraints and expected support. | Mainly Indicative owing to the difficulties of attribution |

contiguous villages, forming a watershed, and those outside the cluster. The basic idea is to see whether the two sets of villages have differential pattern of impact of the CPLR-management, other things remaining same. This aspect however, is difficult to examine empirically, given the wide variations in other characteristics (such as agro-climatic, location and age of CPLR-management, socio-economic conditions, presence of similar interventions especially for soil-water conservation by other agencies) of the sample villages.

The study villages in Madhya Pradesh are located in Shajapur district whereas that in Rajasthan have been spread over five districts- Bhilwada, Ajmer, Udaipur, Bundi and Pali. The control village in Rajasthan is located in Pali district, adjacent to Ajmer district; the control village thus has limited applicability confined mainly to the villages in Ajmer.

A sample of households has been selected from each of the 17 villages using quota sampling method. A minimum of fifty households have been selected in the villages where total number of households was less than 100; villages with less than 50 households have been fully covered. For those having more than 100 households, the sample consisted of 50 per cent of the total households in the village. The quota of households has been divided into three categories; those having land and irrigation; those having land but no irrigation; the very poor defined as having no irrigation-less than 5 veghas of land-less than five sheep/goat and no milch animal. The sample was drawn by seeking information from the informed persons in the village. Attempt was made to cover households from different settlements (often representing different ethnic groups) within the village. The actual sample may have some deviation given the limitations of the prior information about the households. The sample in the control village is smaller owing to non-response of the households.

A large part of the data was collected during 2007. Details of the sample villages and the size of sample households has been presented below [Chart 2].

There are three important variations among the sample villages. These are: spatial/ agro-climatic; approach of project interventions; and the year of starting the interventions. The variations however, are more pronounced in the case of the villages in Rajasthan as compared to those in Madhya Pradesh. For instance, all the study villages in Madhya Pradesh are located in one block within Shajapur district whereas those in Rajasthan are spread across five districts having significantly different agro-

**Chart 2: Profile of the Sample Villages**

| Sr. No. | State/Villages | District | Total No. HHS | Sample HHS | Agency | Year of Starting the Project Intervention |
|---|---|---|---|---|---|---|
| | | | Madhya Pradesh | | | |
| 1 | Karwakhedi | Shajapur | 108 | 52 | FES | 1999 |
| 2 | Bhanpura | Shajapur | 77 | 50 | FES | 1997 |
| 3 | Rajakhedi | Shajapur | 55 | 55 | FES | 2002 |
| 4 | Jagatpura | Shajapur | 92 | 50 | FES | 1998 |
| 5 | Rojani | Shajapur | 130 | 67 | FES | 1998 |
| 6 | Ahirwadiya (Control) | Shajapur | 216 | 101 | | |
| | | | Rajasthan | | | |
| 7 | Bharenda | Bhilwara | 60 | 50 | FES | 1998 |
| 8 | Amratiya | Bhilwara | 90 | 52 | FES | 1999 |
| 9 | Sanjadi Ka Badiya | Bhilwara | 60 | 51 | FES | 1998 |
| 10 | Saredi Kheda | Bhilwara | 68 | 50 | FES | 1998 |
| 11 | Jodha Ka Kheda | Bhilwara | 163 | 84 | BAIF | 1991 |
| 12 | Thoria | Ajmer | 136 | 69 | FES | 1991 |
| 13 | Dhuwadiya | Ajmer | 92 | 57 | FES | 1991 |
| 14 | Gudha Gokulpura | Bundi | 257 | 125 | BAIF | 1997 |
| 15 | Cheetrawas | Udaipur | 155 | 51 | FES | 2001 |
| 16 | Dheemri | Udaipur | 167 | 50 | FES | 2002 |
| 17 | Pilpai (Control) | Pali | 100 | 39 | | |

climatic and socio-economic conditions especially between Udaipur and other districts in the state. In terms of approach of project intervention, Rajasthan has presence of both-FES and BAIF (covering Jodha Ka Kheda and Godha Gokulpura). Finally, the year of initiating the project intervention varies across the villages. Whereas three villages had a fairly early start i.e. in 1991, another three villages had project interventions started after 2000. The year of starting in the remaining nine out of the total 15 project-villages was during the period 1997 and 1999. The variation is relatively more in the case of villages in Rajasthan. All these variations may have significant influence on the impact on biomass and other indicators. The analysis therefore tries to look into these three sets of variations.

The valuation exercise is based primarily on the data collected by FES team on the changes in vegetation on CPLRs (see annexure 1 and 2), and augmentation of water through creation of water harvesting structures at the lower part of the CPLRs. The data collected from a sample of households within the study villages, would help mainly in understanding distribution of benefits across different categories of households and the perceived impact thereof.

The study, given the limited time frame and resources, aims at providing a broad magnitude of estimated benefits (mainly direct benefits) from the project interventions, and has provides indicative evidence on the change in livestock ownership (mainly quantitative) resulting from the project initiatives. In doing so, it would exclude the environmental benefits, which usually are far more substantial than the direct benefits [ Kadekodi, 2004; p 228].

# 2. The Approach of FES and BAIF: Main Features

## 2.1 FES-APPROACH

FES has undertaken a comprehensive initiative for development and management of common property land resources (CPLRs) in a number of states in India. The initiative assumes special importance as it centres round degraded land, mainly under public ownership, with a view to regenerate livelihood of the village community. This is being attempted in a manner, which strengthens regeneration of ecosystem and farming systems in a region specific context. Developing sustainable livestock economy with special focus on poor livestock owning households assumes special significance in this context.

The FES-initiative consists of three major interventions. These are: treatments for soil-water conservation on the CPLRs; institutional arrangements for protection and management of CPLRs; and community mobilisation. Conversely, a number of direct as well as indirect benefits flow from the various activities undertaken by the initiative. The major among these include increased availability of fodder and NTFPs; soil-moisture and water for irrigation; and a forum for promoting collective action for CPLRs, which is the most critical constraint facing management of this rapidly degrading resource. It is would be useful to assess economic value of the benefits resulting from the FES intervention especially in so far it may help gauging the size, composition, and distribution of the benefits among across households within the village communities.

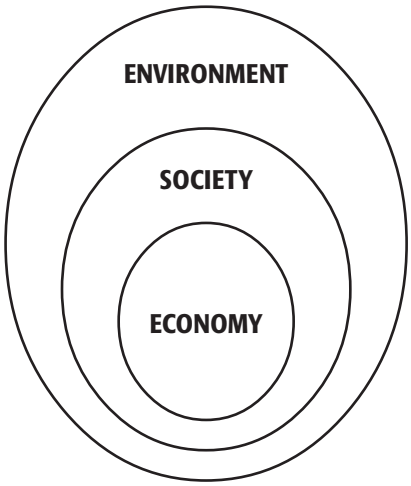
The main features of the FES-approach has been described as follows:

FES' approach is based on the concept of sustainable development encompassing the social, economic and ecological spheres of human existence. The interplay between the ecology of the region and the social arrangements engage to produce economic action. Economic action in turn works to reinforce/alter the social fabric and to an

extent influences the ecology of the region. The three spheres are in a dynamic interplay and are also embedded in the trajectory of the larger political processes. The interplay influences the political process and conversely also gets shaped by the larger political process. Current inequities are symptomatic remnants of a power play within and across these forces. The approach visualizes the social arrangements and economic action as couched within the ecological sphere, thereby denoting that they are in fact bounded by the natural environment and do not operate in isolation from the ecological sphere.

## Focus on Common Pool Resources

CPR serve as a vital livelihood safety net in times of hardship for these communities. Therefore, we believe that by design the intervention should be centred around the improvement of natural resources, more particularly CPR (where communities also have a stake, and in facilitating collective action to analyse, resolve and take proactive steps in gaining control of their lives and surroundings.




The work on commons has been guided by following broad principles:

- To work towards the stability of the entire ecosystem through working on physical and institutional dimensions on various categories of common land – gaucher (common pasture lands), revenue wastelands and - and water regimes for the regeneration and restoration of the watersheds.
- To treat commons and the private lands as one organic unit where work on the commons would provide for stabilisation of the nutrient and water cycles thus improving the productivity of the private lands for agriculture and livestock.
- To enable processes that take into consideration the social inequalities present in a village context and provide the disadvantaged sections a space in decision-making and governance.

Our work in restoring degraded forests and other common lands is spread over five out of the ten bio-geographic regions of the country. In most cases these lands are unproductive and require years of restraint and careful attempts to rejuvenate and

revive. Blessed with a sub-tropical climate and natural rootstock, our efforts are largely centred on assisting natural regeneration. Depending upon the stages of succession, appropriate pioneer species are introduced to assist the natural recovery. Geo-hydrological studies assist in designing appropriate measures to retain soil and water that, besides helping recharge of ground-water or harvesting surface water, also assist in providing a micro climate conducive for vegetative growth. Nature heals by itself and small measures in restraint pay immediate dividends in terms of improved biodiversity, biomass and moisture regime, resulting in double crops, increased crop productivity, milk production and availability of water for longer periods.

Our interventions in degraded landscapes follow the watershed approach of moving from ridge to valley. Watersheds make for an integrated units of natural resources for analysis and treatment. While the focus of initiatives are the commons, collective action once strengthened/facilitated is also encouraged to deliberate on aspects of privately owned and individual treatment plans are facilitated within the domain of collective action. Natural resource boundaries cut across administrative boundaries and necessitate management initiatives at appropriate levels. The landscape approach (described below) lends an appropriate perspective to engage in deliberation of resource governance and management strategies.

## Commons and Community Institutions

FES works in areas that have a significant human presence and where we believe conservation of natural surroundings is critical for the survival of the poor and the viability of the farming systems. By locating forests and natural resources within the larger ecological, social and economic landscape, it assists communities in determining conservation action where efforts on ecological restoration, social mobilization and poverty alleviation are multitudinal strategies aimed at ecological well being, decentralised governance and improved livelihoods. Overall FES works on systemic drivers that can bring about a multiplier change.

In fostering collective action for the safeguard of natural surroundings, common lands and water in particular, the approach is to begin by building on existing practices and reviving institutions of collective action at the habitation level. Issues concerning conservation of natural resources form the backdrop of discussions on inclusion of all residents particularly the poor and women as equal partners, their rights and responsibilities, mechanisms for consensus building and rules for appropriation and

provision. What remains to be seen is whether the community based institutions and their association would mature into platforms and face up to challenges on complex issues such as restraining from over exploitation of natural resources and designing measures for equal access across villages.

## 2.2 BAIF-APPROACH

BAIF Development Research Foundation is a national level NGO, working in over 12 states in India for the development of the rural-tribal areas; through its various programmes like livestock development, watershed development, agriculture-horticulture-forestry development as well as promoting grassroots organization at the village community.

Promoting the development of common community land for the benefit of the poor and the marginalized families in rural Rajasthan was the pioneering initiative taken by BAIF Development Research Foundation. The community members of the village collectively own the common lands. The legalities of these lands are entirely handled by the governing body of the village, usually the Gram Panchayat. The primary beneficiaries of the community pasture lands are the resource poor families of the village.

The **long-term objective** for cultivating the common lands is:

- To develop rain-fed pasture to create nutritive feed resources for livestock as well as fuel especially for the resource poor families
- To fruitfully utilize the degraded lands to improve environment and income and nutrition of the village communities
- To develop programmes for women and landless labour through Self Help Group (SHG)
- To build local institution Village Management Committee (VMC) for sustainability of activity and strengthening of Panchayati Raj System (PRS)
- To revive old culture for the protection of village common for mutually beneficial purpose (Man/Livestock)

### Rationale for Common land Development

The argument for the cultivation of common fodder lands can be explained from two perspectives:

A. Resource rich and resource poor farmers

a. The focus of (relative) Resource Rich (RR) fe/male farmers is primary on agriculture while livestock in general is of secondary importance, i.e. plenty of milk for home consumption, manure for agriculture, etc. they may sell surplus milk and may invest in cultivated fodder (Berseem, Lucerne, etc.) in order to have easy access to quality fodder for the animals and less/no dependency on common land
b. The focus of (relative) Resource Poor (RP) fe/male farmers is primary on livestock keeping. These households have no or little land and thus normally depend fully on livestock. They depend on the income deriving from livestock while the little agriculture activities (if at all) contribute to feeding the family (home consumption)
c. The RP have normally little or no land and therefore the keeping of livestock implies making use of fodder/ biomass produced on common lands. In addition, they may have some agri by-products and/or have access to these by-products through sale, barter exchange, etc.

While dealing with common lands specific rules and regulations for the management and sharing the produce of the land must be laid out meticulously to avoid any conflicts. As per the general rule, 50 per cent of the total harvested grass under the cut and carry arrangement is deposited with the Village Management Committee. Subsequently, this is auctioned, and earning are deposited in a common fund. In controlled grazing method a fixed amount is paid for grazing the common land by the animal for 15 days and the proceeds are deposited in the same common fund. The common fund is utilized for the upkeep of the common land and purchase of seeds plus payment of wages to the workers.

The Village Management Committee (comprising of the community members from different sections of the society) controls the ownership and the management of the land. It ensures the involvement of all the community members in the village, who have to pay up a nominal amount for the development of the common land every year. This ensures the ownership of the villagers towards the common land. The VMC epitomizes a self-sustained village level institution, while creating land-based asset for the fodder production.

Sustaining the ecological balance is a challenging task particularly in a semi arid environment where degradation is often very severe and widespread. It is important to maintain the harmony between the community and its environment for the sake of striking up a balance between both. BAIF's interventions seek to explore new institutional arrangements by mobilizing people's participation in the management of the commons over a long period of time.

The above descriptions of the approaches of FES and BAIF suggest a fairly amount of commonalities though, there may be important differences in terms of the relative importance of soil water conservation measures and livestock promotion, notwithstanding the inter-linkages between the two.

# 3. CPLRs and Livestock: Macro Scenarios and the Micro Setting

While there are no firm estimates of common pool land resources in India, a rough estimates suggest that about 70 million hectares (ha) i.e. nearly 21 per cent of the land mass in the country could be covered under this category. Of this 25 million ha is under the jurisdiction of forest department and the remaining 45 million ha is under the purview of revenue department, village panchayat, and other local governing bodies [Chopra and Dasgupta, 2002].

According to a comprehensive survey by the National Sample Survey Organisation (NSSO) about 15 per cent of the geographical area was formally under Common Property Resources (CPLRs). Among the Indian States, Rajasthan has the highest proportion of area (32 %) under this category, followed by Gujarat (27 %), and then by Madhya Pradesh (22 %) [NSSO, 1999]. The common pool land resources include community pastures, forests, wetland, village ponds, rivers, other water bodies, drainage lines, and dumping/threshing grounds. The property rights regime governing these resources is characterized by non-exclusive yet, differential, multiple and overlapping rights as well as access among the community.

It appears that much of the common pool land resources is covered under the category of 'waste land', which constituted nearly 17 per cent of the land mass; these may exclude areas under water bodies and rivers [Waste Land Atlas, 2003]. The estimates for Madhya Pradesh and Rajasthan are 15.7 and 25.2 per cent respectively.

## 3.1 LAND USE

According to the Land-Use Statistics, 10.8 per cent of the reported area in the country was under the three major categories, which may consist (fully or partially) of common pool land resources. These are: Barren and Unculturable; Village Pastures; and Area under Miscellaneous Trees/Shrubs. The proportion of land under these categories in Madhya Pradesh and Rajasthan were 9.7 and 12.4 per cent respectively [Table 1].

**Table 1: Land Use in India, Madhya Pradesh and Rajasthan-2000-01 (% to Reported Area)**

| Land Use Categories | India | M. P. | Rajasthan |
|---|---|---|---|
| **1. Forests** | **21.1** | **28.0** | **7.6** |
| 2. Land Not Available For Cultivation | **13.9** | **10.2** | **12.6** |
| a) Under Non Agriculture Use | 7.7 | 5.8 | 5.1 |
| b) **Barren and Unculturable** | 6.2 | 4.4 | 7.5 |
| 3. Other Uncultivable land other than Fallow | **9.1** | **5.4** | **19.2** |
| **a) Miscellaneous Tree Crops** | 1.1 | – | 0.004 |
| **b) Pastures and Other Grazing** | **3.5** | **5.3** | **4.9** |
| c) Culturable Waste | 4.5 | 0.1 | 14.3 |
| **4. Net Area Sown** | **46.1** | **49.0** | **46.3** |
| **(Gross Irrigated Area:2003-04)** | | | |
| 5. Fallow | **8.1** | **3.4** | **14.3** |
| **Total Reporting Area** | 100 | 100 | 100 |

Source: CMIE (2005), Agriculture, Centre for Monitoring Indian Economy, Mumbai.

Besides this, 21.1 per cent of the area under forest; a part of this (under protected and unclassified forest) is accessible to the village communities; the area under forest in Madhya Pradesh is fairly high i.e. 28 per cent. Compared to this Rajasthan has only 7.6 per cent of the area under forest though, as large as 14.3 per cent of the land is under the category of fallow-current and permanent. Some of the land could be suitable for development of pastures. Less than half of the reported area is under cultivation; about 46 per cent in the case of All India and Rajasthan and 49 per cent in Madhya Pradesh. The land use pattern especially, the cultivated area is subject to year-to-year fluctuations depending mainly on rainfall pattern.

