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ENVIRONMENTAL ECONOMICS RESEARCH COMMITTEE

Theme: CPRs and Forests
EERC Working Paper Series: CPR-2

CPR Institutions in West Bengal: An Analysis of Environment Economic Interface

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Final Report

CPR INSTITUTIONS IN WEST BENGAL

An Analysis of the Environment-Economy Interface

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The World Bank Aided
"India : Environment Management Capacity Building"
Technical Assistance Project

2002

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EXECUTIVE SUMMARY

Background to the Problem

Common Property Resources (CPRs) are an important form of natural resources. The following features characterize these resources:

a) Consumption generates externalities in the form of subtraction from the total stock of resource;

b) It is difficult to apply the exclusion principle.

Such resources perform an important function in both production and consumption of rural households. They are also an important source of employment and form an essential component of the social security system. Finally, in many cases, resource users have themselves established rules to exclude outsiders and control resource use. The creation of such common property resource institutions has ensured sustainability of such resources.

Objectives of Project

Our objective was to analyse the process of evolution of CPR institutions as a response to resource degradation.

Short-term Objectives

Collective action is necessary to create new CPR regimes or modify existing ones. We sought to examine the factors that were relevant in this process –either encouraging collective action, or hindering such attempts.

Long-term Objectives

This would enable us to demarcate areas where meaningful policy intervention can help to enhance the indigenous capacity to manage the environment.

Hypothesis

Our project focussed on the process of creation of CPR institutions and its changes in response to changes within and outside the community. Our hypotheses thus related to the creation and evolution of CPR institutions.

Central Hypothesis

Our central hypothesis was that the awareness of the problem of resource degradation would generate processes leading to collective action and the emergence of sustainable communal management systems. This means that we are interpreting the emergence of CPR institutions as a collective response to the degradation of the environmental resource base. This collective action is manifested through the supply of appropriate institutions.

Sub-Hypotheses

The process of evolution of CPR institutions was linked to several factpors. Our sub-hypotheses was related to these factors. I.e. in identifying the factors affecting collective action and the direction of causality.

1. The resource appropriators perceive that the resource is being degraded and this can lead to disaster;

2. The resource appropriators acknowledge their role in creating this crisis, i.e. they acknowledge that outcomes are jointly produced and can be avoided by changes in their existing behaviour;

3. Pro-social norms directed towards arresting the process of degradation and activated;

4. Economic cost of cooperation are low;

5. Social and economic conditions of agents are more or less uniform and recurrently shared (i.e. agents have mutually consistent expectations);

6. The expected flow of net benefit is an important determinant of the institutional form of the property regime;

7. Another determinant of the institutional form of the CPR regime is the physical characteristics of the resource in question;

8. The feed backs to resource conserving behaviour are positive;

9. Situational factors, like a temporary fall in income may lead to defection;

10. Such defection will be tolerated up to certain limits without punishment. However, the contingent fulfilment of the threat will have to be credible.

Methodology Employed

For our purpose we decided to use an empirical approach. We examined four CPR institutions in detail, and another CPR regime cursorily.

Database

Since our study relates to the historical development of institutions, we relied on primary data. This data was collected based on field surveys undertaken in five areas.

Survey Sites

We have undertaken surveys in the following areas: Belemath in the district of Burdwan (forest resource), Matha in the district of Purulia (forest resource), Hazamdihi in the district of Bankura (water body), and two fishermen's co-operative in Bon Hooghly and Charcharia in Calcutta (water body).

We selected the site partly to enable us to make comparisons across resources, and between management systems for the same resource. In the case of forests we studied a co-produced management regime – Forest Protection Committees. Both the survey sites were basically similar to each other with regard to their socio-economic background. Both were poor villages, with low level of literacy. The main occupation was agriculture. Dependence on forests was high in both cases. The only difference was that the population in Matha was tribal, while that in Belemath was mixed. These two studies formed an interesting contrast as – despite their similarities – the performance of the regimes was different in these villages: in Matha, it was a failure, while in Belemath it was a success.

The other three sites studied are similar with regard to the resource. However, while the regimes in Charcharia and Bon Hooghly are formal Fishermen's Co-operative, that in Hazamdihi is a multi-use water body managed informally by the village. The cases of the formal co-operative are also important in view of their location – both are situated in an urban belt, within the Calcutta Metropolitan Area. Hazamdihi, in contrast, is in the poor under-developed district of Babnkura.

Methodology of Field Survey

Our survey methods consisted of interviewing community members using a structured questionnaire. In view of the historical nature of the information required we also employed non-conventional techniques like group discussions

Sample Size

We have not relied on sampling but attempted to interview all members (census enumeration). However, in all cases, some members were not available during our survey. In such cases we simply interviewed the available population.

The group discussion was undertaken with about 8-10 members at a time in each of the villages in the three villages. In the case of the co-operative, participants of the group discussion were chosen randomly with replacement. To factor out the view of a particular individual being repeated we identified participant repeatedly joining such discussions.

Theoretical Framework

The data so collected was integrated using the Oakerson framework. The conclusions from our empirical study were then contrasted with the results of game theoretic models.

Findings

Our central hypothesis is not validated by our survey. The emergence of CPR regimes does not seem to be related to the onset of resource degradation problem. In Matha, degradation did not evoke any response from the community. Although the

water bodies were being managed with varying degrees of success, in none of these cases was the resource threatened.

Our central hypothesis had been divided into several components. We analyse the validity of each of these sub-hypotheses below.

1. We have seen that the emergence of CPR institutions is not always linked to degradation issues. Our first sub-hypothesis is therefore invalid. This will affect the other sub-hypotheses that were linked sequentially to each other.

2. Outcomes need not always be joint. Further, interdependence may be manifested across generations – especially in the case of forests. However, some amount of reciprocity is needed to foster co-operation.