It may however, be noted that absence and/or limited changes in the land use pattern noted above may not reflect the actual scenario on ground. These could be due to: (a) limitations in the official statistics on land use, the issue already noted earlier; and (b) the changes taking place at micro (village) level may often get suppressed in the estimates at the state/national level. Looking at the dis-aggregated data, notwithstanding the limitations, may therefore be useful in gauging the scenarios obtaining in the study region. This has been attempted by examining the pattern at district level, below which secondary data are not readily available.

A cursory glance at the estimates changes in land use pattern in Shajapur district in Madhya Pradesh suggests a decline in the land under permanent pastures and also under the category of barren and uncultivable land [Table 2]. Whereas net sown area

### Table 2: Changes in Land Use-Madhya Pradesh

| No | Land- Use Category | Shajapur | | Madhya Pradesh | |
|---|---|---|---|---|---|
| | | 1998-99 | 2002-03 | 1998-99 | 2002-03 |
| 1 | Forest | 1.10 | 0.00 | 27.62 | 27.62 |
| 2 | Not Available for Cultivation Total | 13.45 | 15.25 | 10.38 | 10.75 |
| (2.a) | Barren and Unculturable Land | **(5.45)** | **(6.88)** | **(4.38)** | **(4.61)** |
| 3 | Culturable Waste Land | 3.08 | 2.52 | 3.82 | 3.95 |
| 4 | Other Uncultivated Land Excluding Fallow Lands Total | 10.29 | 10.86 | 5.58 | 8.54 |
| (4.a) | Permanent Pastures and Other Grazing Lands | **(10.28)** | **(8.33)** | **(5.52)** | **(4.53)** |
| 5 | Fallow Lands Total | **0.50** | **0.60** | **3.38** | **5.27** |
| 6 | Net Area Sown | 71.58 | 72.31 | 49.21 | 47.54 |
| 7 | Total Cropped Area | **116.60** | **89.13** | **66.62** | **59.12** |
| 8 | Total Geographical Area | 100.00 | 100.00 | 100.00 | 100.00 |

has increased marginally, the total cropped area has declined in the district. The pattern is somewhat similar to that observed at the state level except that net sown area has increased unlike that in the district.

The pattern in Rajasthan suggests that there has been a marginal decline in the area under permanent pastures (except in Bhilwara) and also under barren and uncultivated land [Table 3]. Similarly, net sown area has remained more or less same or marginally declined whereas total cropped area has declined in most cases. This brings us back to the issue of variability in land-use pattern especially under cultivation and irrigation.

### Table 3: Changes in land Use-Rajasthan

| No. | Land-Use Category | Ajmer | | Bhilwara | | Udaipur | | Rajasthan | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1997-98 | 2003-04 | 1997-98 | 2003-04 | 1997-98 | 2003-04 | 1997-98 | 2003-04 |
| 1 | Forest | 5.81 | 6.61 | 6.88 | 7.07 | 26.75 | 28.13 | 7.38 | 7.76 |
| 2 | Not Available for Cultivation Total | 16.95 | 16.44 | 20.33 | 20.28 | 37.27 | 33.87 | 12.61 | 12.43 |
| (2.a) | Barren and Uncultivable Land | **(11.43)** | **(10.55)** | **(14.34)** | **(13.89)** | **(24.49)** | **(23.16)** | **(7.65)** | **(7.29)** |
| 3 | Cultivable Waste Land | 8.24 | 8.32 | 15.28 | 14.61 | 9.17 | 8.96 | 14.64 | 13.27 |
| 4 | Other Uncultivated Land Excluding Fallow Lands Total | 17.75 | 17.74 | 26.75 | 26.12 | 15.48 | 15.21 | 19.71 | 18.30 |
| (4.a) | Permanent Pastures and Other Grazing Lands | **(9.50)** | **(9.41)** | **(11.45)** | **(11.49)** | **(6.27)** | **(6.17)** | **(5.03)** | **(4.98)** |
| 5 | Fallow Land | 9.60 | 9.79 | 10.36 | 10.83 | 5.80 | 6.04 | 10.46 | 10.75 |
| 6 | Net Area Sown | **49.89** | **49.43** | **35.67** | **35.69** | **16.76** | **16.74** | **49.83** | **50.76** |
| 7 | Total Cropped Area | **70.88** | **55.53** | **53.11** | **43.59** | **24.64** | **20.42** | **65.16** | **63.22** |
| 8 | Total Geographical Area | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

Overall, the information on the changes in land use at district and state levels indicate not so favourable scenarios with respect to the CPLRs on one hand and irrigation on the other. To the extent, the estimates on cultivated land and that under irrigation is subject to year-to-year fluctuations, it is difficult to get a sense of any long term changes in land-use in these two important categories. Together, these suggest limitations of using secondary data for capturing the actual and the sustained changes in land-use pattern. Relating that with the project interventions is althmore difficult in absence of primary data.

## 3.2 LIVESTOCK

Table 4 presents changes in livestock pattern for India and also for Madhya Pradesh and Rajasthan. The pattern observed at the All India level suggests that whereas the population of buffalo, sheep, and goat has increased during 1997-2003, that of cattle has declined. A similar pattern is observed in the two states except that number of sheep has registered a decline unlike that at the All India level. Overall, livestock population has registered a marginal decline in the country as a whole, tat in Madhya Pradesh has increased whereas in Rajasthan the total livestock population declined by nearly 10 per cent. Much of the decline in Rajasthan could be due to significant reduction (about 30 %) in Sheep population over a short period of six year.

**Table 4: Changes in Livestock Population: India, Madhya Pradesh, Rajasthan (1997-2003)**

| | India | Madhya Pradesh | Rajasthan |
|---|---|---|---|
| Cattle | -7.4 | -2.99 | -10.73 |
| Buffaloes | +8.2 | +13.94 | +7.07 |
| Sheep | +6.5 | -16.80 | -29.90 |
| Goat | +1.3 | +25.84 | +8.61 |
| All | -0.1 | +5.47 | -9.57 |

The above information regarding the changes in land use and also livestock at the national and state/district levels provide the backdrop within which the changes in the study villages could be examined subsequently in section 6. A part of the changes could be attributed to the project interventions by FES and BAIF.

# 4. Estimates and Valuation of Biomass

This section presents results of the valuation exercise based on the estimates of biomass generated with the help of RS-data base. The estimates cover 12 villages, which cover 11 out of the 17 villages selected for the primary survey. Of the 11 villages 4 are in Madhya Pradesh and 7 in Rajasthan. The villages covered for the biomass-assessment also include the two control villages-Ahirbadia and Pilpayi in the two state respectively. Chart 3 presents some important features of the area under management in the 12 villages and watershed (cluster of villages) in Thoria and Ladwan. The estimates for the two clusters are inclusive of the estimates for the respective villages.

An important observation emerging from Chart 3 pertains to the area under management per household. Given the wide variations in the total area covered under CPLR-management and also in the total number of households in the village, one finds substantial variations in the area per household. In Rajasthan Thoria village has the highest area under CPLR-management per households i.e. 6.74 ha. This is followed by Dhuwadiya (3.08 ha) and then by Bharenda and Sanjadi-ka-Badia (2.92 ha). The variations in the CPLR-managed area per household may have significant influence on the impact that biomass regeneration could make on the livestock economy at household level, notwithstanding the variations in the biomass regeneration across the villages.

Another important point pertains to the larger area per household in the control villages, especially in Rajasthan. This mainly because the total area considered as CPR is fairly high; 829 and 944 ha respectively in Rajasthan and Madhya Pradesh. To an extent this is misleading because the area considered in the case of the project villages refer only to those under CPLR-management; the area not covered under the management is missing from the estimates here. This phenomenon has a significant bearing while comparing the total biomass at the village level; such comparisons should be treated as out of place.

**Chart 3: Profile of Area Under Management**

| | Area Under Management (Ha) | Households (No.) | Area/Household (Ha) | Year of Starting the Intervention |
|---|---|---|---|---|
| **RAJASTHAN** | | | | |
| Bharenda | 175 | 60 | **2.92** | 1998 |
| Amratiya | 145 | 90 | 1.61 | 1999 |
| Sanjadi Ka Badiya | 175 | 60 | **2.92** | 1998 |
| Saredi Kheda | 102 | 68 | 1.50 | 1998 |
| Dheemri | 113 | 167 | 0.68 | 2002 |
| Cheetrawas | 431 | 155 | **2.78** | 2001 |
| Dhuwadiya | 283 | 92 | **3.08** | 1991 |
| Gudha Gokulpura | 45 | 257 | 0.18 | 1997 |
| Jodha Ka Kheda | 60 | 163 | 0.37 | 1991 |
| Control | 829 | 100 | 8.29 | N.A. |
| Thoria TGCS | 583 | 136 | **4.29** | |
| Thoria Watershed | 4561 | 677 | 6.74 | 1991 |
| **MADHYA PRADESH** | | | | |
| Bhanpura | 156.44 | 77 | **2.03** | 1997 |
| Rajakhedi | 92.56 | 53 | 1.75 | 2002 |
| Rojani | 67.18 | 130 | 0.52 | 1998 |
| Jagatpura | 114.11 | 92 | 1.24 | 1998 |
| Karwakhedi | 286.43 | 108 | **2.65** | 1999 |
| Control (Ahirwadiya) | 944 | 216 | **4.37** | N.A. |
| Ladwan TGCS | 1263 | 134 | **9.43** | |
| Ladwan Watershed | 3152 | 771 | 4.09 | 1998 |

Lastly, the variation in the year of starting the intervention may also influence the impact on biomass regeneration and then on the households. It is expected that villages having interventions for more than 7-10 years may have already realized higher level of regeneration as compared to the newer ones.

Given this backdrop, the analysis in this section captures the value of the standing stock of the biomass in three categories viz; trees, shrub, and grass. Converting the stock into flow-values would require additional information on the girth and survival rate besides age of the standing trees/shrubs. The change-detection study conducted by the FES-team provided the estimates of biomass per hectare of land for the major species on the different categories of plots. These have been multiplied by the market prices in the case of the major tree species; these ranged from Rs. 155 to Rs. 11 lakh per tonne. Biomass for Shrub has been valued @ Rs.1500 per tonne whereas fodder has been valued @ Rs. 900 per tonne. The valuation exercise uses market prices for major trees/shrub species and also for fodder applicable in the study region. Besides market

value, we have also derived estimates leaf-material by drawing upon existing study in the region. In what follows we present the major findings emanating from the exercise.

## 4.1 STANDING BIOMASS AND ITS VALUE: AN AGGREGATE PICTURE

Tables 5 and 6 present estimates of the three categories of biomass across villages and the type of CPLR-management. Those under the project-management are covered as Plots and those under other kind of management are covered as Kakar [See Appendix 1]. The distinction of management type does not apply to the villages in Madhya Pradesh.

It may be noted that the estimates of TGCS in Thoria and Ladwan include all the protected plots in these villages; the estimates for watersheds exclude these plots.

According to the estimates, the standing biomass amounts to about 1,21,754 Tonnes among the six scattered villages in Rajasthan (Table 5a). Of this, about 1,08,874 (i.e.

**Table 5a: Bio-mass Estimates for Watersheds, Scattered and Control Villages in Rajasthan 2007**

(Tonnes)

| Villages | Year of Starting | No. of HHs | Area (Ha) | Tree | Shrub | Grass | Total |
|---|---|---|---|---|---|---|---|
| Bharenda | 1998 | 60 | 175 | 1363.50 | 2839.50 | 85.25 | 4288.25 **(24.5)** |
| Amaritya | 1999 | 90 | 145 | 1319.75 | 534.35 | 109.90 | **1964.00** (13.53) |
| Sanjadi Ka Badiya | 1998 | 60 | 175 | 1780.5 | 856.5 | 313.0 | 2950.00 **(16.85)** |
| Saredi Kheda | 1998 | 68 | 102 | 1434.3 | 229.86 | 114.0 | 1778.16 **(17.43)** |
| Dheemri* | 2002 | 167 | 113 | 4432.92 | 398.33 | 591.05 | 5422.3 **(55.79)** |
| Cheetrawas* | 2001 | 155 | 431 | 98543.46 | 4005.72 | 2802.09 | 105351.27 **(244.43)** |
| All Villages (Tonne/Ha) | | **600** | **1141** | **108874.43 (95.42)** | **8864.26 (7.77)** | **4015.29 (3.52)** | **121753.98 (106.71)** |
| Thoria TGCS | | 136 | 583 | 5526 (9.17) | 3052 (5.23) | 736 (1.26) | 9314 (15.97) |
| Thoria Watershed | 1991 | 677 | 4561 | 28245 (6.19) | 19955 (4.37) | 6579 (1.44) | 54779 (12.01) |
| ***Control*** | | **100** | ***829*** | ***689* (0.83)** | **1326 (1.60)** | **588 (0.71)** | **2603** ***(3.14)*** |

Note: Figures in parentheses indicate biomass per hectare.

89%) is from trees. Shrubs and grass account for 7.2 and 3.3 per cent respectively. It may be noted that a substantially large proportion (94 %) of the total biomass from trees among the scattered villages come from two villages in Udaipur district viz; Dheemri. A part of this biomass in Dheemri and Cheetrawas is due the forest management over a period of time. The phenomenon of significantly high contribution of biomass from these two villages is Reflected in terms of relatively high rate of high rate of biomass per hectare viz; 65.39 tonnes in Dheemri and 282.82 tonnes in Cheetrawas (Table 5b).

Another important feature observed from Table 5b is that the rate of biomass per ha is higher on the FES_Plots as compared to Kakar in all the six villages. The scenario for Shrub and grass is somewhat mixed; there are a few exceptions where the biomass in Kakar is higher than that in the plot. These are: Saredi Kheda in the case of Shrub and Bharenda and Sanjadi-Ka –Badia in the case of grass [For details on Plots and Kakar see Appendix 1].

Table 5a also gives estimates of biomass for Thoria-TGCS, Watershed, and a Control village i.e. Pilpayi. The rate of biomass (per ha) is found to be higher in the case of scattered villages as compared all the three noted above. The estimate for tree-biomass (per ha) is higher among the scattered villages even if we exclude Dheemri and Cheetrawas (Table 5b). Compared to trees and grass, biomass from shrub does not vary so significantly between the scattered villages (excluding Dheemri and Cheetrawas) and Thoria (TGCS and Watershed). Between Thoria TGCS and watershed, the former has better biomass from trees and shrubs; the rate of biomass (per ha) is higher among villages in the watershed as compared to TGCS, which of course is part of the Thoria watershed.

**Table 5b : Difference in Biomass between Plots and Kakar (Rajasthan)**

(Tonnes/ha)

| Villages | Tree | | | Shrub | | | Grass | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plot | Kakar | Total | Plot | Kakar | Total | Plot | Kakar | Total |
| Bharenda | 16.90 | 0.96 | 7.79 | 20.74 | 12.84 | 16.22 | 0.31 | 0.62 | 0.49 |
| Amaritya | 12.43 | 7.35 | 9.10 | 8.73 | 1.03 | 3.68 | 0.83 | 0.72 | 0.76 |
| Sanjadi Ka Badiya | 11.70 | 1.02 | 10.17 | 5.10 | 3.66 | 4.89 | 1.89 | 1.18 | 1.79 |
| Saredi Kheda | 20.49 | – | 14.06 | 2.67 | 3.53 | 2.25 | 1.40 | 0.50 | 1.12 |
| Dheemri | 65.39 | – | 39.23 | 4.21 | 2.49 | 3.52 | 8.50 | 0.29 | 5.23 |
| Cheetrawas | 282.82 | 140.43 | 228.64 | 13.16 | 3.00 | 9.29 | 5.63 | 0.26 | 6.50 |

The biomass in control village is significantly lower as compared to the rest. To a large extent the difference could be due to absence of management of the CPLRs in the control village. It may however, be reiterated that the lower estimates among the control villages are despite the large area considered for the assessment (as compared to the project-villages where the area is confined to those covered under CPLR-management), the issue already noted above. In this sense the estimates of total biomass and also for biomass per household is not comparable across the project and the control villages.

The estimates of biomass diversity in Table 5c suggest significant variations across type of management and also across villages.