3. We found an absence of normative or institutional constraints to free riding attempts in all our case studies.

4. Low economic costs of co-operation was significant in explaining success in Bon Hooghly, Charcharia and Hazamdihi. In the case of Belemath, the reduction in income due to co-operation was low. In the case of Matha, the high costs of co-operation appeared to significantly inhibit co-operation.

5. Heterogeneity remains a contested factor in explaining collective action. This is line with the conclusions of recent works on this area.

6. The surplus from the resource has determined the *choice* of the regime in each case – though it has not affected its efficiency.

7. The physical feature of the resource is an important factor explaining the range of possible forms of regimes is set by the nature of the resource.

8. Feedbacks either in the form of visible restoration or stable income flows is an important factor contributing to the success of the regimes in Belemath, Bon Hooghly, Charcharia and Hazamdihi.

9. Despite the success of these regimes, we found that transgressions of the rules were also present. Such violations were due to temporary fall in income. A seasonal pattern of defection was observed in both Belemath and Matha.

10. The community that did not normally take any action tolerated such violations. However, reputation was used to judge whether such behaviours was temporary or a manifestation of deviant behaviour. Only in case of the later, sanctioning was applied.

Game Theoretic Structure

Collective action problems come in diverse forms, and there is no unique best solution to all of them. The nature of the problem and its solution method thus needs to be approached from the perspective of the type of game played. However, we have observed that a unique type of game may be unable to capture the nature of the problem in all its entirety and hence we experimented with several proximate game structures.

Policy Implications

Our theories and experiences based on the case studies show that in many situations, though not always, co-ordination and leadership problems play a dominant role. When poor people overexploit local natural resources even when they are aware of the ecological impact of their actions, it is often because they face acute subsistence constraints, which lead them to discount streams of future benefits heavily. They generally need externally provided economic incentives to be induced to conserve their resources. External catalytic role by State via local level institutions can play a significant role here. Even a political party, as we have seen, can act as a catalytic agent. Trust and co-ordination can be created under impulse of catalytic agents who often come from outside the community. All these imply that in many situations state intervention could be reshaped to institutionalize collaboration between state administration and local resource users. The precise mode of such partnership will, of course, depend on the specific contextual factors.

Acknowledgements

We would like to express our debts – accumulated in diverse ways – to a host of persons.

Firstly, to the all those who assisted us during our field surveys and the respondents who patiently tolerated our insistent questioning. Specifically, we would like to thank the following persons:

Mehboob Zahedi (Member of Parliament, Katwa Constituency), Krishnachandra Halder (ex-Minister, Excise Tax), Syed Mosih (Executive Officer, Burdwan Zila Parishad), Jan-E-Alam (ex-Executive Officer, Forest and Land Reform Permanent Committee, Burdwan Zila Parishad), Kader Molla (Vice President, All India Krishak Sabha, Amarpur Branch), Nanigopal Chakraborty (ex-District Magistrate, Purulia), Bon Hooghly Fishermen Co-operative Society, Ujjal Chatterjee (Ex-Municipal Commissioner, Kolkata Municipal Corporation), Krishna Mondol (Charcharia Fishermen's Co-operative Society), Prof. Satya Mondol (Siliguri College), Krishnapada Mondol (President, Sholana of Hazamdihi).

Ahmed Management Technologies, especially Nabarun Bhattacharya, prepared the software for the analysis of the data collected during our field surveys.

Secondly, we would like to thank Dr. U. Sankar, Dr. Jyoti Parikh, Dr. Gopal Kadekodi, Dr. Kanchan Chopra, Dr. Sudarshan Iyengar, and Dr. Robin Mukherjee for their valuable comments and suggestions offered not only during the project review workshops but during discussions on various issues at various occasions. We would also like to express our gratitude to all participants of the Proposal Review and Project Review Workshops. Dr. Kartar Singh, our Peer Reviewer, made various valuable suggestions which sharpened the thrust of our work. The usual disclaimer applies.

There were many persons in Kalyani University who helped us in various ways with the administration and finance of the project: Shyamal Pal (Research Fellow), Sunil Haldar, Dibakar Hawladar, Swaraj Ghosh (Head Clerk), Ashutosh Debnath and Apurba Chakraborty (Finance Section). Abhijit Brahmachari, Research Assistant,

also helped us with our Accounts. Our colleagues also deserve mention for their support and advice.

Last, but not the least, we would like to thank all the Research Fellows and Field Investigators without whose help the project would not have been completed.

CHAPTER 1: INTRODUCTION

Section 1.1: Definition of CPRs

Man interacts with natural resources and natural environments through a variety of property rights. By property rights we, like many others, mean not a relation between individuals and the object owned (in this case the environmental natural resource), but between the individual(s) and a legally/socially endorsed *stream of benefits* arising from the resource. One can therefore have 'property' in things supposedly 'owned' by someone else. By 'rights' we imply the capability of the claimants to the property to secure acknowledgement to honour the claim by 'others' who do not have such claims. Such claims and duties may be codified through either written law or unwritten custom. Property rights are embedded and evolve in specific social, political and ecological and economic contexts.

We can, therefore, think about a spectrum of property right regimes for natural resources. Common property regime is one such regime within this spectrum. Common Property Resources (CPRs) are those "resources which are collectively used by a group of people" (Pasha, 1992). Alternately they can be defined as "those (non-exclusive resources) in which a group of people have coequal use rights. Membership in the group of co-owners is typically conferred by membership in some other group, generally a group whose central purpose is not the use or administration of the resource (per se), such as a village, a tribe, etc. " (Jodha, 1990). Even if the legal ownership of the resource rests with some other agency (waste lands may belong to the Revenue Department of the State), the resource community exploits the resource as if they are the de facto owners.