**Table 5c: Diversity Indices**

| Sr. No | Village | Plot | | Kakar | |
|---|---|---|---|---|---|
| | | Tree | Shrub | Tree | Shrub |
| | **RAJASTHAN** | | | | |
| 1. | Bharenda | 0.69 | 0.37 | 0.00 | 0.32 |
| 2. | Amaritya | 1.47 | 0.37 | 0.68 | 0.29 |
| 3. | Sanjadi Ka Badiya | 1.15 | 2.13 | 0.69 | 2.05 |
| 4. | Saredi Kheda | 1.08 | 1.80 | – | 2.00 |
| 5. | Dheemri | 2.01 | 2.55 | – | 1.23 |
| 6. | Cheetrawas | 2.09 | 2.74 | 1.00 | 1.17 |
| | **MADHYA PRADESH** | | | | |
| 1. | Rajakhedi | 0.00 | 1.59 | – | – |
| 2. | Rojani | 0.48 | 1.73 | – | – |
| 3. | Jagatpura | 0.62 | 1.88 | – | – |

The scenario in Madhya Pradesh is somewhat different [See Table 6 ). The scattered villages perform better only in the case of trees as compared to Ladwan-TGCS and watershed. Biomass rates for Shrubs and Grass are higher in Ladwan (both TGCS and Watershed) as compared to the scattered villages. It may be useful to

**Table 6: Bio-mass Estimates for Watersheds, Scattered and Control Villages in Madhya Pradesh - 2007**

(Tonnes)

| Villages | Year of Starting | HHs | Ha | Tree | Shrub | Grass | Total |
|---|---|---|---|---|---|---|---|
| Rajakhedi | 2002 | 53 | 92.56 | 1458.74 (15.76) | 194.37 (2.10) | 177.71 (1.92) | 1830.83 (**19.78**) |
| Rojani | 1998 | 130 | 67.18 | 512.58 (7.63) | 295.59 (4.40) | 168.62 (2.51) | 976.79 (**14.54**) |
| Jagatpura | 1998 | 92 | 114.11 | 661.83 (5.80) | 253.32 (2.22) | 360.58 (3.16) | 1275.75 (**11.18**) |
| All Villages (Tonne/ha) | | 275 | 273.85 | 2633.15 (9.61) | 743.28 (2.71) | 706.91 (2.58) | 4083.37 (**14.91**) |
| Ladwan TGCS | | 134 | 1263 | 6903 (5.47) | 7410 (5.87) | 6250 (4.95) | 20563 (16.28) |
| Ladwan Watershed | 1998 | 771 | 3152 | 16655 (5.28) | 18303 (5.81) | 14317 (4.54) | 49275 (15.63) |
| Control | | 216 | 944 | 334 (0.35) | 4790 (5.07) | 1146 (1.21) | 6270 (6.64) |

Note: Figures in parentheses indicate biomass per hectare.

understand the reasons for better tree-biomass among scattered villages as compared to the TGCS and Watershed both in the case of Thoria and Ladwan.

Apparently, the control village (i.e. Ahirbadia) has fairly comparable biomass from Shrubs as compared to Ladwan (both TGCS and watershed). What explains this? The phenomenon needs further probing. Overall, Madhya Pradesh has better grass-biomass among all categories viz; villages/TGCS/watersheds as compared to Rajasthan. This perhaps, may be due to better agro-ecological conditions in general and rainfall in the recent years in particular. It may be noted that the study villages in Rajasthan have experienced sub-normal rainfall in the past few years whereas rainfall in Madhya Pradesh-villages has been quite favourable.

## 4.2 VALUATION OF BIOMASS: SELECT ESTIMATES

This part of the section presents estimates of monetary value of the standing bio-mass depicted in Tables 12 and 13. The estimates are based mainly on the market prices for major tree species found during the vegetation study. Biomass from shrub is valued in terms of fuel wood whereas grass has been valued as fodder.

According to the estimates in Table 7 total value of biomass from the six scattered villages worked out to be about Rs.1883 lakhs. Of this 88 per cent of the value comes

**Table 7: Total Value of Biomass in Rajasthan**

(value Rs. lakh)

| Village | Plot + Kakar | | | |
|---|---|---|---|---|
| | Tree | Shrub | Grass | All |
| Bharenda | 25.13 | 56.87 | 0.77 | 82.77 |
| Amaritya | 34.80 | 10.69 | 0.99 | 46.47 |
| **All** | **59.93** | **67.56** | **1.76** | **129.24** |
| Sanjadi Ka Badiya | 38.04 | 17.83 | 2.82 | 58.68 |
| Saredi Kheda | 29.02 | 6.28 | 1.03 | 36.32 |
| **All** | **67.06** | **24.11** | **3.85** | **95.02** |
| Dheemri | 66.71 | 8.07 | 5.32 | 80.10 |
| Cheetrawas | 1484.07 | 80.46 | 13.96 | 1578.50 |
| **All** | **1550.78** | **88.53** | **19.28** | **1658.59** |
| **Grand Total** | **1677.77** | **180.2** | **24.89** | **1882.85** |
| Thoria TGCS* | 116.80 | 61.39 | 5.92 | 184.81 |
| Thoria* Watershed | 478.22 | 380.39 | 59.11 | 917.72 |
| **Control** | 10.32 | 26.53 | 5.30 | 42.15 |

* The value of trees and shrubs in Thoria-TGCS and Watershed is based on the value of biomass for specific species identified by the change-detection study. The estimates, especially for tree-biomass in the watershed is somewhat lower than the estimates given in Table 5a.

from the two villages in Udaipur district-the phenomenon noted earlier. The total value of biomass, excluding Dheemri and Cheetrawas is Rs. 224.23 lakhs. Compared to this, total value of biomass in Thoria-TGCS and Watershed is about Rs. 185 and Rs. 918 lakhs. For the control village the estimated value is Rs. 42 lakhs.

Similarly, the value of tree-biomass account for nearly 90 per cent whereas shrubs and grass contribute 9.5 and 1.3 per cent of the total value of biomass in these villages. The patter however, is different in Thoria-TGCS and watershed- and also in the control village. Here, value of biomass from shrub accounts for relatively larger proportion of the total value; in fact it constitutes the largest category in the case of the control village. This may imply that the impact of CPLR-management is more on regeneration of trees and grass as compared to fodder.

The estimated value of grass-biomass is about Rs. 25 lakhs among the scattered villages; 59.11 in Thoria-watershed; 6.6 in Thoria-TGCS and 5.3 in control village.

The value of biomass is higher on the FES-plots as compared to Kakar as indicated in able 8.

**Table 8: Value of Biomass for Plots and Kakar-Rajasthan (Rs. in Lakh)**

(value)

| Villages | Plot | | | | Kakar | | | |
|---|---|---|---|---|---|---|---|---|
| | Tree | Shrub | Grass | All | Tree | Shrub | Grass | All |
| Bharenda | 23.69 | 31.19 | 0.21 | 55.09 | 1.44 | 25.68 | 0.56 | 27.68 |
| Amaritya | 24.33 | 8.73 | 0.37 | 33.43 | 10.47 | 1.96 | 0.62 | 13.05 |
| **All** | 48.01 | 39.92 | 0.58 | 88.52 | 11.91 | 27.64 | 1.17 | 40.72 |
| Sanjadi Ka Badiya | 37.55 | 15.93 | 2.55 | 56.03 | 0.48 | 1.90 | 0.27 | 2.65 |
| Saredi Kheda | 29.02 | 3.82 | 0.88 | 33.72 | 0.00 | 2.46 | 0.14 | 2.60 |
| **All** | 66.57 | 19.75 | 3.43 | 89.76 | 0.48 | 4.36 | 0.41 | 5.25 |
| Dheemri | 66.71 | 5.83 | 5.20 | 77.74 | 0.00 | 2.24 | 0.12 | 2.36 |
| Cheetrawas | 1138.61 | 70.62 | 13.58 | 1222.81 | 345.46 | 9.84 | 0.38 | 355.68 |
| **All** | 1205.32 | 76.45 | 18.78 | 1300.55 | 345.46 | 12.08 | 0.50 | 358.04 |
| **Grand Total** | 1319.90 | 136.13 | 22.80 | 1478.83 | 357.85 | 44.07 | 2.08 | 404.01 |

We tried to estimate the value of biomass per hectare of land (see Table 9). According to the estimates the value is Rs. 1.65 lakhs per hectare for the scattered villages. If we exclude the value of biomass for Dheemri and Cheetrawas villages in Udaipur district the estimates are per ha are fairly low; Rs. 0.4 lakhs for Bhranda and Amaritya and Rs. 0.34 for Sanjadi-ka-badia and Sared-Kheda. The estimates of biomass-value in Thoria-TGCS and watershed are found to be lower in almost all the cases. The estimates

**Table 9: Value of Biomass per Hectare (in Rs. Lakhs)**

Value (in Rs. Lakhs)

| Village | Plot | | | | Kakar | | | | Plot + Kakar* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tree | Shrub | Grass | All | Tree | Shrub | Grass | All | Tree | Shrub | Grass | All |
| Bharenda | 0.316 | 0.416 | 0.003 | 0.734 | 0.0144 | 0.257 | 0.005 | 0.277 | 0.143 | 0.325 | 0.004 | 0.473 |
| Amaritya | 0.486 | 0.175 | 0.007 | 0.668 | 0.0110 | 0.021 | 0.006 | 0.137 | 0.240 | 0.074 | 0.007 | 0.320 |
| **All** | **0.384** | **0.319** | **0.005** | **0.708** | **0.061** | **0.142** | **0.006** | **0.209** | **0.187** | **0.211** | **0.005** | **0.404** |
| Sanjadi Ka Badiya | 0.250 | 0.106 | 0.017 | 0.373 | 0.019 | 0.076 | 0.011 | 0.106 | 0.217 | 0.102 | 0.016 | 0.33 |
| Saredi Kheda | 0.414 | 0.055 | 0.013 | 0.482 | 0 | 0.077 | 0.004 | 0.081 | 0.284 | 0.061 | 0.010 | 0.356 |
| **All** | **0.303** | **0.090** | **0.016** | **0.408** | **0.008** | **0.076** | **0.007** | **0.092** | **0.242** | **0.087** | **0.014** | **0.343** |
| Dheemri | 0.981 | 0.086 | 0.076 | 1.143 | 0 | 0.050 | 0.003 | 0.052 | 0.590 | 0.071 | 0.047 | 0.709 |
| Cheetrawas | 4.248 | 0.263 | 0.051 | 4.563 | 2.106 | 0.060 | 0.002 | 2.169 | 3.435 | 0.186 | 0.032 | 3.654 |
| **All** | **3.598** | **0.228** | **0.056** | **3.882** | **1.653** | **0.058** | **0.002** | **1.713** | **2.85** | **0.162** | **0.035** | **3.04** |
| Grand Total | 1.941 | 0.200 | 0.517 | 2.175 | 0.776 | 0.096 | 0.004 | 0.876 | 1.47 | 0.158 | 0.022 | 1.65 |
| Thoria TGCS | 0.200 | 0.105 | 0.011 | 0.317 | | | | 0 | 0.20 | 0.10 | 0.01 | 0.32 |
| Thoria Watershed | 0.105 | 0.083 | 0.013 | 0.201 | | | | 0 | 0.10 | 0.08 | 0.01 | 0.20 |
| **Control** | 0.012 | 0.032 | 0.006 | 0.051 | | | | 0 | 0.01 | 0.03 | 0.006 | 0.051 |

for control village is much below all other villages and Thoria –TGCS as well as watershed.

To an extent the higher values of bio-mass per hectare could be attributed to the better management of CPLRs in these villages. We would get back to this aspect at a later stage.

Table 10 presents estimates of biomass-values per household in the study villages. It is observed that the value of total biomass per household is Rs. 3.13 lakhs. Of this Rs. 2.79 lakhs come from trees whereas a smaller contribution come from shrubs (Rs. 0.3 lakh) and grass (Rs.0.04 lakh). It may be noted that whereas only a small proportion of the biomass from trees and shrubs could be used for direct consumption by the households, much of the grass could be available for the direct use. The values of grass biomass per household vary from Rs. 1000 in Bhranda to Rs. 9,000 in Dheemri village. The value is Rs. 5000 per household in the case of Thoria watershed and also in the control village. This is quite significant if the flow of benefits continue over time

In fact one may expect that the biomass-value may be higher during a normal rainfall year. However, it is not possible to gauge the variations in biomass owing to the fluctuation in rainfall. We may however, work out some broad estimates based on certain assumptions. This has been attempted subsequently in section 4.3.

### Table 10: Value of Biomass per Household (in Rs. Lakhs)

Value (in Rs. Lakhs)

| Village | Plot | | | | Kakar | | | | Plot + Kakar | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tree | Shrub | Grass | All | Tree | Shrub | Grass | All | Tree | Shrub | Grass | All |
| Bharenda | 0.39 | 0.52 | 0.00 | 0.92 | 0.02 | 0.43 | 0.01 | 0.46 | 0.42 | 0.95 | 0.01 | 1.38 |
| Amaritya | 0.27 | 0.10 | 0.00 | 0.37 | 0.17 | 0.03 | 0.01 | 0.22 | 0.38 | 0.12 | 0.01 | 0.52 |
| **All** | **0.32** | **0.26** | **0.003** | **0.59** | **0.079** | **0.18** | **0.007** | **0.27** | **0.4** | **0.45** | **0.01** | **0.86** |
| Sanjadi Ka Badiya | 0.63 | 0.27 | 0.04 | 0.93 | 0.01 | 0.03 | 0.00 | 0.04 | 0.63 | 0.30 | 0.05 | 0.98 |
| Saredi Kheda | 0.43 | 0.06 | 0.01 | 0.50 | 0.00 | 0.04 | 0.00 | 0.04 | 0.43 | 0.09 | 0.01 | 0.53 |
| **All** | **0.52** | **0.15** | **0.026** | **0.70** | **0.004** | **0.034** | **0.003** | **0.04** | **0.52** | **0.19** | **0.03** | **0.74** |
| Dheemri | 0.40 | 0.03 | 0.03 | 0.47 | 0.00 | 0.04 | 0.00 | 0.04 | 0.40 | 0.05 | 0.03 | 0.48 |
| Cheetrawas | 7.35 | 0.46 | 0.09 | 7.89 | 5.76 | 0.16 | 0.01 | 5.93 | 9.57 | 0.52 | 0.09 | 10.18 |
| **All** | **3.74** | **0.24** | **0.058** | **4.04** | **1.07** | **0.037** | **0.001** | **1.11** | **4.82** | **0.26** | **0.06** | **5.14** |
| **Grand Total** | **2.2** | **0.22** | **0.038** | **2.46** | **0.59** | **0.073** | **0.003** | **0.67** | **2.79** | **0.3** | **0.04** | **3.13** |
| Thoria TGCS | 0.86 | 0.45 | 0.05 | 1.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.86 | 0.45 | 0.05 | 1.36 |
| Thoria Watershed | 0.71 | 0.56 | 0.09 | 1.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.71 | 0.56 | 0.09 | 1.35 |
| **Control** | 0.10 | 0.27 | 0.05 | 0.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.27 | 0.05 | 0.42 |

Table 11 presents total value of biomass in the three scattered villages and also for Ladwan TGCS as well as Watershed and a control village i.e. Ahirbadia. The estimated value for the three villages is Rs.180 lakhs. The estimates for Ladwan –TGCS and watershed are 1028 and 2809 lakhs respectively. In the control village the total value of biomass is about Rs. 111 lakhs.

### Table 11: Total Value of Biomass in Madhya Pradesh (Rs. Lakh)

Value (in Lakh)

| Village | Tree | Shrub | Grass | All |
|---|---|---|---|---|
| Rajakhedi | 21.88 | 19.61 | 1.60 | 43.09 |
| Rojani | 7.69 | 5.92 | 1.52 | 15.12 |
| Jagatpura | 92.70 | 7.04 | 3.25 | 102.99 |
| **All** | 122.27 | 32.57 | 6.37 | 161.21 |
| Ladwan TGCS | 815.65 | 156.32 | 56.27 | 1028.23 |
| Ladwan Watershed | 1994.74 | 685.98 | 128.79 | 2809.51 |
| **Control** | 4.96 | 95.72 | 10.28 | 110.96 |

Note: The value of trees and shrubs in Ladwan-TGCS and Watershed is based on the value of biomass for specific species identified by the change-detection study. These estimates, especially for tree-biomass in the watershed are somewhat lower than the estimates given in Table 6.

The estimated value of biomass per hectare is Rs. 0.59 lakh for the three villages, which is lower than that in Ladwan-TGCS (0.81) and watershed (0.89). The control villages has significantly lower value of biomass per hectare i.e. Rs. 0.12 lakhs. Again

value of biomass from trees constitutes a significantly large proportion of the total biomass-values as depicted in Table 19a.