From these definitions two characteristics of CPRs stand out: consumption of the resources are rival, the principle of exclusion cannot be applied. By rival consumption we mean that exploitation of the resource by one individual reduces the stock of resource, thereby affecting consumption by others. In other words, exploitation of CPRs generates externalities in the shape of reduced consumption - either in the present, or (which is more common) in the future. Now a local community - a group of people, a village, a few neighbouring villages, etc, may

exploit the resource. Such resources are referred to as local commons, as opposed to global commons, which are exploited by nations.

Inapplicability of the principle of exclusion refers to the fact that a resource user cannot be prevented from utilizing the resource even if he does not pay for it. The reason for this is that that each resource user is a co-owner, having equal rights of usage.

Using these two characteristics, we can classify all goods into four categories as follows (Musgrave & Musgrave, 1989).

Table 1.1: Classification of Private, Public and Common Property Resources

Characteristic	Exclusion Feasible	Exclusion Not Feasible
Rival Consumption	1	2
Non Rival Consumption	3	4

Resources in category 1 refer to privately owned resources, while those in categories 3 and 4 are public goods (with 4 referring to `pure' public goods), and those in category 2 are CPRs. Such resources are of various types : community pastures, community forests, waste lands, common dumping and threshing grounds, village ponds, rivers, aquifers, etc.

Section 1.2: Importance of CPRs in Rural Economy

CPRs have historically played an important role in the rural economy :

"*In the past the peasants who had small pieces of land, who couldn't eke out enough from it for their survival, use to eat fruits from their nearby forests and used to collect leaves, flowers and dried tree branches, and by selling these to others supplemented their income. They also used to maintain a couple of cows, goats and were living happily in their villages depending on the village common grazing land."* (Jyotibha Phule, Shetkaryacha Asad, qtd. in Kothari, Singh & Suri, 1996).

CPRs perform various functions in the rural economy - physical supply of products (fuel, fodder, water, manure, etc.), employment generation (in collection of the products of CPRs), income generation (from collection of CPR products and from that portion of animal husbandry which is attributable to grazing on common land) and asset accumulation (directly, or complementing the private resource based activities). In addition there are other contributions by CPRs - which are seldom recognized as they constitute a part of the daily routine of villagers - which are briefly indicated below (Jodha, 1986):

[1] The demographic pressure on land has led to the per capita land holdings of Indian farmers being very low. This calls for efficient utilization of the scarce land holdings. By supplying fodder and grazing space, CPRs help to economize on land use.

[2] Ground water reservoirs, dry beds of rivers/tanks used for off-season cropping and rivulets and tanks used to collect irrigation water, are an important complement to private property based farming systems.

[3] In dry regions the farming system is based on an integrated production strategy involving crops, livestock, and trees/bushes. The inclusion of the latter component ensures the viability of the farming system by reducing its sensitivity to variability in rainfall. Village forests, grazing lands, rivulets, and watershed drainages play a significant role in this strategy.

[4] During crisis periods (like droughts) CPRs cushion the fall in the standard of living of the poor farmers by providing physical supplies (food/fibre items, for instance), and generating employment and income.

[5] The impact of rural inequalities are greatly minimized by CPRs as the poor can supplement their meager resources free of cost from CPRs.

[6] CPRs also contribute to the quantity and quality of nutrition of the poor by facilitating his food gathering from forests, ponds, and other sources, thereby strengthening his self- provisioning system (Rudra, et al, 1991).

[7] CPRs help to maintain the ecological balance by way of checking soil erosion, deforestation and siltation.

[8] The commons all along allowed wives and mothers to combine child rearing and domestic activities with attempts to augment family income by exploiting traditional rights on CPRs.

Thus, CPRs form an integral component of the rural environmental base and they are of special importance to the rural poor.

Section 1.3: CPRs and the Rural Poor

Non-poor households have been found to derive greater benefits from CPRs in terms of absolute income (Jodha, 1986, 1990; Pasha, 1992). The relative importance of income from CPRs in the budget, however, is greater for the poorer households.

Jodha (1986) has estimated that the average income per household per annum from CPRs ranges from Rs. 447 to Rs. 831, which represented about 15-23 % of total household income of the rural poor. The corresponding proportion for non-poor households was only 1-3 %.

In another study (Pasha, 1992) it was found that the proportion of income from CPRs was 10 % for the rural poor - in contrast to 6.2 % for the non-poor (see Table 1) :

Table 1.2: Share of Gross Income From CPRs to Gross Income of Poor Households

Type of Village	Gross Income per Household (Rs.)	Gross Income from CPRs per Household (Rs.)	Percentage of Gross Income from CPRs per Household
Developed	8666	**626**	**7.2**
Medium	**7066**	**906**	**12.8**
Backward	**8932**	**726**	**8.1**
All Villages	**7918**	**794**	**10.0**

Source : Pasha (1992)

The greater dependence of poor households on CPRs can be attributed to several factors :

[1] The land-man and land-animal ratios for poor households are typically low. In such circumstances, access to CPRs provide an important means to adjust the factor proportions.

[2] During drought, or other crisis periods, when productivity of rural resources fall drastically, the richer households depend on their cash reserves for sustenance. Poorer households lack such reserves and have to depend upon CPRs for their subsistence.

[3] The extraction costs of CPRs are generally low and require only labor power. Since poorer households have surplus labor (with low opportunity cost), dependence on CPRs is consistent with their labor endowments, and is economically rational.

[4] The value of products from CPRs may be quite low. In that case it may not be profitable for the richer households to exploit the CPR. But poorer households having surplus labor with zero alternative cost can exploit the resource, specially as the nature of most of CPR-based activities is such that they can be indulged in without sacrificing alternative employment.

Section 1.4: Decline in CPRs

Decline of CPRs can occur in three ways :

[a] Physical loss of resources, due to construction of infrastructure.

[b] Detoriation of physical productivity (i.e. quality) of the resource.

[c] Changes in the usage and property rights of CPRs.