**Table 12a: Value of Biomass per Hectare (Rs. Lakh)**

Value (in Rupee)

| Village | Tree | Shrub | Grass | All |
|---|---|---|---|---|
| Rajakhedi | 0.24 | 0.21 | 0.017 | 0.46 |
| Rojani | 0.11 | 0.09 | 0.02 | 0.22 |
| Jagatpura | 0.81 | 0.06 | 0.028 | 0.90 |
| All | 0.45 | 0.12 | 0.023 | 0.59 |
| Ladwan TGCS | 0.64 | 0.12 | 0.045 | 0.81 |
| Ladwan Watershed | 0.63 | 0.22 | 0.041 | 0.89 |
| **Control** | 0.005 | 0.10 | 0.011 | 0.12 |

**Table 12b: Value of Biomass per Household-Madhya Pradesh (Rs. lakh)**

Value (in Lakh)

| Village | Tree | Shrub | Grass | All |
|---|---|---|---|---|
| Rajakhedi | 0.41 | 0.37 | 0.03 | 0.81 |
| Rojani | 0.059 | 0.045 | 0.0114 | 0.116 |
| Jagatpura | 1.00 | 0.076 | 0.035 | 1.11 |
| **All** | 0.55 | 0.15 | 0.03 | 0.73 |
| Ladwan TGCS | 6.09 | 1.17 | 0.42 | 7.67 |
| Ladwan Watershed | 2.59 | 0.89 | 0.17 | 3.64 |
| **Control** | 0.02 | 0.44 | 0.047 | 0.51 |

Table 12b presents estimates of biomass-value per household. Whereas the value of biomass from all the three sources is Rs. 0.58 lakhs, that from trees is Rs.0.44 lakhs, and that from shrubs is Rs. 0.12 lakhs. The value of grass-biomass is Rs. 2,300 per household. Surprisingly, the value of shrub-biomass is higher in the control village as compared to the scattered villages. Overall the value of biomass in control village is moderately lower i.e. Rs. 051 lakhs as compared to the scattered villages (0.58). This phenomenon needs further probing.

## Biomass and Its Value in BAIF-Villages

The estimates for two villages viz; Jodha Ka Kheda and Gudha Gokulpura presented, covered under the interventions by BAIF have been presented in Tables 13 (a & b). The total value of biomass in the two villages is about 2326 and 1961 tonnes respectively. While a large proportion of the biomass in Jodha Ka Kheda is obtained from tree that in Gudha Gokulpura is from shrubs. The total value of biomass is Rs. 46.88 lakh in Jodha Ka Kheda and Rs. 29.66 lakhs in Gudha Gokulpura [See Table 13a].

### Table 13a: Estimates of Biomass and its Value among Two Villages Covered by BAIF

(Biomass in Tonnes/Rs. lakh)

| | | Jodha Ka Kheda | | Gudha Gokulpura | |
|---|---|---|---|---|---|
| | | Total Biomass | Total Value | Total Biomass | Total Value |
| Plot | Tree | 845.4 | 14.97 | 450.9 | 7.33 |
| | Shrub | 141.6 | 2.12 | 49.1 | 0.73 |
| | Grass | 36.0 | 0.32 | 36.5 | 0.33 |
| | All | 1023 | 17.42 | 536.5 | 8.39 |
| Kakar | Tree | 1068.6 | 26.71 | 0 | 0 |
| | Shrub | 106.6 | 1.60 | 1408.0 | 21.12 |
| | Grass | 127.4 | 1.15 | 16.5 | 0.15 |
| | All | 1302.6 | 29.46 | 1424.5 | 21.27 |
| Total | Tree | 1914 | 41.69 | 450.9 | 7.33 |
| | Shrub | 248.2 | 3.72 | 1457.1 | 21.85 |
| | Grass | 163.4 | 1.47 | 53.0 | 0.48 |
| | All | 2325.6 | 46.88 | 1961.0 | 29.66 |

### Table 13b: Estimates of Biomass and its Value among Two Villages Covered by BAIF

| | | Jodha Ka Kheda | | Gudha Gokulpura | | Jodha Ka Kheda | | Gudha Gokulpura | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total Value of Biomass (Rs. in lakh/Ha) | Total Value of Biomass (Rs. in lakh/HHs) | Total Value of Biomass (Rs. in lakh/Ha) | Total Value of Biomass (Rs. in lakh/HHs) | Total Biomass (Tonne/ HHs) | Total Biomass (Tonne/ Ha) | Total Biomass (Tonne/ HHs) | Total Biomass (Tonne/ Ha) |
| Plot | Tree | 0.250 | 0.092 | 0.163 | 0.029 | 5.19 | 14.09 | 1.75 | 10.02 |
| | Shrub | 0.035 | 0.013 | 0.016 | 0.003 | 0.87 | 2.36 | 0.19 | 1.09 |
| | Grass | 0.005 | 0.002 | 0.007 | 0.001 | 0.22 | 0.60 | 0.14 | 0.81 |
| | All | 0.290 | 0.107 | 0.186 | 0.033 | 6.28 | 17.05 | 2.09 | 11.92 |
| Kakar | Tree | 0.103 | 0.164 | 0 | 0 | 6.56 | 4.11 | 0 | 0 |
| | Shrub | 0.006 | 0.010 | 0.038 | 0.082 | 0.65 | 0.41 | 5.48 | 2.56 |
| | Grass | 0.004 | 0.007 | 0 | 0.001 | 0.78 | 0.49 | 0.06 | 0.03 |
| | All | 0.113 | 0.181 | 0.039 | 0.083 | 7.99 | 5.01 | 5.54 | 2.59 |
| Total | Tree | 0.130 | 0.256 | 0.012 | 0.029 | 11.74 | 5.98 | 1.75 | 0.76 |
| | Shrub | 0.012 | 0.023 | 0.037 | 0.085 | 1.52 | 0.78 | 5.67 | 2.45 |
| | Grass | 0.005 | 0.009 | 0.001 | 0.002 | 1.00 | 0.51 | 0.21 | 0.09 |
| | All | 0.147 | 0.288 | 0.050 | 0.115 | 14.27 | 7.27 | 7.63 | 3.30 |

The estimates for total value of biomass per hectare of land under CPLR-management are presented in Table 20b. It is observed that the value of biomass per hectare is Rs. 14,700 in the case of Jodha Ka Kheda and Rs. 5,000 in Gudha Gokulpura. The estimated value per households in the two villages is Rs. 28,800 and 11, 500 respectively. These estimates are somewhat lower than that obtained for the scattered villages in Rajasthan,

even if we exclude the two villages in Udaipur district. It is however, difficult to attribute the differences in the value of biomass across the two types of project interventions i.e. by FES and BAIF, in absence of the comparable scenario with respect to the agro-ecological conditions obtaining in the two sets of villages.

The estimates presented in sections 4.1 and 4.2 are based on the standing biomass at the given point of time. It is difficult to generate a flow value from these estimates since the requisite information on the age as well as girth of the trees and shrubs is not available. Alternatively we tried to work out the value of direct use considering sustainability aspect. This is based on the assumption about the rate of sustainable extraction of the standing trees and shrubs. For this we have used a thumb rule of 2 and 10 per cent of the standing biomass from trees and shrub and 100 per cent for grass. Further we estimated leaf biomass by using a ratio of 0.61:1 between leaf and grass biomass. This ratio is based on an observation by a study undertaken by Conroy and Lobo (2002) carried out under a similar situation in Rajasthan. Table 14a presents some broad estimates of biomass available for use on a 'sustainable' basis.

According to the information in Table 14a, a total of Rs. 210 lakhs of biomass-value could be treated as available for sustainable use during a year among the villages in Rajasthan. If we exclude the value of biomass from the control village, the figures work out to be Rs. 192.51 lakhs. Of this, 42.77 lakhs come from tress whereas 47.78

**Table 14a: Total Value of Biomass for Direct Use (Rs. Lakh)**
**(this is not per ha , areas in control villages are large)**

| | | Trees | Shrub | Grass | All | Leaf-Material |
|---|---|---|---|---|---|---|
| **RAJASTHAN** | | | | | | |
| 1. | Scattered Villages | 32.65 | 13.29 | 36.13 | 82.07 | 22.0 |
| 1.1 | Excluding. Udaipur | (1.75) | (6.69) | (5.60) | (14.04) | (3.41) |
| 2. | TGCS | 1.65 | 4.57 | 6.62 | 12.84 | 4.48 |
| 3. | Watershed | 8.47 | 29.92 | 59.21 | 97.60 | 36.12 |
| 4. | Control | 9.84 | 1.99 | 5.29 | 17.12 | 3.23 |
| 5. | All | 52.61 | 49.77 | 107.25 | 209.63 | 65.42 |
| 6. | Excluding Control Village | 42.77 | 47.78 | 101.96 | 192.51 | 62.19 |
| **MADHYA PRADESH** | | | | | | |
| 1. | Scattered Villages | 0.79 | 1.11 | 6.36 | 8.26 | 3.88 |
| 2. | TGCS | 2.07 | 11.11 | 56.25 | 69.43 | 34.31 |
| 3. | Watershed | 3.33 | 27.45 | 12.88 | 161.30 | 7.86 |
| 4. | Control | 0.10 | 7.18 | 10.31 | 17.59 | 6.29 |
| 5. | All | 6.29 | 46.85 | 85.80 | 256.58 | 52.33 |
| 6. | Excluding Control Village | 6.16 | 39.67 | 75.49 | 238.99 | 46.04 |

lakhs come from shrubs and about 102 lakhs come from grass. The value of usable biomass in the control village is likely to be over-estimated in a relative sense because the entire area under CPLR is used for the assessment-this issue is already highlighted earlier. It is therefore useful to consider only the estimates excluding the control village.

The information for Madhya Pradesh are: Rs. 238.99 lakhs of the total biomass value for a year, excluding the control village. This consists of 6.16 lakhs from trees, 39.67 lakhs from shrub and 75.49 lakhs from grass.

The figures in Table 14a are fairly substantial even for individual villages. Of course these estimates may provide only a broad order of magnitude rather than systematic estimates. There may be an element of overestimation. Also there is no predictability of such values to flow year after year. The value of leaf-material in Rajasthan is Rs. 62.19 lakhs and Rs. 46.04 lakhs in Madhya Pradesh. These values however, may be treated as tentative.

**Table 14b: Incremental Value of Biomass per Hectare (Rs. Lakh/Ha)**

| States | Diff. between Control and other Villages/TGCS/Watershed | | | |
|---|---|---|---|---|
| | Tree | Shrub | Grass | Total |
| Rajasthan-All | 0.36 | 0.09 | 0.01 | 0.47 |
| Excluding Udaipur | 0.13 | 0.09 | 0.01 | 0.23 |
| Madhya Pradesh-All | 0.63 | 0.19 | 0.04 | 0.86 |

Note: the estimates are based on Tables 14 and 18.

Lastly, we have estimated incremental value of biomass per ha by comparing the values for the project and control villages. The estimates are presented in Table 15. It is revealed that the incremental value of biomass is Rs. 47,000 per hectare in Rajasthan and Rs. 85,000 per ha in Madhya Pradesh. While it may not be realistic to attribute the entire difference to the CPLR-management undertaken in the project villages, a significantly large proportion could be due such interventions. Again, it may be noted that the estimate of incremental value is somewhat under-estimated as it has been out by taking the estimates for the control village as a base, which as we have noted above, is likely to be overestimated.

Moreover the values, based on the estimates of standing biomass, however capture only a part of the total valuation, which may include various environmental services. An earlier analysis based on a small area of regenerated land indicated that the total value, based on Natural Resource Accounting System, was about 1.30 lakhs per hectare [Mondal et.al; 2007].

We tried to work out expenditure incurred till now for developing CPLRs in the villages for which biomass estimates have been generated. The information in Table 15 suggests that the expenditure per hectare varies significantly across villages. It ranges from Rs. 2000/ to Rs. Rs. 10,000 per hectare in Madhya Pradesh whereas it ranges from Rs. 2,000 to Rs. 12,000 per hectare in Rajasthan. This suggests fairly wide variations in the expenditure per hectare across villages. To an extent, this could be due to the variations in the intensity of investment in water harvesting structures. Also, it is likely that the estimates of expenditure by FES, in certain villages, constitute only a part of the total investment in water harvesting structures and other measures for soil-water conservation in case the activities undertaken by FES is linked to the ongoing schemes like watershed development in the study areas. This aspects needs to further clarification.

**Table 15 : Expenditure for CPLR-Management in the Study Villages**

| | Villages | (Rs. Lakh ) | Total Area (Ha) | Exp/Ha (Rs. lakh) |
|---|---|---|---|---|
| | **RAJASTHAN** | | | |
| 1 | Thoria -watershed | 94.90 | 4561.00 | 0.02 |
| 2 | Bharenda | 13.91 | 175.00 | 0.08 |
| 3 | Amaritya | 11.82 | 102.00 | 0.12 |
| 4 | Sanjhadi ka Badia | 15.30 | 175.00 | 0.09 |
| 5 | Saredi Kheda | 11.50 | 145.00 | 0.08 |
| 6 | Cheetrawas | 11.54 | 431.00 | 0.03 |
| 7 | Dheemri | 9.67 | 113.00 | 0.09 |
| | **Total - Rajasthan** | 168.63 | 5702.00 | 0.03 |
| | **MADHYA PRADESH** | | | |
| 1 | Ladwan - watershed | 48.02 | 3152.00 | 0.02 |
| 2 | Rajakhedi | 3.36 | 133.36 | 0.03 |
| 3 | Jagatpura | 6.71 | 114.11 | 0.10 |
| 4 | Rojani | 9.77 | 67.18 | 0.09 |
| | **Total Madhya Pradesh** | 67.86 | 3399.47 | 0.02 |

* The expenditure has been on intensive treatment of common lands and drainage line treatment. Interventions on private lands have been limited. Administrative costs @ 30% of the expenditure in each village are additional.

# 5. Increased Irrigation and Value of Crops

This section tries to assess direct impact of CPLR-management, especially with respect to soil water conservation on extent of irrigation, cropping pattern and net returns from the major crops. The secondary data on area under irrigation however, is difficult to obtain for the study villages. Nevertheless, the field observations suggest that there has been a substantial increase in the area under irrigation, as total number of irrigation wells has been increasing in most parts of the region, including that in the study villages. To an extent this has been influenced by the soil water conservation measures especially, water harvesting structures created through the project interventions by FES and other schemes by the Government.

It may be noted that increased number of wells may not always result in increased area under irrigation. This is because of the phenomenon of increased competition for ground water across households within a village/watershed. There is also a chance that a new well is created in order to partly/fully compensate the loss of ground-water table owing to increasing competition. On the other hand, improved access to power/machinery may lead to expanding the area under irrigation. Gauging the net change is difficult.

## Wells and Water Harvesting Structures

Watershed treatment, especially water harvesting structure, is an important initiative for facilitating expansion of irrigated area on a relatively sustainable basis. It works as a counter force for checking depletion of water under the scenario of growing competition for ground water within the village/watershed. Tables 16 & 17 present basic information on the number of wells and water harvesting structures in sample villages. Whereas the information on WHS is incomplete for the villages in Rajasthan, it could be presumed that each village may have at least 3-4 such structures, each rendering direct benefits to about 7-8 well/well-owners within a village/micro watershed with treated area of 500 ha [Shah, et. al; 2008].

It may also be noted that change in area under irrigation captures the extent rather than intensity of irrigation; the official data do not capture this.

**Table 16: No. of Wells and Water Harvesting Structures in Madhya Pradesh**

| Villages | No. of Hand Pumps | Number of Wells | | | Number of Water Harvesting Structures | | | |
|---|---|---|---|---|---|---|---|---|
| | | Total | Functional | Dry | TGCS | Panchayat | DPIP | Agri. Dept. |
| Jagatpura | 15 | 36 | 32 | 4 | 7 | 1 | 1 | |
| Rajakhedi | 4 | 47 | 42 | 5 | 1 | 3 | | |
| Bhanpura | 4 | 39 | 26 | 13 | 5 | 3 | | |
| Karwakheri | 4 | 47 | 39 | 8 | 3 | 2 | | |
| Rozani | 12 | 84 | 80 | 4 | 5 | 3 | | 3 |
| Ahirwadiya | 20 | 116 | 87 | 29 | | 4 | | |

**Table 17: No. of Wells and WHS among Sample Villages in Rajashtan**

| Village | No. of Wells | | No. of Functional Wells | | Water Harvesting Structure |
|---|---|---|---|---|---|
| | Before | After | Before | After | |
| Amritiya | 16 | 20 | 13 | 18 | 11 |
| Bharenda | 19 | 24 | 22 | 23 | 3 |
| Dholawdia | 29 | 33 | 18 | 28 | 7 (14) |
| Gudha Gokalpura | 218(2003) | 288(2007) | 145 | 250 | NA |
| Jodhaka Kheda | 17 (1991) | 17 (2007) | 12 | 12 | NA |
| Sanjari ka Badia | 20 | 27 | 4 | 12 | 2 |
| Saredi Kheda | 45 | 60 | 44 | 59 | 3 |
| Thoria | 34 | 39 | 26 | 34 | 2 (35) |
| Pilpayi | | | | | NA |
| Cheetrawas | 20(2001) | 30(2007) | 20(2001) | 30(2007) | 6 |
| Dhimdi | 28(2001) | 37(2007) | 30 Wells, 1 Tube Well | 36 Wells, 2 Tube wells | 1 |

## 5.1 SURVEY OF SELECTED WELLS

Alternatively we have tried to identify the direct impact by focusing on selected water harvesting structures (WHS), which in most cases may have helped recharging of the ground water table in the vicinity. Of course, geographical proximity may not necessarily result in the positive impact on ground water table, irrespective of the hydrological structures therein. We had therefore consulted the FES-functionaries and the village communities for identifying the wells and the beneficiaries, likely to have obtained the direct benefit from WHSs. Such information was not available in the control villages, which in turn, was reflected as not-so-appropriate selection of the wells; this was particularly observed in Ahirbadia-the control village in Madhya Pradesh.