For the moment we concentrate on only the third cause. In a village level study in Karnataka (Pasha, 1991) it was estimated that the area under CPRs declined from 6999 acres (35.6% of the geographical area of the villages covered) to 4654 acres - a decline of 23.7%. The main cause of this decline was privatization, by both the rich and the poor. About 52% of the land lost, was appropriated by the rich

households. The poor households obtained 25.6% of the land lost through Government redistribution programs, and encroached illegally on a further 22.4% of the CPR land lost (see Table 3).

Table 1.3: Decline in CPRs in Selected Villages in Karnataka

1. Total number of villages	14
2. Total geographical area (acres)	19644.8
3. Total CPRs available in the past	6999
4. Percentage of CPR land available in the past	35.6
5. Total CPRs available at present (acres)	4654
6. Percentage of CPR land presently available	23.7
7. Total CPRs lost	2345
8. CPRs enroached by the poor	525
9. Percentage of CPR land enroached by poor	22.4
10. CPRs distributed to poor by Government	600
11. Percentage of CPR land distributed by Govternment to poor	25.6
12. CPRs enroached by rich	1220
13. Percentage of CPR land enroached by rich	52.0
14. CPRs taken up for development under social forestry programs	740
15. Percentage of land taken up for development under social forestry programs	10.6

Source: Pasha, 1992

It is clear from the above table that privatization is the main form of decline in CPRs, a conclusion borne out by other studies (Singh, 1986; Jodha, 1990; Dasgupta, 1989). Moreover, this trend has been actively supported by the Government as part of an integrated strategy to alleviate poverty.

In reality, however, the impact on the poor has been the opposite of what was intended. The reason is that the lack of complementary factors and economic distress forced the transfer of a major part of the land distributed under land reform and other programs from the poor to the non-poor. Consequently, the loss of access to CPRs (due to appropriation by the poor) could not be compensated by an increase in privately owned land.

This process of disentitlement has adversely affected the economic status of the rural poor. However, the increase in intra-generation inequity has been justified on grounds of environmental sustainability and efficiency.

Section 1.5: Inter-generation versus Intra-generation Equity

The assumption behind this approach is that common property resources are generally over-exploited and consumed in an unsustainable manner. Privatization of the CPRs is therefore suggested as a possible solution to check their degradation and ensure their physical rehabilitation. The crux of the argument is that intra-generation inequity is a necessary cost to prevent the emergence of inter-generation inequity.

This argument is based on the "Tragedy of the Commons" paradigm. Early writers on the commons believed that the inability to apply the exclusion principle due to the high cost involved would lead to the entry of users beyond the optimal level. This would lead to the dissipation of responsibility of maintaining and conserving the resource, and lead to their over-exploitation and ultimate degradation. The most influential statement – and, indeed, the coining of the term "Tragedy of the Commons" was made by Garett Hardin (1968), based on an analysis of the destruction of the common grazing lands of Medieval England.

The "Tragedy of the Commons" model had a strong influence on economists and policy makers in the 1960 and 1970s. In fact, we can even find remnant of this influence in, for instance, the writings of Gabriela Chicilinsky (1994), and in some of the modern day legislation relating to forests (Baland and Platteau, 1994). However, despite it's popularity, there were some weaknesses in the conceptual underpinnings of the model.

Section 1.6: Open Access versus Community Based Management

The traditional approach to the commons dilemma assumes that common property resources are not owned by any one: they are free goods, or non-property[1]. This approach views CPRs as open access (*res nullius*) resources freely available to all users. In the case of such goods there is an absence of attenuation so that over-consumption of such resources may occur.

[1] Goods "owned by no one and belonging to every one", as defined NOAA (1985) Fishery Management - Lessons From Other Research Management Areas. National Oceanic and Atmospheric Administration, Washington D.C.; qtd. in Berkes (1989).

Now, Ciriacy-Wantrup (1971) & Bishop suggest, the community may realise that it is over-exploiting the resource. If community members desire the manifestation of this consciousness the institutional structure may generate collective ownership of resources - a phenomenon common in non-European societies - where the resource can be used by all members of the resource community, all of whom can take decisions regarding the using and sharing of the common pool jointly. This implies a form of management regime that closely resembles private property for a group of co-owners. Such resources should also be included within the category of common property resources.

In such cases the benefits from such resources cannot be enjoyed in an unrestricted fashion by all members of the resource community ; the resource consumption pattern is guided by the need to conserve and preserve the resource.

Ciriacy-Wantrup observes :

" Effective institutions to conserve common property resources have been developed for the administration of forest resources in many countries. The same is true for the conservation of game and fish whether by primitive tribes in pre-Colombian America or modern game managerial departments. Agricultural land held in common by villages in medieval Europe was conserved by institutions based on custom and law before private property and the profit motive broke up those decision systems. During the colonial period of the 18th and 19th centuries the spread of private property rights in resources did not prevent serious depletion of forests range and agricultural land in many parts of the land."[2]

Such a view is basically opposed to the neo-colonial attitude towards indigenous resource ownership which assumes as a matter of course that traditional resource management forms are incapable of comprehending the desirability of ecological consideration in their decision making and that they are incapable of rational decision making. This, however, is not so in reality. "Serious investigation of indigenous ethnobiological/ethnoecological knowledge is rare, but recent studies … show that indigenous knowledge of ecological zones, natural resources, agriculture, aquaculture, forest and game management, tend to be far more sophisticated than

previously assumed. Furthermore, this knowledge offers new models for development that are both ecologically and socially sound." [3]

The acknowledgement that traditional resource groups may also be capable of resource conservation has led to reclassification of the different property rights system into the following divisions :