A primary survey was conducted using a brief schedule for collecting information from the selected owners of the wells, identified as above. In all 87 households were contacted in 8 villages in Madhya Pradesh and 33 households in 3 villages in Rajasthan. Tables 18 & 19 presents summary of the major observations in Madhya Pradesh and Rajasthan respectively.

**Table 18 : Summary of the Survey of Wells in Madhya Pradesh**

| Details | Main Findings | Remarks |
|---|---|---|
| 1. Coverage: 87 wells for 15 WHS | Average no. of beneficiaries per WHS 5.8 households | No. of beneficiaries range from 2 to 13 per households |
| 2. 63 out of 87 wells had registered increase in irrigated area | Average increase in irrigated area is 1.03 ha per well; 5.72 ha per WHS. The area is 1.36 ha for the 63 wells reporting the increase in irrigated area | The increase in irrigated area is mainly in Rabi season |
| 3. For extrapolation we may assume 4 WHSs with 4 households actually benefiting from each structure in a village | About 22 ha of additional irrigated area due to WHSs in a village | The estimates are subject to rain fall variations |
| 4. The survey covered 20 wells in the control village-Ahirbadia | Only 4 out of 20 households reported positive change in irrigated area; most of the remaining households reported no change | Absence of change in water table in majority of wells is due to inappropriate selection of wells as there was no prior information on this aspect in the control village |

The summary presented in Table 18 depicts a fairly positive picture especially if one compares the scenario in the project villages with the control village. What is however noteworthy is that about 28 per cent of the sample wells/households in the project villages did not experience any positive impact on irrigation; this is despite the fact that the rainfall condition in the study area in Madhya Pradesh has been quite favourable for the past few years.

The scenario in Rajasthan however, is different as depicted in Table 19.

The observations reinstate the findings from a number of studies on watershed development, especially in drought prone/dry land regions about the limited and selective impact of WHSs on crop production and income [Shah, 2001].

We have tried to verify the scenario of impact on irrigated area by looking at the change sin cropping pattern in the study villages.

**Table 19 : Summary of the Survey of Wells in Rajasthan**

| Details | Main Findings | Remarks |
|---|---|---|
| 1. A total of 33 wells in three villages were covered under the survey. This included 8 wells in Pilpayi- the control village | 19 out of 33 wells had benefited directly; 18 from the two project villages and one from the control village | 7 out of 15 wells in Thoria village did not report direct benefits; low impact in Pilpayi could be due to the absence of a priori information about the wells having received direct benefits from the WHS in the village |
| 2. Most of the wells (except 7) are older than 20 years | 30 out of the 33 wells have been deepened after 2001 | Continuous increase in the no. of wells in the recent time-phenomenon common to most of the dry land regions in the country |
| 3. Depth of ground water table has increased in the case of most of the wells | Increase in irrigated area reported in the case of 19 out of 33 wells despite the lowering down of water table raises the issue of sustainability; it is difficult to gauge direction of the cause and effect of the reported increase in irrigation | Information from well-monitoring by FES partly confirm this phenomenon |
| 4. Average increase on 0.66 ha per wells in the sample; 1.15 ha per wells reporting increase in irrigation | Almost 50 % of the sample wells in Thoria did not receive positive impact. This needs to be probed as Thoria is an important village from the view point of the project-intervention | To a large extent this could be due to low rainfall in this area during the past few years |
| 5. It is reasonable to assume an average of 4 WHSs with 3 wells actually benefiting from each of the structures in this drought prone area | This may amount to about 14 ha of additional area under irrigation per village on a sustained basis | The impact is variable over time; also there is increased competition for drawing ground water |

## 5.2 CHANGES IN CROPPING PATTERN

The information on changes in cropping pattern is available for nine villages in Rajasthan and eight villages in Madhya Pradesh. These include 4 out of the 11 villages covered by the micro level study in Rajasthan (excluding two villages where the period covered for comparison is less than 3 years) and 5 out of the six villages in Madhya Pradesh. The comparative picture of cropping the pattern has been presented in Appendix 2.

The information presents comparative picture of cropping pattern over time [see Appendix 1]. The major observations emerging from the comparative scenario of cropping pattern among these villages are: (i) There is a substantial increase in cropped area in the case of 4 out of 5 villages in Madhya Pradesh; this also includes the control village. The increase in area is accompanied by cultivation of new crops such as soybeans, gram, Masoor, wheat that were not cultivated earlier in these villages. (ii) In Rajasthan whereas irrigated area has declined in the later year, perhaps due to the

sub-normal rainfall conditions in the recent years, there has been a substantial increase in the area under un-irrigated crops in Dhuwadi and Cheetrawas. Overall the cropped area has increased in these two villages unlike in Sanjadi Ka Badiya and Saredi Kheda where the changes very marginal. Cotton and vegetable are new crops. The major increase in cropped area has taken place under Jowar and Bajra in Dhuwadiya.

Overall the scenario does not indicate a significant and/or uniform increase in the area under Rabi-crops or irrigated crops. Also the comparison with the control village (in the case of Madhya Pradesh) does not suggest differential pattern vis-avis the project villages unlike what was observed in the case of biomass estimates in the previous section.

Given this scenario we have tried to estimate the incremental income from crops by using the information from the survey of wells as depicted in Tables 18 & 19

## 5.3 INCREMENTAL INCOME FROM CROPS

The estimates in this section are based on three important assumptions: (i) Increased in irrigated area is mainly due to recharge of irrigation wells influenced by the construction of WHSs under the project; (ii) The increased irrigated area especially during Rabi is put mainly under wheat in the case of Rajasthan and Wheat, Gram, Dhaniya in the case of Madhya Pradesh plus soyabeans in Kharif; and (iii) an average estimate of net returns derived from collection of primary data from a few framers in the study villages. The estimates of net returns are inclusive of the cost of family labour. In what follows we present some tentative estimates of the incremental income from irrigation in the study area [Table 20].

**Table 20: Incremental Income due to Increased Irrigation**

| Details | Madhya Pradesh | Rajasthan |
|---|---|---|
| 1. Average Increase in Irrigated Area (from 4 WHSs) per Village | 22 ha in Rabi | 14 ha in Rabi |
| 2. Main Crops | Soybeans; Wheat and Gram | Maize and Wheat |
| 3. Net Returns for Major Crops (Rs./ha) | Soybeans- 10,000<br>Wheat -23,500<br>Gram- 20,300 | Miaze-15,600<br>Wheat-25,500 |
| 4. Net Returns per Village (Rs.) | 5, 170,00 from wheat | 3,57,000 from wheat |
| 5. Additional Fodder from the Crops Residue | Not Available | Not Available |
| 6. Remarks | Net returns could be reduced in the wake of the hike of energy prices and better compliance for paying the actual charges for using electricity | Same as in M.P. Plus the issue of over drawl of ground water under the situation of scanty rainfall. |

Two important aspects deserve special attention in this context: (a) the above estimates are under reported to the extent it does not capture the changes in cropping pattern in Kharif season; also increased yield due to increased irrigation intensity and/or soil-moisture is not taken into account; and (ii) the increase in irrigated area may vary according to the actual number of water harvesting structures in a village; this may vary from 1 to 5 depending on the topography and also on existing structures that may have been created under other schemes/interventions. Working out incremental area and income thus becomes difficult.

# 6. Impact on Land Livestock: Some Estimates at Village Level

This section captures the change in land-use and livestock in the study villages. The analysis of the change ion land use is based on the secondary data whereas that on livestock is based on primary data collected by FES through a census of all the households in the study village. The census survey on livestock in Rajasthan provides information for two points of time whereas that for Madhya Pradesh is for one year, which makes it difficult for ascertaining the changes in livestock economy.

## 6.1 CHANGES IN LAND USE

Table 21 & 22 present the changes in the major categories of land use among the study villages in Madhya Pradesh and Rajasthan. The information for Madhya Pradesh is somewhat incomplete due to non-availability of data from the official records. The information on the changes in net sown area for 5 out of 6 villages suggest that the area has increased substantially in two villages-Rajakhedi and Ahirbadia, which is a control village; in Bhanpur the net are sown has increased only marginally. Similarly, area under irrigation has in two villages viz; Rajakhdi and Karwkhedi; for other villages either comparable data are not available or, there has been a decline in irrigated area e.g. in Rojani.

Average rainfall in the region is fairly good; around 900mm and that the rainfall has been consistent good for the past 3-4 years. Ideally, one would have expected significant positive impact on net sown area and irrigated, given the favourable rainfall conditions in the region. Absence of this may however, take us back to the issue of non-reliability of data on land use-the issue already mentioned earlier in section 3.

Conceding that the project intervention has led to creation of a few water harvesting structures in each of the study villages (except the control), and that these structures have resulted in the increase in irrigated area, as demonstrated in the previous section 5, the land use data presented in Table 21 seem to have missed out on some of these

changes that reportedly have occurred in the post-project period in these villages. However, in absence of the reliable data it may not be useful to draw any meaningful observations from Table 21 .

**Table 21: Changes in Land-Use among Sample Villages in M.P (Land in Ha)**

| Village (No. of HHS) | Total Area | Net sown | Gross Irrigated | Fallow | Rainfall (mm) | Area under Regenerated commons | Area under Other commons |
|---|---|---|---|---|---|---|---|
| **Bhanpura (77)** | | | | | | | |
| 1999-2000 | 396 | 213.92 | NA | | | | |
| 2006-07 | | 218.47 | 39.40 | 179.16 | 950 | 122.4 | |
| **Ahirwadiya –Control (216)** | | | | | | | |
| 1999-2000 | 977 | 458.62 | NA | | | | |
| 2006-07 | | 541.23 | 76.70 | 136.96 | 900 | 178.2 | |
| **Rojani (130)** | | | | | | | |
| 1999-2000 | | 446.62 | 102.75 | | | | |
| 2006-07 | | 426.90 | 97.30 | | | 67.18 | |
| **Rajakhedi (53)** | | | | | | | |
| 2003-04 | 525.96. | 19.08 | 9.36 | | | | |
| 2006-07 | | 86.79 | 18.84 | 400.00 | 900 | 92.564 | |
| **Karwakhedi (108)** | | | | | | | |
| 1999-2000 | 270.71. | 310.68 | 54.43 | | | | |
| 2006-07 | | 306.18 | 68.18 | 61.83 | 900 | 277.9 | 8.46 |
| **Jagatpura (92)** | | | | | | | |
| 2007 | | | | 300 | 900 | 114.11 | |
| 2004 | | | | | | | |

Note: Data on land-use is from Patwari's record.

An important observation from the table is that It also observed that about 100 ha of common land has been brought under community management by FES; the highest in Karwakhedi (about 276 ha) and lowest in Rojani ( 76 ha). Community management in the control village i.e. Ahirbadia has started only since the last year. A total of about 716 ha of land have been brought under community management by FES in five villages having 460 households. This excludes Ahirbadia-the control village. The average land under community management per household works out to be 1.55 ha. This, given the declining size of CPLRs, is a fairly substantial area. Assuming that one adult cattle unit could be supported on one acre of land, the average land area under CPLRs inn the study villages could support nearly 4 ADUs per households. The scenario is somewhat different in Rajasthan. This issue has been discussed subsequently in this section.

## Table 22: Land Use among Sample Villages in Rajasthan (Land in Ha)

| Villages (No. of HHs) | Land Use Category | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Area | Fallow land | Gross sown area | Gross irrigated area | Net sown area | Annual rainfall of the nearest point of the study village | Area under other Manage-ment | Area under regene-rated commons |
| **Amritiya (90)** | | | | | | | | |
| 1999-2000 | 295 | 65 | 249 | 124 | 134 | | 95 | 50 |
| 2006-07 | | 12 | 289 | 140 | 187 | | | |
| **Bharenda (60)** | | | | | | | | |
| 1999-2000 | 331. | 53 | 77 | 37 | 38 | | 100 | 75 |
| 2006-07 | | 19 | 124 | 61 | 72 | | | |
| **Dhuwdia (92)** | | | | | | | | |
| 2001-02 | 993. | 148 | 251 | 78 | 209 | 629 | 209 | 83.3 |
| 2005-06 | | 120 | 320 | 99 | 237 | 402 | | |
| **Gudha Gokalpura (257)** | | | | | | | | |
| 1997-98 | 947 | | 336 | 148 | 262 | 445 | 0 | 45 |
| 2001-02 | | | NA | | 252 | 487 | | |
| **Jodhaka Kheda (163)** | | | | | | | | |
| 2003 | 720 | 56 | 112 | 15 | 57 | | 0 | 60 |
| 2007 | | | NA | | | 377 | | |
| **Sanjari ka Badia (65)** | | | | | | | | |
| 2003 | | 56 | 112 | 15 | 57 | | 25 | 150 |
| 2007 | | | NA | | | 377 | | |
| **Saredi Kheda (90)** | | | | | | | | |
| 2003 | | 116 | 168 | 30 | 57 | 544 | 32 | 70 |
| 2007 | | | NA | | | | | |
| **Thoria (136)*** | | | | | | | | |
| 2001-02 | 628. | 128 | 707 | 396 | 394 | 629 | 115 | 62.56 |
| 2005-06 | | 22 | 275 | 118 | 248 | 402 | | |
| **Pilpayi -Control (100)** | | NA | NA | NA | NA | NA | NA | NA |
| **Cheetrawas (155)** | | | | | | | | |
| 2003 | 856. | 27 | 107 | 5 | 102 | 687 | 364 | 267 |
| 2007 | | 27 | 118 | 5 | 102 | | | |
| **Dheemri (167)** | | | | | | | | |
| 2003 | 232. | 44.44 | 93 | 25 | 68 | 564 | 25 | 68 |
| 2007 | | 43.44 | 94 | 25 | 69 | 588 | | |

Note: Based on Village Level Information from FES. * The village was split into two villages during 2001-02. This information pertains to Thoria village after the split.

The estimates for Rajasthan in Table 22 also present somewhat similar scenario in so far as the data is incomplete for six out 11 villages. The information for Thoria is non-comparable because the data for the initial period pertain to a larger undivided village; later on it has been split into two villages. As a result all the estimates for Thoria

indicate a decline, which is misleading. The information in Table 22 thus suggest that there has been increase in net and gross sown area and also in gross irrigated area in three villages viz; Amaritya, Bharenda, and Dhuwadiya. The area has more or less remained same in the case of Dheemri and Cheetrawas. For the remaining six villages, comparable data are not available.

It may be noted that the rainfall in the study area is low to moderate. What is worse is the high year to year fluctuations with the last two years having lower than average rainfall. Given the low and erratic rainfall in the region, and given the limited availability of land use data, it is once again, difficult to discern sustained changes in land-use in the region.

Limited impact on land-use pattern and the variability over time, may also impinge on the impact of project interventions on livestock. Given this caveat we may look at the scenarios of livestock population in Madhya Pradesh and Rajasthan; the changes would be traced only in the case of Rajasthan for which information for two points of time is available.

## 6.2 CHANGES IN LIVESTOCK

Tracking changes in livestock population is as complex as that of gauging irrigated area. The problems pertain to inadequacy of information on quality of livestock and also about the frequent changes taking place in the number of livestock even during a year.

Notwithstanding the limitations, we have presented total number of livestock (major species) among the sample villages. The information is based on the primary survey conducted by the village community with the support of FES-functionaries.

**Table 23 : Livestock among Sample Villages in MP (No.)**

| Village | | Cow | Bullock | Buffalo | Goat |
|---|---|---|---|---|---|
| Bhanpura | 2008 | 209 (3.17) | 45 (0.68) | 179 (2.71) | 155 (2.35) |
| Ahirwadiya | 2008 | 457 (2.42) | 140 (0.74) | 280 (1.48) | 463 (2.45) |
| Rojani | 2008 | 244 (2.14) | 87 (0.76) | 89 (0.78) | 175 (1.54) |
| Rajakhedi | 2008 | 174 (3.22) | 35 (0.65) | 128 (2.37) | 143 (2.65) |
| Karwakhedi | 2008 | 371 (3.64) | 64 (0.63) | 177 (1.74) | 339 (3.32) |
| Jagatpura | 2008 | 221 (2.01) | 37 (0.34) | 157 (1.43) | 157 (1.43) |

Note: Figures in parentheses indicate number per household.

While we do not have comparable data for the villages in Madhya Pradesh information in Table 23 indicate that the total number of livestock cows and buffalos is higher in the case of the control village as compared to other villages. This could be a combined effect of the larger area under CPLR and also larger number of households (i.e. 216) as compared to other villages. It is however, difficult to ascertain whether the gap between the control and other villages would have been larger prior to the project-intervention or not. Estimates of livestock ownership per household, based on the census information however, suggest a mixed scenario.