Table 1.4: Types of Resource Regimes

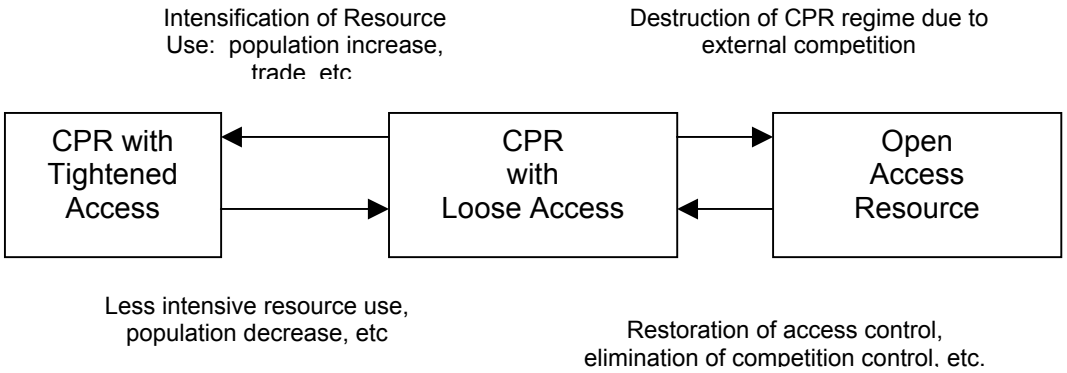
Property Rights System	**Characteristics**
State property	Individuals have a duty to observe use/access rules determined by a controlling/managing agency; agencies have a right to determine use/access rules
Private Property	Individuals have a right to undertake socially acceptable uses and have a duty to refrain from socially unacceptable uses and have a right to expect that that only socially acceptable uses will occur
Communal property	The management group (the owners) has a right to exclude non members, and non members have a duty to abide by exclusion; individual members of the management group (the co-owners) have both rights and duties with respect to use rates and maintenance of the thing owned.
Non property (Open Access)	No defined group of users or owners and benefit stream is available to anyone; individuals have both a privilege and no right with respect to use rates and maintenance of the asset; the asset is an "open access resource".

Source : Bromley (1989).

The property rights school has argued that as open access resources gets depleted, the need for attenuation develops. If economic conditions permit the establishment of private property rights then the resource can be nourished; otherwise it is doomed to be depleted. But, Berkes (in Berkes ed, 1989) points out, instead of establishing private property rights, communal rights can also develop. Such property right changes occur in a smooth trajectory – which may even follow a circular path (Fig. 1.1). Over time there has been an increasing number of case studies illustrating instances where precisely such a trend occurred.

[2] S.V. Ciriacy-Wantrup (1971) The Economics of Environmental Policy. *Land Economics*. Vol. 47, No. 1; February, 1971. Qtd. in Clawson (in Haefale, 1974).
[3] Posey, D.A. (1985) Management of Tropical Forest Ecosystems : The Case of the Kayapo Indians of the Brazilian Amazon. *Agroforestry Systems*; 3[2], pp. 139-140/158. Qtd. in Warren, 1992.

Figure 1.1: Dynamic Trajectory of Property Rights



Source: Berkes, in Berkes ed., 1989

For instance, it was pointed out that Hardin's common field system – on which his proposition was based upon - was communally owned, and not an open access resource. In general, resource users may realise the benefits of co-operation and create institutions (both formal, as well as informal) which incorporates ecological conservation as an objective within their structure. Such institutions contain mechanisms for both exclusion of resource owners, and for allocation of the resource between members of the resource community. Examples of such community-based resource management systems includes the Spanish *Huertas*, the *Zanjiras* in the Phillipines, the Alpine summer grazing systems, Japanese common forests (Iriaichi), the common pastures in the Andes and Himalayas, the Lofoten fishery system, etc. In India, too, researchers have documented success stories (Chopra et al, 1990). Such community based systems can provide an environmentally sustainable alternative to private ownership by building up group identity.

Section 1.7: Advantages of Communal Management

It has been argued (Kramer & Brewer, 1984) that group identity encourages co-operation because members of a social group tend to regard other members favourably and believe them to be trustworthy, honest and co-operative. Other

members of the same group are expected, therefore, to reciprocate co-operative behaviour. In addition, inclusion within a social group reduces social distance between members so that they make less distinction between their own and other's welfare. In fact, experimental studies have indicated that feed backs regarding group outcome has a greater impact than feedback on his individual performance.

Therefore, property rights regimes are not sufficient to ensure environmental sustainability - they are only necessary conditions. What is necessary is that rules exist for exclusion of `outsiders' and for resource sharing. This can be ensured by private property rights. But, private property rights can not be always enforced (for instance, the resource may be indivisible and have to be managed in their entirety, like forest eco-systems). In addition, property rights must also contain ecological wisdom. This implies that no single type of property rights can be prescribed a priori as a remedy for environmental degradation.

Now, it can be seen that communal management resembles private ownership but by a group, and not an individual. But, even private ownership may not always imply ownership by an individual - it may also refer to ownership by partners or through corporations. This raises the question: what is the advantage of communal management over ownership by such entities.

Such advantages are summarised below :

1. "Solution seeking behaviour is based on indigenous creativity leading to experimentation and innovations as well as the appraisal of knowledge and technologies introduced from other societies" (Warren, 1992).

2. Resource users have access to lengthy time series data, extensive information relating to species and environmental parameters, and are in a better position to be able to determine the appropriate harvest size.

3. Information about the resource is generally diffused within the resource community. It is therefore available only when the resource users can be involved in the process of management.