The information for the 10 out of 11 villages in Rajasthan provides a picture of changes that have taken place in the villages. Unfortunately the information for the control village is not available [Table 24). It is observed that number of cows have declined in 7 out of 10 villages; this pattern is consistent with the macro picture observed in section 3. What is somewhat surprising is that number of buffalo has declined in five out of 10 villages; the villages covered by BAIF (i.e. Godha Gokulpura, Jodha Ka Kheda) have shown substantial increase in buffalo-population. Cross breed cows seem to have been introduced in Godha Gokulpura, Jodha Ka Kheda, and Dheemri.

A major difference with the state level scenario is that sheep population has increased in six out of 10 villages. Goat population has increased in all the villages except Amaritya and Jodha Ka Kheda. The increase, though selective, in livestock population, despite not-so-favourable rainfall conditions in the past 2-3 years, could be due to CPLR-management. Also the information on the changes in livestock population especially, the increase in number of goats, suggest that the impact, is more in favour of the small livestock.

How far the increase in livestock population is attributable to the CPLR-management is a complex issue, which requires further probing in the light of the fact that livestock population, especially the ruminants, tends to vary year by year, depending on a number of factors including rainfall. Also the information in Table 24 11 suggests significant variations in the extent of increase in the number of buffalo, sheep, and goat across the villages. Establishing a one-to-one relationship however, may be difficult. The issue will be taken up in the subsequent part of this section.

Chart 4 presents a summary of the important variables influencing the livestock economy in the study region.

**Table 24: Changes in Livestock among Sample Villages in Rajasthan (No.)**

| Village | Bullock | Cow | Cross- bred Cow | Buffaloes | Sheep | Goat |
|---|---|---|---|---|---|---|
| **Amritiya** | | | | | | |
| 1997 | 103 | 340 | 0 | 157 | 235 | 404 |
| 2007 | 96 (1.06) | 315 (3.5) | 8 | 154 (1.71) | 187 (4.41) | 397 (N.A.) |
| **Bharenda** | | | | | | |
| 2001 | 99 | 110 | 0 | 143 | 93 | 470 |
| 2007 | 70 | 90 | 0 | 110 | 150 | 725 |
| **Dhuwdia** | | | | | | |
| 2002 | NA | 210 | 0 | 128 | 285 | 449 |
| 2007 | 13 (0.14) | 231 (2.51) | 0 | 183 (1.99) | 372 (4.04) | 538 (5.65) |
| **Gudha Gokalpura** | | | | | | |
| 1997 | 180 | 312 | 6 | 137 | 250 | 850 |
| 2003 | 106 | 155 | 22 | 177 | 140 | 1170 |
| **Jodhaka kheda** | | | | | | |
| 1993 | 64 | 160 | 0 | 106 | 360 | 728 |
| 2008 | 13 (0.08) | 79 (0.79) | 51 | 96 (0.59) | 151 (0.93) | 592 (3.63) |
| **Sanjari ka Badia** | | | | | | |
| 2002 | 45 | 54 | 0 | 66 | 266 | 211 |
| 2007 | 19 | 46 | | 58 | 391 | 238 |
| **Saredi Kheda** | | | | | | |
| 2002 | 24 | 165 | 0 | 101 | 596 | 297 |
| 2007 | 77 | 169 | 0 | 114 | 797 | 402 |
| **Thoria (new data)** | | | | | | |
| 2002 | NA | 149 | 0 | 250 | 239 | 336 |
| 2007 | 26 (0.20) | 304 (1.28) | 0 | 212 (1.59) | 328 (2.00) | 543 (4.67) |
| **Cheetrawas** | | | | | | |
| 2001 | 422 | 548 | 0 | 313 | 703 | 1845 |
| 2007 | 393 | 508 | 0 | 484 | 567 | 2042 |
| **Dheemri** (Revenue Village) | | | | | | |
| 2001 | 201 | 310 | 11 | 277 | 196 | 1756 |
| 2007 | 189 | 297 | 77 | 350 | 148 | 1869 |
| **Thoria (old data)** | | | | | | |
| 2002 | NA | 126 | 0 | 221 | 191 | 342 |
| 2007 | 28 | 174 | 0 | 216 | 272 | 635 |

Note: Figures in parentheses indicate number per household.

This is an indicative Chart; this could be developed further by getting additional information for Dhuwadiya. A preliminary glance of the pattern in the chart would suggest that Bharenda, Cheetrawas, Thoria, and Pilpayi have some favourable features. In MP the villages are –Bhanpura, Karwakhedi, Ladwan, and Ahirbadia. How do we interpret this, remains to be explored in case you choose to do that.

## Chart 4: Linking Biomass with Livestock-A Synoptic View

| | Area Under Management | HHs | Area/ HHs | Year | Shrub/ Ha | Grass/ Ha | No. of WHS | Change in Buff | Change in Sheep |
|---|---|---|---|---|---|---|---|---|---|
| **RAJASTHAN** | | | | | | | | | |
| **Bharenda** | 175 | 60 | **2.92** | **1998** | **16.23** | 0.49 | 3 | - | **+** |
| Amratiya | 145 | 90 | 1.61 | 1999 | 3.69 | 0.76 | 11 | - | - |
| Sanjadi Ka Badiya | 175 | 60 | 2.92 | 1998 | 4.89 | 1.79 | 2 | - | + |
| Saredi Kheda | 102 | 68 | 1.50 | 1998 | 2.25 | 1.12 | 3 | + | + |
| Dheemri | 113 | 167 | 0.68 | 2002 | 3.53 | 5.23 | 1 | + | - |
| **Cheetrawas** | 431 | 155 | **2.78** | **2001** | **9.29** | **6.50** | **6** | **+** | - |
| Dhuwadiya | 283 | 92 | 3.08 | 1991 | | | 7 (14) | + | + |
| Gudha Gokulpura | 45 | 257 | 0.18 | 1997 | **2.45** | 0.09 | | **+** | - |
| Jodha Ka Kheda | 60 | 163 | 0.37 | 1991 | 0.78 | 0.51 | | - | - |
| **Pilpai (Control)** | **829** | **100** | **8.29** | **N.A.** | **1.60** | **0.71** | | | |
| **Thoria TGCS** | 583 | 136 | **4.29** | | **5.23** | **1.26** | **2 (35)** | **-** | **+** |
| Thoria Watershed | 4561 | 677 | 6.74 | 1991 | 4.38 | 1.44 | | | |
| **MADHYA PRADESH** | | | | | | | | | |
| **Bhanpura** | 156.44 | 77 | **2.03** | **1997** | | | **8** | | |
| Rajakhedi | 92.56 | 53 | 1.75 | 2002 | 2.1 | 1.92 | 4 | | |
| Rojani | 67.18 | 130 | 0.52 | 1998 | 4.4 | 2.51 | 8 | | |
| Jagatpura | 114.11 | 92 | 1.24 | 1998 | 2.22 | 3.16 | 9 | | |
| **Karwakhedi** | 286.43 | 108 | **2.65** | **1999** | | | **5** | | |
| **Ahirwadiya (Control)** | 944 | 216 | **4.37** | **N.A.** | **5.07** | **1.21** | **4** | | |
| **Ladwan TGCS** | **1263** | **134** | **9.43** | | **5.87** | **4.95** | | | |
| Ladwan Watershed | 3152 | 771 | 4.09 | 1998 | 5.81 | 4.54 | | | |

# 7. Perceived Benefits: Impact on Livestock and Livelihood

The analysis in this section draws mainly from the primary survey of 1053 households carried out during 2007. The main purpose for the survey, as noted earlier, was to (a) gauge people's perceptions about the various benefits that have resulted from the CPLR-management with a special focus on livestock; and (b) understand how the benefits estimated in the previous three sections have been distributed among the village communities. This was particularly important because ascertaining quantitative impact of increased biomass-both on CPLRs and on farmers' fields (due to increased crop production) on the size, quality, and productivity of livestock is difficult given the scope of the study. This is particularly so, because unlike the direct impact on irrigation and crop-production, livestock economy does not tend to respond directly and immediately unless other constraints-financial, technical, labour-related, and distress (drought) driven-also get simultaneously attended to.

## 7.1 SOCIO-ECONOMIC PROFILE OF THE SAMPLE HOUSEHOLDS

Before examining the perception and distribution of benefits it may be useful to get a brief profile of the sample households. The sample has been drawn by adopting a method of stratified quota-sampling. A quota of minimum 50 households was selected from each village; in case the total number of households in a village is higher than 100, then the sample was to be increased to 50 per cent of the total number of households in the village. Overall the sample, consisting of 1053 households, constitutes about 54 per cent of the total number of households in the study villages. There are however, a few deviations from the original scheme of sample size; this was mainly due to the logistics and other difficulties in getting respondents during the short span of survey period.

Selection of sample households was governed by two considerations: (i) coverage of most of the habitations/clusters within the village; and (ii) coverage of households

with land and irrigation; land without irrigation; and landless or semi-landless with no or limited livestock ownership and no buffalos. The idea behind the second aspect was to include some of those, considered as the least resourceful among the village community. The actual selection was based on the information obtained from the informed persons in the village. Table 25 presents main features of the sample households in the two states.

**Table 25: Socio-Economic Profile of the Sample Households-Main Features**

| Details | Madhya Pradesh | Rajasthan |
|---|---|---|
| 1. Caste Composition (% to total the sample households) | SC-35.2<br>ST-Nil<br>OBC-52.8<br>Other-12.0 | SC-11.8<br>ST-33.8<br>OBC-46.2<br>Other-8.2 |
| 2. Economic Status ( %) | Not-so Poor-80.3<br>Very Poor-19.7 | Not-so Poor-90.7<br>Very Poor-9.3 |
| 3. Ownership of Land (%) | Landed-92.5<br>Landless-7.5 | Landed-97.9<br>Landless-2.1 |
| 4. Access to Irrigation (%) | 68.0 | 86.7 |
| 5. Land Holding Size in Vegha ( % to all households) | < 1 Ha- 27.5<br>1-2 Ha – 32.0<br>>2 Ha – 33.1<br>Landless-7.5 | < 1 Ha – 45.6<br>1-2 Ha – 31.9<br>>2 Ha – 20.5<br>Landless-2.1 |
| 6. Irrigation from Wells | 215 out of 347 landed households (i.e. 62 %) have access to irrigation from wells | 559 out of 664 landed households (i.e. 84 %) have access to irrigation from wells |
| 7. Households with Ownership of Livestock (% ) | Local Cows-78.4<br>Buffalo-45.1<br>Bullock-38.1<br>Sheep-0.3<br>Goat-36.0<br>Any of the Above-93.7<br>No Sheep or Goat-63.7 | Local Cows-59.6<br>Buffalo-61.5<br>Bullock-43.1<br>Sheep-15.1<br>Goat-77.7<br>Any of the Above-94.6<br>No sheep or Goat-55.3 |

The information presented above give a fairly good snap shot of the households asset-base. The important observations emerging from Table 25 could be highlighted as follows:

a. Nearly 27 per cent of the households in Madhya Pradesh and 45 per cent in Rajasthan are land poor i.e. landless or having less than one hectare of land. Among those having land a substantial proportion of the households have irrigation-68 % in Madhya Pradesh and 87 % in Rajasthan. A large majority of households having access to irrigation, sources it from wells.

b. In Madhya Pradesh ownership of livestock, especially goat and bullock is confined to a relatively smaller sub-set of the sample households; sheep are almost non-existent in the study villages in this state. The profile in Rajasthan is quite different. Whereas nearly 60 per cent of the households own local cows and buffalos, a significantly large proportion i.e. nearly 78 per cent of the households own goats; ownership of sheep is confined to only 15 per cent of the sample households among study villages in the state. The relatively better coverage of households with ownership of livestock in Rajasthan is despite the fact that nearly 46 percent of the households in the state land poor.

c. Overall, the socio-economic profile of the sample households suggests that whereas access to land and irrigation is fairly extensive, that of livestock is somewhat limited. This may reinstate the proposition raised earlier in section about the complex and non-linear relationship between increased access to fodder from CPLRs and incidence as well as composition of livestock ownership among the village community.

The last point raises the issue of link between land-irrigation and livestock ownership in the study area. This is important as it may help setting the stage for understanding the trajectory through which livestock economy could be enhanced in a situation where a majority of households are land (and water) poor. We turn to this issue briefly.

## 7.2 LIVESTOCK OWNERSHIP-LINKS WITH LAND AND WATER

We have worked out ownership of different types of livestock by and landholding size classes, and also by access to irrigation.

Table 26 presents information on the average number of livestock owned per households in the study villages. These estimates are worked out by considering the actual number households owning the specific livestock within each village. According to the estimates, average number of cows (local) per household is 2.58 in Madhya Pradesh and 2.18 in Rajasthan. For Buffalo the numbers are 2.34 and 2.17 respectively. Average number of goats is higher in Rajasthan (5.28) as compared to Madhya Pradesh. (4.21)

## Table 26: No. of Livestock Owned among Sample Households

| State/Village | Average No. of Livestock | | | | | |
|---|---|---|---|---|---|---|
| | Local Cow | Buffalo | Bullock | Sheep | Goat | All |
| **MADHYA PRADESH** | | | | | | |
| Karwakhedi | 2.28 | 1.87 | 1.39 | 1.00 | 5.33 | 6.30 |
| Bhanpura | 3.19 | 3.38 | 1.69 | – | 3.83 | 7.19 |
| Ahirwadiya | 3.18 | 2.62 | 1.53 | – | 5.38 | 7.58 |
| Rajakhedi | 2.34 | 2.42 | 1.32 | – | 3.18 | 5.18 |
| Jagatpura | 1.97 | 1.62 | 1.67 | – | 3.44 | 3.70 |
| Rojani | 2.10 | 1.85 | 1.73 | – | 3.14 | 4.80 |
| **All Villages** | **2.58** | **2.34** | **1.56** | **1.00** | **4.21** | **5.98** |
| **% of HHs*** | **78.4** | **45.1** | **38.1** | **0.3** | **36.0** | **93.7** |
| **RAJASTHAN** | | | | | | |
| Cheetrawas | 1.83 | 1.60 | 2.27 | 5.27 | 6.57 | 12.86 |
| Dheemri | 1.50 | 1.69 | 1.87 | 9.00 | 3.11 | 7.19 |
| Bharenda | 2.66 | 3.03 | 2.00 | 14.00 | 7.42 | 13.00 |
| Amaritya | 3.21 | 2.37 | 2.00 | 57.00 | 6.83 | 11.22 |
| Sanjadi Ka Badiya | 1.63 | 1.46 | 1.80 | 16.28 | 3.81 | 12.35 |
| Saredi Kheda | 1.65 | 1.74 | 1.80 | 19.45 | 3.79 | 15.66 |
| Thoria | 2.85 | 3.50 | 1.42 | 20.60 | 5.78 | 9.71 |
| Dhuwadiya | 2.85 | 2.24 | 1.29 | 25.67 | 6.68 | 12.38 |
| Godha Gokulpura | 1.55 | 1.57 | 1.99 | 10.08 | 4.37 | 8.31 |
| Jodhaka Kheda | 1.55 | 1.66 | 1.67 | 12.20 | 5.54 | 8.24 |
| Pilpayi | 3.32 | 3.60 | 1.33 | 15.73 | 6.17 | 14.66 |
| **All Villages** | **2.18** | **2.17** | **1.94** | **16.87** | **5.28** | **10.84** |
| **% of HHs*** | **59.6** | **61.5** | **43.1** | **15.1** | **77.7** | **94.6** |
| **Combined- Two States** | **2.35** | **2.22** | **1.79** | **15.74** | **5.06** | **9.12** |

Note: * Indicates percentage of the sample households owning the specific type of livestock.

The above estimates, though based on a sample of households in Madhya Pradesh seem to be lower than what has been obtained by a recent census of livestock conducted by the village-community under the guidance of FES-team. The estimates obtained from the census survey have been presented in Tables 26a & 26b. The estimates presented in Table 26 (a & b) have been worked by taking all the households in the sample (in the case of sample survey conducted for the study) and all the households in the village (in the case of FES-survey).

Whereas the estimates in Tables 26a & 26b show higher values in the case of FES-survey, there are quite a few situations where the sample-survey has either higher or more or less similar estimates as that of the FES-survey. Such situations have been highlighted in the tables.