4. Decisions are based on simple rules of thumb requiring easily observable and familiar parameters.

5. The intuitive approach leaves room for error.

6. Techniques of resource control are easy to apply and control.

7. Monitoring costs are lower as user participation increases management legitimacy and leads to better compliance.

8. They utilise local skills and resources.

9. They are compatible with local culture.

Section 1.8: Research Problem and Its Importance

Our review of alternative management forms indicates the relative efficiency of communally managed resources. The gradual privatisation of CPRs found in various studies (Jodha, 1986, 1990; Pasha, 1992) is, therefore, not encouraging. In addition, in recent years, demographic expansion, technological change, expansion of the domestic markets, and their integration with world markets, have led to increased exploitation of natural resources. This will not only lead to their degradation, but, as pointed out by Dasgupta & Maeler (1997), may also affect the resilience of the entire ecological system. At the same time, degradation will increase the vulnerability of the substantial section of the population dependent on the environmental resource base. The destruction of the environmental resource base and the safety-net of the rural poor (Jodha, 1986,1989;Aggarwal, 1990; Pasha,1992; Marothia,1993a; Dasgupta,1995;IFAD,1995) in turn accentuates the crisis as it intensifies pressure on natural resources (Sen,1981;Bromley,1991;Dasgupta & Maeler,1997).

The market fails to solve this crisis. In fact, as shown by Perrings (1989), globalization delinks prices from scarcity values so that the rate of exploitation of natural resources increases. Nor does the Government by itself succeed in resolving this crisis (Haeffale, 1974; Chand,1994; Hannah & Munasinghe,1994; Dasgupta & Maeler,1997;Rees,1987). In such cases informal CPR regimes based on traditional

ecological knowledge may develop to control the exploitation of resources (Berkes, 1989). Such institutions, however, may be dysfunctional (Arnott & Stiglitz,1991).Further, their lack of legitimacy may reduce their effectiveness (MacKean, in McKay & Jones,1997). In that case State support is necessary to create an effective resource management system (Berkes,1989). It is in this context that the concept of co-management has emerged.

Ostrom (1991) has argued that mere presence of collective interests may not suffice to induce co-operation. Self-interested persons will try to free ride on the environmental concerns of others and this will prevent the emergence of institutions which achieve the collective goals. Nevertheless *"… the analytically uncomfortable fact … remains : from the most primitive to the most advanced societies, a higher degree of co-operation takes place then can be explained as a merely pragmatic strategy for egoistic man*" (Dawes & Thaler, 1988). This has led scholars from various disciplines – economics, geographers, anthropologist, sociologists – to analyze how these institutions are created and how they evolve under the changing socio-economic conditions.

Such studies of common property resources have typically examined the functioning of CPR systems from within. They consider CPR systems as a closed system functioning in an insulated environment. But there are different forces that are at work in influencing the evolution of CPR regimes. It is being increasingly recognized that a significant proportion of these forces is exogenous to the community. Examples of such forces are urbanization, commercialization, etc. The influence of these forces are, however, traditionally over-looked. For instance, the forces of commercialization are either ignored – as in the works of Ostrom – or treated as destabilizing forces – as in Goodland et al (Berkes, 1989). However, CPRs often composed of marketable commodities. As their market expands, increasing demand for these products will create incentives to increase the rate of exploitation. The response of the community in such situations forms an interesting study.

Our project, therefore, sought to examine the evolution of CPR systems as a response to endogenous as well as external forces. This enables us to identify potential areas where government intervention is required to support community-based systems.

According to World Resource Institute (1990), merely 500 million people in India depend upon non-timber forest products (NTFP) for their livelihood. Another estimate states that NTFP collection generates about 1063 million man-days of employment in India. In other words CPRs provide a significant component of income and growth of the masses in India.

How much CPRs are there and how do we identify them? This identification is not easy. When, by law such property rights are mention, it is a matter of counting them. But in traditional societies such rights are quite often established beyond law, by conventions and traditions. Some understanding has however emerged among revenue, forest and other rural developmental administrators, about the categories of lands that can come under CPRs in India. We have one such estimate based on the CMIE and Land Utilization Statistics of the Ministry of Agriculture, Government of India (1990 – 1 and 1994).

According to the above estimate total area under CPRs (forest and non-forest) in West Bengal comes around 646,000 hectares. CPR as a percentage of geographical area of West Bengal is less than ten percent and as such is low compared to some other states. Bureau of Applied Economics and Statistics, Government of West Bengal has currently undertaken the job of updating the database on CPRs. Unfortunately it is yet to be made public. However, there are informal indications that unlike many other states the CPRs in West Bengal have not shown any significant decline. To asses some features of these existing CPRs in West Bengal and to set them in a broader context of evolution and management of CPRs in general we have chosen our selective case studies in the socio-economic context of West Bengal.

Section 1.9: Research Methodology

We adopted an empirical approach to study our problem. We relied on primary data collected from the resource users using structured semi-open questionnaires. Our surveys was planned to be executed in the following phases:

1. Selection of survey sites (the sites chosen, and the basis for selection is detailed later on);

2. Pilot surveys;

3. Census enumeration to obtain socio-economic characteristics of resource community;

4. Elicitation of responses to a semi-open questionnaire;

5. Group discussion with 8-10 persons at a time using PRA techniques;

6. Re-survey to check selective responses;

7. Examination of official records (if any); and,

8. Measurement of use and non-use value (in one case) to obtain a valuation of the resource using the Contingent Valuation Method. It was expected that this would indicate how the perceptions and attitudes of local non-users would influence the evolution of the CPR regime.

The survey was carried out in January - February 2000 in Belemath, March – April 2000 in Matha, September – October 2000 in Bon Hooghly, and January – February 2001 in Hazamdihi.

We faced several problems in the execution of our planned programme of work. The first problem related to the non-availability of respondents. We had intended starting our survey by a census enumeration to identify the socio-economic characteristics of the villages and the dependence of the resource community on the CPR. However, we were hampered in our attempts by the absence of some villagers due to personal reasons, or in search of employment. This problem was specially serious in *Hazamdihi* (Bankura), Bon Hooghly (Calcutta), and Chorchoria (Calcutta). At a rough estimate, we failed to obtain responses from 60, 30 and, 90 households respectively. One possible way to solve the problem was to obtain responses from female members of the households. However, females were not articulate, lacked information and were reluctant to respond, specially to male interviewers. In the water bodies of Calcutta, on the other hand, the interviews had been arranged in the offices of the co-operative. The other members of the households of absentee respondents were, thus, not accessible to us. So we ignored the absentee members of the community.

Secondly, during our preliminary attempt to use the Contingent Valuation Method in Bon Hooghly we became doubtful of its efficacy for our purpose. Respondents were reluctant to reveal true willingness-to-pay out of a fear that the Government (or the co-operative) would impose a charge on use of facilities using the stated preference valuation. The price of a free (or lowly priced) good would increase reducing the consumer surplus of the users. Further, the extent of *deliberate* inter-action between the resource community and external users was limited. What relation existed between the two was basically impersonal and market-oriented, so that the limited influence of external users on the functioning of the resource community was unconscious. So we abandoned the CVM and presented our preliminary findings in an appendix.

Section 1.10: Survey Areas

We carried out our survey in five areas as described below. In choosing our sites we attempted to achieve both variety and contrasting experiences. Thus we selected two types of resources – forests and water body. But within each category of resource, there were differences in the nature of the organization governing the common property resource, and hence differences in the functioning of the resource regime and its successes.

We also deliberately chose two urban resource communities. Studies, especially in India, have mainly studied rural common property resources. The reason for this bias is perhaps an unconscious equating of environmental consciousness with a traditional, village based life style and an implicit assumption that living in proximity to nature breeds environmental consciousness. But economic pressures and lack of alternative means of livelihood may lead to a significant dependence of the community on the resource. This may also breed environmental consciousness within a modern concrete jungle. As illustrations of this point, we have selected two resource regimes situated within the Calcutta Metropolitan District.

Table 1.5. Description of Survey Sites

Area	District	Nature of Resource	Form of Regime	Whether Successful
Belemath	Burdwan	Forest	Forest Protection Committee	Successful
Matha	Purulia	Forest	Forest Protection Committee	Failure
Hazamdihi	Bankura	Water Body	Family Based Village Committee	Mixed Success
Bon Hooghly	Calcutta Metro-politan District	Water Body	Registered Co-operative	Successful
Chorchoria	Calcutta Metro-politan District	Water Body	Registered Co-operative	Successful

The socio-economic characteristics of the five areas are not very similar. But the essential differences lies in the external environment of these resource communities and in their historical settings. We now discuss the features of the survey sites and the reasons for choosing them.

Burdwan is a prosperous agricultural district. It's population is highly literate and politically conscious. In contrast, Belemath – a village situated in the Jungal Mahal area near the Birbhum-Burdwan border, is a poor village. The population is mixed – consisting of Muslims and Hindus, tribals and non-tribals. Although the villagers are politically conscious and the ruling Communist Party of India (Marxist) has a strong base, the level of development is low. Belemath is an enclave in another sense. Although Forest Protection Committees have been established in the surrounding areas like Jalikunda, Hedegauda, etc., such Committees have not been very successful.

In contrast, the village of Matha is a typical village in Purulia. Its population is tribal, illiterate, and extremely poor. The red laterite soil, and the arid climate has restricted the potential for agricultural development. This has led to an under developed economy. Simultaneously, there is a lack of alternative opportunities available to the

villagers. These conditions would appear to be favorable for the emergence of collective action directed towards conserving the resource (Dasgupta, 1997). However, the actual facts do not tally with our *a priori* hypothesis.

The study of Matha and Belemath form an interesting comparison. This is because the State has introduced a similar institution in similar historical and socio-economic settings in two different areas. However, the experience of the FPCs has been different in these two villages.

Bankura has a agro-climatic zone similar to Purulia. This has led to a low level of development. Bankura too has a tribal population. However, the village surveyed by us was not a tribal village – it was dominated by Schedule Caste and Scheduled Tribe Hindus, with a few households of upper caste Hindus. The interesting feature of the CP regime was that it was family based, persisting over 5-6 generations. The resource – a water body – was initially owned and used by a family. Over time, with expansion of the family, the shares of each member have been fragmented into insignificant portions. Common use of the pond, however, continues. Another interesting feature is the fact that the water body has multiple uses, with each use having a specific form of property right attached to it; further, the property right attached to a particular use fluctuates across seasons. In this sense, our case study of Bankura is unique in the annals of CPR theory.

Finally, we have studied two registered fishermen's co-operatives using the water bodies within the Calcutta Metropolitan District. The existence of a CP regime within a metropolitan area appeared interesting to us. We would expect that commercial forces and the social structure would weaken norms and traditional/local sources of authority. That this has not happened goes against mainstream CPR theory.

Section 1.11: Scheme of Work

We will start our report with a survey of the CPR literature. We will state Hardin's model and show how this has been rejected by the CPR school led by Ostrom. We will examine the main tenets of Ostrom's analysis. In recent years, Ostrom's works have been examined using alternative perspectives. This has led to suggestions to

modify her basic framework and incorporate the effect of new variables. One such variable has been contextual factors (Edwards & Steins). We will define contextual factors and examine its importance in influencing the course of the CP regime.

One proposition, in this context, could be that while the general principles of CP regimes may work across contexts, success of the regime depends crucially on the specifics of the resources considered as well as the related human context. Our second proposition relates to the dynamics of CP regimes. It has been now accepted that no specific rights regime is inherently suited to any particular natural resource (Eggertson, 1990). Based on this, we will argue that property rights regimes co-evolve with human activity, but not necessarily along a smooth linear trajectory (or even smooth circular trajectory, as argued, for example by Berkes, in Berkes ed., 1989; refer to Figure 1.). For example an open access regime or a private regime may initially be claimed by the State for the purpose of managing them. These may then be handed over to a group or community for management as a community property (subject to community control). This group or community, in turn, may confer private rights or even open access rights to harvest the resource within the broad framework of the CP regime. Even a CP regime may evolve out of a private property regime. The exact nature of the trajectory will depend upon the characteristics of the cost functions for extraction, exclusion and governance activities.