**Table 26a: Livestock per Households-Comparison of Two Surveys –Madhya Pradesh**

| Livestock | Rojani | | Jagatpura | | Rajakhedi | | Bhanpura | | Karwakheri | | Ahirwadiya | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample 67 | All HHS 114 | Sample 50 | All HHS 110 | Sample 55 | All HHS 54 | Sample 50 | All HHS 66 | Sample 52 | All HHS 102 | Sample 101 | All HHS 189 |
| Cow | 1.63 | 2.14 | 1.34 | 2.01 | 1.87 | 3.22 | 2.68 | 3.17 | 2.02 | 3.64 | **2.40** | 2.42 |
| Bullock | **1.06** | 0.76 | **0.50** | 0.34 | **0.45** | 0.65 | **0.88** | 0.68 | **0.96** | 0.63 | **0.83** | 0.74 |
| Buffalo | 0.55 | 0.78 | 0.94 | 1.43 | 1.15 | 2.37 | 1.76 | 2.71 | 0.83 | 1.74 | **1.17** | 1.48 |
| Goat | **1.31** | 1.54 | 0.62 | 1.43 | 1.27 | 2.65 | 1.38 | 2.35 | 1.85 | 3.32 | **2.13** | 2.45 |

**Table 26b: Livestock per Households-Comparision of Two Surveys-Rajasthan**

| Livestock | Thoria | | Dhuwadiya | | Amaritya | | Jodha Ka Kheda | |
|---|---|---|---|---|---|---|---|---|
| | FES | Sample | FES | Sample | FES | Sample | FES | Sample |
| Bullock | 0.20 | **0.25** | 0.14 | **0.16** | 1.06 | **1.11** | 0.08 | **0.18** |
| Cow | 1.28 | **1.36** | 2.51 | 1.85 | 3.5 | 2.34 | 0.79 | **0.60** |
| Buffalo | 1.59 | **2.02** | 1.99 | **1.34** | 1.71 | **1.46** | 0.59 | **0.92** |
| Sheep | 2.00 | **1.49** | 4.04 | 2.70 | 4.41 | 2.19 | .0,93 | **0.73** |
| Goat | 4.67 | 3.77 | 5.65 | **5.51** | NA | | 3.63 | **4.56** |

An important observation emerging from the above estimates is that values in the sample survey are particularly lower in the case of sheep and goat. This could partly be due to high concentration of these livestock among a few say, 5-10 households within the village. These households may not have been adequately captured in the sample. This may imply under-representation of households having large number of livestock. Moreover, estimates from the census survey by FES do not indicate a significantly high level of livestock ownership in the study villages. The difference though, significant, may not still suggest major difference in the order of magnitude.

A more substantive issue however, is about the distribution of livestock among households with different levels asset-base. Information in Tables 27 and 28 are very pertinent in this context.

It is observed that households having larger land holdings have relatively higher average number of livestock. This holds across type of livestock and states. A similar pattern is also observed in the case of access to irrigation. The results suggest that average number of livestock is higher among those not having irrigation as compared to those having limited irrigation; the highest number however, is found among those with largest area under irrigation.

### Table 27: Livestock Ownership by Land Holding Size

| Type of Livestock | Land Holding Size (No. per household) | | | | |
|---|---|---|---|---|---|
| | Landless | Up to 1 Ha | 1-2 Ha | > 2 Ha | All |
| **MADHYA PRADESH** | | | | | |
| Cow | 2.8 | 1.7 | 2.5 | 3.30 | 2.6 |
| Goat | 4.0 | 3.29 | 2.88 | 6.02 | 4.21 |
| Bullock | 1.5 | 1.35 | 1.34 | 1.73 | 1.56 |
| Buffalo | 1.5 | 1.30 | 1.70 | 3.08 | 2.34 |
| **RAJASTHAN** | | | | | |
| Cow | 2.0 | 1.6 | 2.2 | 3.09 | 2.2 |
| Goat | 3.78 | 4.33 | 5.60 | 7.13 | 5.28 |
| Bullock | - | 1.89 | 1.98 | 1.82 | 1.93 |
| Buffalo | 1.0 | 1.39 | 2.10 | 3.44 | 2.17 |

Source: Primary Survey of Sample Households

### Table 28: Livestock Ownership by Extent of Irrigation (Among Landed Households)

| Type of Livestock | Irrigated Area (No. per HHs) | | | | All |
|---|---|---|---|---|---|
| | No Irrigation | < 0.51 Ha | 0.51 – 1.50 Ha | 1.50 + Ha | |
| **MADHYA PRADESH** | | | | | |
| Cow | 2.3 | 2.3 | 2.3 | 3.7 | 2.6 |
| Goat | 3.5 | 2.9 | 4.1 | 7.1 | 4.2 |
| Bullock | 1.4 | 1.3 | 1.5 | 1.9 | 1.6 |
| Buffalo | 2.3 | 1.5 | 1.8 | 3.8 | 2.3 |
| **RAJASTHAN** | | | | | |
| Cow | 2.2 | 1.8 | 2.2 | 2.7 | 2.2 |
| Goat | 6.1 | 4.1 | 5.8 | 6.4 | 5.3 |
| Bullock | 1.9 | 1.9 | 1.9 | 2.1 | 1.9 |
| Buffalo | 2.7 | 1.6 | 1.8 | 3.6 | 2.2 |

Source: As in Table 27.

Results from sample survey also reinstated the fact that average number of livestock is higher among not-so-poor as compared to very poor households. In a sense this is a tautology since size of livestock ownership (i.e. up to 1 cow and 5 sheep/goat) was an important criteria for selecting the very poor households.

An interesting feature however, is that households without land and irrigation at times have larger size of livestock as compared to those in the middle ranges. This could be due to the fact that such households either belong to livestock herder communities or do not own/cultivate the land jointly owned by the family. While we do not have information on the later aspect, it may nevertheless be noted that the

phenomena observed in Tables 27 and 28 by and large reflect the larger picture observed at the state as well as national levels [Shah, 2007]. This in turn, has significant implications for promoting livestock activities especially among the land and water scarce households in the middle ranges.

We tried to probe this aspect by enquiring whether the households (a) plans to buy additional livestock in the current or the next year; and (b) envisages any problems in continuing with livestock as part of the main source of livelihood in the next 5-10 years. The responses to these questions may help gauging the scope/preference for livestock activity in the villages where CPLR-management has already taken place.

Of course, we recognize the fact that more than the number, quality of livestock assumes special significance for promoting livestock as an important source of livelihood. Nevertheless, responses to these two questions seen in conjunction with each other may give us a better handle to understand the scope and the preferences.

The findings from Table 29a suggest that whereas 32 per cent of the households in Madhya Pradesh had reported purchase of livestock during the last five years that in Rajasthan was 24 per cent. Compared to this, a smaller proportion of the household reported selling of Livestock; about 22 per cent in Madhya Pradesh and 10 per cent in Rajasthan. The largest proportion of households reporting purchase and selling of livestock was found to be among those having > 2 hectares of land in Madhya Pradesh. The pattern is somewhat mixed in the case of Rajasthan. It may be noted that the landless have the lowest proportion of households reporting purchase or sale of livestock with a minor exception in the case of selling in Rajasthan.

Moreover it was observed that about 58 per cent of the households in Madhya Pradesh and 53 per cent in Rajasthan reported their intention to buy additional livestock.

**Table 29a: Purchase and Selling of Livestock in the Last 5 Years**

| | Land Holding Size | | | | All |
|---|---|---|---|---|---|
| | Landless | Up to 1 Ha | 1 to 2 Ha | 2 + Ha | |
| **Purchase (% of households)** | | | | | |
| Madhya Pradesh | 25.0 | 28.1 | 29.2 | 39.5 | 31.7 (120) |
| Rajasthan | 14.3 | 27.2 | 21.7 | 20.9 | 23.9 (162) |
| **Selling** | | | | | |
| Madhya Pradesh | 17.8 | 16.5 | 23.3 | 25.8 | 21.7 (82) |
| Rajasthan | - | 9.4 | 9.2 | 12.2 | 9.7 (66) |

A significantly large proportion of the households indicated that they may face constraints in continuing with livestock activity as an important source of livelihood during the next 10 years. For instance 76 per cent of the sample households in Madhya Pradesh had reported some kind of problems/constraints in perusing this activity in the next 10 years; the proportion was 64 per cent in the case of Rajasthan. Table 29b presents the responses on the constraints faced in strengthening the livestock base among the households. The pattern across the economic categories of households however, is mixed. To an extent, these responses could be influenced by the implicit expectations for getting financial support from the state/developmental agencies like FES or BAIF. Notwithstanding these limitations we tried to probe the major constraints faced in strengthening the livestock sector within the household economy.

**Table 29b: Major Constraints in Adopting/Continuing with Livestock Activity**

| Main Constraint | Land Holding size | | | | |
|---|---|---|---|---|---|
| | Landless | Up to 1 Ha | 1 to 2 Ha | 2 + Ha | All |
| **MADHYA PRADESH** | | | | | |
| 1. Financial Scarcity of Fund | 53.8 | 65.7 | 57.3 | 42.6 | 54.5 |
| 2. Scarcity of Water and Fodder | 15.4 | 15.7 | 9.4 | 11.5 | 12.3 |
| 3. Nobody to take Care of Livestock | 3.8 | 2.0 | 1.7 | 4.1 | 2.7 |
| 4. The Number is Already Sufficient | - | - | 1.7 | 1.6 | 1.1 |
| 5. Absence of Forward Linkages with Dairy | 26.9 | 15.7 | 23.9 | 24.6 | 22.1 |
| 6. Agriculture is More Remunerative | - | 1.0 | 1.7 | 4.9 | 2.5 |
| 7. No Constraints | - | - | 4.3 | 10.7 | 4.9 |
| **All** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |
| **RAJASTHAN** | | | | | |
| 1. Financial Scarcity of Fund | 75.0 | 53.2 | 48.4 | 29.1 | 47.9 |
| 2. Scarcity of Water and Fodder | 12.5 | 31.0 | 30.1 | 34.9 | 31.1 |
| 3. Nobody to take Care of Livestock | - | 3.6 | 2.6 | 3.5 | 3.2 |
| 4. The Number is Already Sufficient | 12.5 | - | 2.6 | 5.8 | 2.0 |
| 5. Absence of Forward Linkages with Dairy | - | 10.3 | 13.7 | 18.6 | 12.6 |
| 6. Agriculture is More Remunerative | - | - | - | 1.2 | 0.2 |
| 7. No Constraints | - | 2.0 | 2.6 | 7.0 | 3.0 |
| **All** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |

As large as 50 per cent of the respondents indicated lack of adequate financial resources as the main constraint in perusing livestock option. While this is quite in tune with the expectations, what is surprising is that nearly one fourth of the households reported lack of water and/or fodder as the main constraint. The proportion is higher i.e. 31 per cent in the case of Rajasthan.

It may be reiterated that while financial constraint may have been reported as the most important factor, resolving that by itself may not work; this has been demonstrated by a number of initiatives especially under the anti-poverty programmes in the country. Nevertheless, CPLR-management may work as an important trigger, though not a complete solution, for promoting livestock economy especially among the very poor and the middle range of households facing several constraints, including scarcity of finance. This issue has been discussed in the light of the
Perceived benefits from the CPLR-interventions in the study villages.

## 7.3 PERCEIVED IMPACTS

Finally, we tried to examine benefits received from the various developmental schemes including FES-interventions. An overwhelmingly large proportion of the households reported increase in availability of fodder, fuel wood, and irrigation. Those reporting increase in income from livestock, improved availability of drinking water for livestock, and reduction in purchase of fodder constituted a relatively smaller proportion [See Table 30]. It may be noted that increase in fodder and fuel wood has been reported by a larger proportion of landless as compared to other households in Madhya Pradesh. In Rajasthan a larger proportion of landless households have reported benefits from fuel wood and wage employment as compared to other households. Similarly increase in ground water table and soil moisture is reported by relatively larger proportion of those in the smallest land holding size as compared to the rest of the landed households. This may indicate pro-poor impact of the project-intervention in Madhya Pradesh.

We tried to ascertain improvements in livelihood support in the past five years. The idea was to understand whether there has been any improvement in the livelihood (income) status and to what extent the improvements are linked to the project interventions in the villages. Of the various sources three sources of livelihood (income) assumed special significance. These are: (i) increase in crop productivity; (ii) increase in irrigation; and (iii) increase in milk production.

Nearly 36 per cent of the households in Madhya Pradesh reported increase in irrigation, the proportion was 48 per cent in Rajasthan. Similarly, 45 per cent of the households reported increase in crop productivity in Madhya Pradesh the proportion was 40 per cent in the case of Rajasthan. The proportion of households reporting increase in milk production was 36 and 50 per cent in Madhya Pradesh and Rajasthan respectively. This is a fairly good coverage.

Table 30: Benefits from Developmental Schemes

| | Land holding size | | | | |
|---|---|---|---|---|---|
| | Landless | Up to 1 Ha | 1 to 2 Ha | 2 + Ha | All |
| **MADHYA PRADESH** | | | | | |
| Increase in Fodder | 80.8 | 51.0 | 57.5 | 54.8 | 56.5 |
| Increase in Soil Moisture | - | 2.0 | 1.7 | 2.4 | 1.9 |
| Increase in Fuel Wood | 3.8 | 2.0 | 1.7 | 1.6 | 1.9 |
| Increase in Irrigated Area | - | 1.0 | 2.5 | 4.0 | 2.4 |
| Improved Access to Drinking Water | - | 2.9 | 4.2 | 3.2 | 3.2 |
| Increase in Ground Water Table | - | 4.9 | 0.8 | 2.4 | 2.4 |
| Wage Employment on Project-Site | - | 2.9 | - | - | 0.8 |
| Benefits from Forest Produces | - | - | 0.8 | - | 0.3 |
| Reduced soil Erosion | - | - | - | - | - |
| No Benefits | 15.4 | 33.3 | 30.8 | 31.5 | 30.6 |
| **RAJASTHAN** | | | | | |
| Increase in Fodder | 25.0 | 46.2 | 43.0 | 47.3 | 45.1 |
| Increase in Soil Moisture | - | 6.8 | 6.3 | 3.3 | 5.9 |
| Increase in Fuel Wood | 12.5 | 1.6 | - | 3.3 | 1.6 |
| Increase in Irrigated Area | - | 0.4 | 0.7 | 1.1 | 0.6 |
| Improved Access to Drinking Water | - | 0.8 | 2.8 | - | 1.2 |
| Increase in Ground Water Table | - | 6.0 | 4.9 | 5.5 | 5.5 |
| Wage Employment on Project-Site | 50.0 | 22.1 | 21.1 | 24.2 | 22.7 |
| Benefits from Forest Produces | - | 1.2 | - | - | 0.6 |
| Reduced soil Erosion | - | 6.0 | 7.7 | 6.6 | 6.5 |
| No Benefits | 12.5 | 8.8 | 13.4 | 8.8 | 10.2 |

## Sources of the Perceived Benefits

Subsequently, we tried to enquire the extent to which such improvements in income could be linked to the project interventions. It is encouraging to note that whereas the increase in milk production was attributed almost entirely to the increased availability of fodder in the case of Rajasthan, this was reported by about 67 per cent of the respondents in Madhya Pradesh.

The pattern with respect to the sources of increased irrigation and crop productivity is somewhat mixed. Whereas 75 per cent of those having reported increase in irrigation, attributed it to the WHS-structures created by FES, the proportion was only 15 per cent in Rajasthan. Private investment in irrigation was sited as the most important source for the reported increase in irrigation. There is obviously an overlap among the various sources of irrigation [See Table 31].

**Table 31: Sources of Change in Irrigation**

| States | Sources | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | WHS-FES | Small Ponds | Kachha Dams | Irrigation Schemes/ Pvt. Efforts | Deepening Of Wells | Improved Methods | Awareness Generation | All |
| Madhya Pradesh | 74.5 | 2.0 | 8.8 | 10.8 | 3.0 | - | - | 100 |
| Rajasthan | 14.9 | 1.0 | 4.4 | 51.7 | 4.7 | 15.2 | 7.4 | 100 |
| Combined | 30.2 | 1.3 | 5.5 | 41.2 | 4.5 | 11.3 | 5.5 | 100 |

Similarly, it is observed that increase in use of improved seeds and chemical fertilizers were among the major reasons for increased crop productivity along with increased irrigation [Table 32]. The present scenario of productivity enhancement seems to be driven mainly by increased use of ground water, accompanied by increased use of chemical inputs. Sustaining the increase in crop productivity and thereby income from agriculture thus may necessitate simultaneous improvement in agronomic practices that are less input-intensive.

**Table 32: Reasons for Change in Crop Productivity**

| Crops | Reasons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Improved Seed-Fertiliser | Use of Pesticides | Increase In Irrigation | Use of Modern Methods | Soil-Moisture | No Change | Other 1 | Other 2 | All |
| **MADHYA PRADESH** | | | | | | | | | |
| Soybeans | 37.6 | 14.6 | 7.8 | 1.6 | 1.9 | 14.9 | 12.4 | 9.3 | 100 |
| Jowar | 33.3 | 7.0 | 8.9 | 2.6 | 2.6 | 25.2 | 10.4 | 10.0 | 100 |
| Wheat | 31.7 | 7.3 | 19.5 | 2.4 | 2.4 | 26.8 | 7.3 | 2.4 | 100 |
| Gram | 55.6 | - | 11.1 | - | - | 11.1 | 11.1 | 11.1 | 100 |
| **RAJASTHAN** | | | | | | | | | |
| Soybeans | 69.9 | 7.0 | 5.9 | 3.0 | 1.9 | 12.0 | 0.2 | - | 100 |
| Jowar | 56.0 | 13.2 | 12.3 | 3.1 | 3.1 | 11.8 | 0.4 | - | 100 |
| Maize | 56.9 | 7.5 | 16.3 | 6.9 | 6.9 | 6.9 | 5.6 | - | 100 |
| Wheat | NA | NA | NA | NA | NA | NA | NA | - | NA |

Overall, the perceptions with respect to various benefits from the developmental schemes highlight the central role of fodder, irrigation, and income from livestock. While these benefits have fairly large coverage of households, the actual quantum may not be so significant as to get reflected in increased income on a sustained basis. This in turn, raises important issues pertaining to the institutions that may address the issues of promoting sustainable livelihood for a large proportion of households, especially the poor, among the village communities. Some of these aspects have been covered under the analysis of good practices in the following Part 2 of this report.

Tables 33 and 34 provide information about the status of grass and trees on the plots under CPLR-management. Whereas we had tried to collect plot wise information, it is likely that the responses may not refer to the same plot with the same specifications. If we consider all the plots together, it is observed that about 55 and 44 per cent of the households in Rajasthan and Madhya Pradesh reported sufficient fodder/good growth respectively. Another 21-24 per cent of the households in the two states reported even a better condition of grass in the two states. A smaller proportion of households viz; 23 per cent in Rajasthan and 32 per cent in Madhya Pradesh reported limited /no increase in grass on the plots [Table 33].

**Table 33: Plot wise Present Position of Grass in Rajasthan and Madhya Pradesh**

| | Plot 1 | | Plot 2 | | Plot 3 | | All | |
|---|---|---|---|---|---|---|---|---|
| | Raj. | M.P. | Raj. | M.P. | Raj. | M.P. | Raj. | M.P. |
| Sufficient + Good Growth | 55.69 (318) | 39.10 (104) | 55.00 (176) | 45.93 (96) | 55.96 (108) | 49.06 (78) | 55.54 (602) | 43.85 (278) |
| Large Quantity + Dense | 19.09 (109) | 19.55 (52) | 26.25 (84) | 26.32 (55) | 18.13 (35) | 27.67 (44) | 21.03 (228) | 23.82 (151) |
| Small Quantity + Sufficient for 2-3 month | 18.56 (106) | 30.83 (82) | 17.50 (56) | 20.10 (42) | 21.76 (42) | 16.35 (26) | 18.82 (204) | 23.66 (150) |
| No Increase at All | 6.65 (38) | 10.53 (28) | 1.25 (4) | 7.66 (16) | 4.15 (8) | 6.92 (11) | 4.61 (50) | 8.68 (55) |
| Total | 100.00 (571) | 100.00 (266) | 100.00 (320) | 100.00 (209) | 100.00 (193) | 100.00 (159) | 100.00 (1084) | 100.00 (634) |

The picture with respect to regeneration of tress is more encouraging as noted in Table 34.

**Table 34: Plot wise Present Position of Trees in Rajasthan and Madhya Pradesh**

| | Plot 1 | | Plot 2 | | Plot 3 | | All | |
|---|---|---|---|---|---|---|---|---|
| | Raj. | M.P. | Raj. | M.P. | Raj. | M.P. | Raj. | M.P. |
| Good Growth / Dense | 57.07 (319) | 30.42 (94) | 50.31 (160) | 23.50 (55) | 48.96 (94) | 25.75 (43) | 53.60 (573) | 27.04 (192) |
| Transplantation is Just Completed | 0.54 (3) | 3.56 (11) | 1.26 (4) | 5.56 (13) | 0.52 (1) | 3.59 (6) | 0.75 (8) | 4.23 (30) |
| Number of Trees is Increasing | 35.60 (199) | 49.84 (154) | 43.71 (139) | 58.12 (136) | 46.35 (89) | 61.68 (103) | 39.94 (427) | 55.35 (393) |
| Small Trees and Bushes | 4.11 (23) | 16.18 (50) | 4.40 (14) | 12.82 (30) | 4.17 (8) | 8.98 (15) | 4.21 (45) | 13.38 (95) |
| No Increase at All | 2.68 (15) | – | 0.31 (1) | – | – | – | 1.50 (16) | – |
| Total | 100.00 (559) | 100.00 (309) | 100.00 (318) | 100.00 (234) | 100.00 (192) | 100.00 (167) | 100.00 (1069) | 100.00 (710) |

Finally we tried to examine improvements in economic status by ascertaining increase in income from various sources. The changes may not be entirely due to the project-interventions in the study villages. Nevertheless a part of the improvement (if any) could indeed be attributed to the development on CPLRs. Table 35 presents the responses on perceived increase in income by land holding size classes.

**Table 35: Increase in Income from Various Sources**

| Sources | | Land Holding Size | | | | All |
|---|---|---|---|---|---|---|
| | | Landless | Up to 1 Ha | 1 to 2 Ha | 2 + Ha | |
| Agriculture | Combined | 9.5 | 51.0 | 52.4 | 63.5 | 52.9 (557) |
| | Rajasthan | 7.1 | 52.4 | 50.9 | 55.4 | 51.6 (350) |
| | M.P. | 10.7 | 46.6 | 55.0 | 72.6 | 55.2 (207) |
| Agri. Labour | Combined | 59.5 | 55.6 | 67.6 | 56.3 | 59.7 (629) |
| | Rajasthan | 28.6 | 49.2 | 63.9 | 66.9 | 57.1 (387) |
| | M.P. | 75.0 | 74.8 | 74.2 | 44.4 | 64.5 (242) |
| Trade in Livestock | Combined | 26.2 | 15.8 | 21.4 | 27.0 | 20.8 (219) |
| | Rajasthan | 21.4 | 17.5 | 26.4 | 25.2 | 22.0 (149) |
| | M.P. | 28.6 | 10.7 | 12.5 | 29.0 | 18.7 (70) |
| Milk and Product | Combined | 7.1 | 20.4 | 26.8 | 44.5 | 27.9 (294) |
| | Rajasthan | 7.1 | 19.4 | 32.4 | 51.8 | 29.9 (203) |
| | M.P. | 7.1 | 23.3 | 16.7 | 36.3 | 24.3 (91) |
| Migration | Combined | 19.0 | 23.8 | 25.6 | 16.7 | 22.4 (236) |
| | Rajasthan | 28.6 | 21.0 | 27.3 | 18.7 | 22.7 (154) |
| | M.P. | 14.3 | 32.0 | 22.5 | 14.5 | 21.9 (82) |
| Other 1 | Combined | - | 0.2 | - | - | 0.1 (1) |
| | Rajasthan | - | 0.3 | - | - | 0.1 (1) |
| | M.P. | - | - | - | - | - |
| Other 2 | Combined | - | - | - | 0.4 | 0.1 (1) |
| | Rajasthan | - | - | - | 0.7 | 0.1 (1) |
| | M.P. | - | - | - | - | - |

It is observed that a majority of households have indicated increase in income from agriculture and agricultural wages. Whereas the proportion of households reporting increase in agricultural income is found to be positively associated with land holding size, that in the case of agricultural wages has a negative association especially in Madhya Pradesh. It may be noted that a smaller proportion i.e. 28 per cent of the households indicated increase in income from milk and milk produce; the proportion of households indicating this increased along with land holding size. Against this, about 21 per cent of the households reported increase in income from trading/selling of livestock; the proportion of households is found to be high in the case of both-the landless as well as the largest farmers. Certainly a substantial part of the increased income could be attributed to the project-interventions in the study area. While there could be some overlap among households reporting increase in income from different sources, it is important to note that 557 households have benefited from agriculture, which could mainly be due to increased irrigation and 294 households have befitted from livestock-produce.

The evidence, notwithstanding the issue of attribution, highlight two important features noted earlier: (a) impact of irrigation hence on agricultural income is more wide spread as compared to that from livestock; and (b) the benefits tend to tilt more in favour of the households with better land (and even livestock) ownership.

# 8. Summary of Main Findings

The foregoing analysis brought out some important findings as well as insights on the benefits from CPLR-management in the location specific situations in Madhya Pradesh and Rajasthan. The analysis has been placed in the backdrop of the large scale and continued degradation, and more recently diversion of pastures and other land resources, available for community management. The contemporary discourse on CPLR-management pertains to three important issues: feasibility of mobilizing collective action; linking ecological security with overall economic security for the village community especially, the poor; and promoting diversified land use pattern with central thrust on sustainable livestock economy to strengthen ecological as well as economic security.

The finding from the study suggests that it is feasible to mobilize collective action for CPLR-management provided certain preconditions are fulfilled. The valuation exercise reconfirmed the fact that effective management of CPLR invariably leads to enhancing ecological services. The biomass estimates suggest that the value of incremental biomass as compared to the situation in control village works out to be Rs. 47,000 to Rs. 85,000 per hectare. Further there is an evidence that the appropriate measures for soil-water conservation, as part of the CPLR-management, does provide significant direct benefits in terms of increased irrigated area and the resultant increase in crop-production. A tentative estimate based on the analysis of irrigation-wells suggests that on an average the treatments on CPLRs lead to an additional income ranging from Rs. 3.60 to Rs.5.20 lakhs in a year. These are fairly substantial benefits, which could more than justify the public investment on such resources.

Notwithstanding the ecological as well as financial justifications, the issue that remains somewhat un-addressed is that of equity and social justice. The issue is complex because the trajectory from vegetative regeneration to promotion of livestock, especially among the poor households, is neither automatic nor unilateral. It requires

institutional support specifically focusing on the issue of economic security by adopting a multi-pronged approach.

The second part of the report may throw some light on the lessons emerging from good practices in the context of institutional processes for CPLR-management.

## ANNEXURE 1: A NOTE ON PLOTS AND KAKAR

There are three broad areas of common pool resources differentiated by the kind of management systems adopted by the village institution

1. Enclosed commons are also referred to as 'plot'. This is an area over which the community has secure tenure in the form of land lease or permissions from the Panchayat. We refer to these as protected commons.

   In the Study villages, we find that communities adopt rules of protection against felling of green wood, indiscrete grazing and privatization by individuals.

2. 'Kakar' in common parlance refers to common lands. In this Study, it is used to refer to the area of common pool resources over which the community does not have tenure but nevertheless adopts certain governance systems. Thus, we refer to these areas as 'governed commons' as against 'protected commons'

   The most common of these rules on the 'kakar' are ban on felling of green wood, rules regarding the sharing of pods from trees in this area and the rule on non-encroachment of this area by individual households for private use. In the Study villages, we find that the rules on the kakar are less stringent than those on the enclosed commons.

3. There remain some common lands of varying extent under open access regimes in the Study villages. These are in the main dispersed patches of land that are not brought under the purview of the institution in consideration of the apprehensions of certain communities regarding bringing all common lands under the management of the village institution. We find that in many villages with the increase in the age of the institution more of this open access land is brought under some governance.

## ANNEXURE 2: CHANGE IN CROPPING PATTERN (AREA IN HECTARE)

| Village | Crops | 1999 - 2000 | 2006 - 2007 | Difference Over 1999 - 2000 |
|---|---|---|---|---|
| | | **MADHYA PRADESH** | | |
| Bhanpura | Soyabean | 73.320 | 93.670 | + |
| | Grass | 56.122 | 44.532 | - |
| | Maize-Soya | 36.900 | 27.220 | - |
| | Gram | | 13.350 | New Crop |
| | Masoor | | 7.770 | New Crop |
| | Wheat | | 7.650 | New Crop |
| | Grass - Rabi | 0.150 | | Not Sown |
| | | **166.49** | **194.19** | **+27.7** |
| Ahirwadiya | Soyabean | 333.865 | 338.860 | + |
| | Grass | 69.357 | 67.727 | - |
| | Maize | 33.750 | 37.460 | + |
| | Gram | 1.390 | 34.230 | + |
| | Wheat | 0.30 | 14.160 | + |
| | Dhaniya | | 9.740 | New Crop |
| | | **438.66** | **502.17** | **+63.51** |
| Rojani | Maize | 145.990 | 146.480 | + |
| | Jowar | 78.300 | 70.120 | - |
| | Grass | 29.840 | 27.660 | - |
| | Gram | 51.340 | 47.070 | - |
| | Wheat | 42.410 | 37.010 | - |
| | Dhaniya | 21.270 | 20.500 | - |
| | | **369.15** | **348.84** | **-20.31** |
| Rajakhedi | Soyabean | 8.280 | 29.660 | + |
| | Grass | | 22.350 | New Crop |
| | Maize | | 6.340 | New Crop |
| | Gram | | 8.250 | New Crop |
| | Wheat | 2.42 | 4.050 | + |
| | Wheat (Ad.) | 1.610 | | Not Sown |
| | Dhaniya | | 2.880 | New Crop |
| | Soya-Jowar | 1.190 | | Not Sown |
| | | **13.50** | **73.53** | **+60.03** |
| Karwakhedi | Jowar | 60.982 | 57.832 | - |
| | Maize | 51.990 | 49.040 | - |
| | Grass | 51.502 | 48.672 | - |
| | Soyabean | | 34.101 | New Crop |
| | Gram | 34.650 | 32.266 | - |
| | Wheat | 29.410 | 29.430 | + |
| | | **228.53** | **251.34** | **+22.81** |
| **Village** | **Crops** | **2001** | **2007** | **Difference Over 2001** |
| | | **RAJASTHAN** | | |
| Cheetrawas | Maize | 29 (I) | 52 (UI) | + (UI) |
| + Thoria | Jowar | 125 (UI) | 126 (UI) | + |
| | Bajra | 131 (UI) | 130 (UI) | - |
| | Til | 22 (UI) | 16 (UI) | - |
| | G. Nut | 7 (UI) | 17 (UI) | + |
| | Chilli | 17 (I) | 12 (I) | - |
| | Onion | 1 (I) | 10 (I) | + |

*Appendix 2 (contd.)*

| Village | Crops | 2001 | 2007 | Difference Over 2001 |
|---|---|---|---|---|
| | Cotton | 11 (I) | 7 (I) | - |
| | Gowar | 16 (UI) | 7 (UI) | - |
| | Richka | 3 (I) | | Not Sown |
| | Mung | | 14 (UI) | New Crop |
| | Gobhi | 17 (I) | 18 (I) | + |
| | Chawla/Kulat | | 6 (UI) | New Crop |
| | | **78 (I)** | **47 (I)** | **- 31 (I)** |
| | | **301 (UI)** | **368 (UI)** | **+67 (I)** |
| Dhuwadiya | Maize | 12 (I) (2000) | 14 (UI) (2006) | + (UI) |
| | Jowar | 104 (UI) | 131 (UI) | + |
| | Bajra | 40 (UI) | 57 (UI) | + |
| | Til | 2 (UI) | 20 (UI) | + |
| | G. Nut | | 4 (UI) | New Crop |
| | Chilli | | 3 (I) | New Crop |
| | Onion | | 3 (I) | New Crop |
| | Cotton | 1 (I) | | Not Sown |
| | Gowar | 2(I) | 8 (UI) | + (UI) |
| | Mung | | 9 (UI) | New Crop |
| | Gobhi | | 3 (I) | New Crop |
| | Chawla/Kulat | | 3 (UI) | New Crop |
| | | **15 (I)** | **9 (I)** | **- 6 (I)** |
| | | **146 (UI)** | **246 (UI)** | **+100 (UI)** |
| Sanjadi Ka Badiya | Maize | 36 (UI) | 36 (UI) | No Change |
| | Gawar | 1 (UI) | | Not Sown |
| | Kulati | 1 (UI) | 1 (UI) | No Change |
| | Udad | 1 (UI) | | Not Sown |
| | Moong | 1 (UI) | 2 (UI) | + |
| | Chola | 1 (UI) | 1 (UI) | No Change |
| | Til | 1 (UI) | 3 (UI) | + |
| | G. Nut | 1 (UI) | 4 (UI) | + |
| | Chilli | 1 (I) | | Not Sown |
| | Cotton | | 2 (I) | New Crop |
| | Chari Jawha | 1 (UI) | 1 (UI) | No Change |
| | Tobacco | 1 (UI) | | Not Sown |
| | | **1 (I)** | **2 (I)** | **+ 1 (I)** |
| | | **45 (UI)** | **48 (UI)** | **+ 3 (UI)** |
| Saredi Kheda | Maize | 43 (UI) | 32 (UI) | - |
| | Gawar | 2 (UI) | 2 (UI) | No Change |
| | Kulati | 2 (UI) | 5 (UI) | + |
| | Udad | 5 (UI) | | Not Sown |
| | Moong | 2 (UI) | 2 (UI) | No Change |
| | Chola | 1 (UI) | 1 (UI) | No Change |
| | Til | 7 (UI) | 4 (UI) | - |
| | G. Nut | 3 (UI) | 14 (UI) | + |
| | Chilli | 4 (I) | 1 (I) | - |
| | Cotton | 6 (I) | 4 (I) | - |
| | Chari Jawha | 5 (I) | 3 (UI) | - (UI) |
| | | **15 (I)** | **5 (I)** | **- 10 (I)** |
| | | **65 (UI)** | **63 (UI)** | **-2 (UI)** |

Note: Information for the remaining seven villages in Rajasthan are not available (5 villages); or the period for comparison covers less than 3 years (2 villages).

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# SOUTH ASIA Pro Poor Livestock Policy Programme

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