This will be followed by an analysis of the case studies in the general context of the above propositions. We will describe the socio-economic features of the site and resource specific respondents. This will be followed by a history of the evolution of the resource regime in the site. We will then examine the functioning of the existing regime, and examine the reasons contributing to their success/failure. In particular, we shall examine the role of contextual factors on the choices of the community members in the collective action arena.

In the next chapter, we shall try to invoke theories to integrate these case studies. We shall attempt to capture the impact of contextual and other factors on the evolution and functioning of CP regimes using a game theoretic framework. We shall also try to assess the relevance of such frameworks in providing insights into the understanding of the experiences of the cases studied

Finally, we shall sum up the policy implications and contributions of our study. In particular we shall try to show how the State can strengthen the local capacity to manage the environment by modifying the pay-off structure facing the community members.

CHAPTER 2: SURVEY OF LITERATURE

Section 2.1: Tragedy of the Commons

Early writers on the commons focussed on the dissipation of responsibility resulting from the inapplicability of the exclusion principle. It was argued that in the absence of coercion, CPRS were inevitably over-exploited and degraded (the Tragedy of the Commons). As mentioned before, Hardin (1968) gave the most influential and popular statement of this proposition:

"Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many herdsmen as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both men and beast well below the carrying capacity of the land. Finally, however, the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximise his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?" This utility has one negative and one positive component.

1) The positive component is a function of the increment of one animal. Since the herdsman receives all of the proceeds from the sale of the additional animal, the positive utility is nearly +1.

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular herdsman is only a fraction of -1.

Adding together the component partial utilitie, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; an another.... But this is the conclusion reached by each and every rational herdsman sharing a commons. therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit - in a world that is limited. Ruin is the destination towards which all men rush, each pursuing his own best

interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all. "

The free riding problem that characterizes behavior on the commons is due to the fact that consequences of one's actions are not entirely borne by the agent (Table 2.1).

Table 2.1: Accrual of Costs/Benefits to Resource User and Community

Action	**Increase in Output**	**Over-grazing**
Addition of extra cattle	Benefit monopolised by individual	Cost of depleted common land spread across all herdsmen
Not adding to herd	Cost, in terms of output foregone, borne entirely by individual.	Benefit enjoyed by all herdsmen – even those free-riding.

In such situations, rationality demands that agents will not act in a collective action to conserve the resource. This is more clearly illustrated using the Prisoner's Dilemma (PG) Framework.

We start from a situation where two cattle owners are using a common grazing area that is at its maximum economic yield. Each grazier has the options of adding to his herd, or not doing so; further there is no collaboration between them. Assume that the marginal revenue product for the grazing area is -2 per animal. This is composed of -6 due to the reduced output from other animals in the herds of both grazier's, and +4 from the value of output of the cattle added to the herd. If we assume identical herdsmen and individual herds, then the loss in terms of value of outputs from existing animals as a result of increasing the cattle size is divided equally between the two herdsmen (i.e. -3 each). For simplicity, we assume that these values are constant for the first two animals grazed beyond the optimum.

Given these assumptions, the pay-off matrix for the two herdsmen is:

Table 2.2: Tragedy of the Commons in a Game Theoretic Framework

Strategies	B does not add to herd	B adds to herd
A does not add to herd	**(0,0)**	**(-3,1)**
A adds to herd	**(1,-3)**	**(-2,-2)**

If both herdsmen decide not to increase the size of their herds then no further cost is imposed on them and the pay-off from their decision is 0 for both of them. If only A decides to add an extra head to his herd, then he is a net gainer: Value of extra output from the cattle added - Value of output lost from the existing herd = 4 - 3 = 1. B's loss is greater as he has to bear a cost in terms of reduced output of his existing herd (-3), but is not compensated - like A - by an increase in his herd size. So his net loss is : 0 - 3 = -3. An exactly symmetrical picture is obtained for B adding to his herd, while A maintains a constant herd size - B's payoff is 1 and A's payoff is -3. Finally, we consider the case of both herdsmen increasing their herds. In that case, each gains 4 from the extra output of the added cattle, but looses 6 from the reduced output from his existing herd as a result of the increase in size of herd of both (3 + 3 = 6). The net loss, therefore, works out to be -2 for each of the two herdsmen. Obviously, in this case the total loss to the grazing area is greatest.

It is easy to see that the strategy of adding to one's existing herd dominates the strategy of not doing so. In the absence of collusion or coercion, both herdsmen will choose to increase their herd size even though the consequent over-grazing adversely affects both of them - which would not have occurred if both of them had practised mutual restraint.

Section 2.2: Co-operation and Iterated Game Theory

Latter developments in the field of game theory have allayed fears over the pessimistic conclusions arising out of the PDG structure. They have shown that extension of the period of the game to an infinite time horizon, or over a finite but

unknown time period, can lead to co-operative plays by the rivals. Literature has focussed on the following aspects:

a) Iterated Prisoner's Dilemma (Axelrod, 1980a & b; Axelrod & Hamilton, 1981; Axelrod & Dion, 1988)

b) Metagames, involving simultaneous play by multiple players (Taylor, 1976)

c) The role of communication (Hackett at al, 1994)

d) Problems involved in recognising the strategies employed by opponents (Komorita et al, 1991)

e) Starting co-operation midway in an iterated game structure (Patchen, 1987)

f) Inferential problems due to noise, etc. (Bendor, 1993; Schuessler, 1990)

g) The role of exit threats and social ostracism (Bonacich, 1971; Bendor & Mukherjee, 1987; Schuessler, 1989; Thomas & Feldman, 1988)

h) The importance of monitoring and sanctioning (Axelrod, 1987; Sethi & Somenathan, 1996)

i) The advantages of community-based governance structures to enforce co-operation (Bowles & Gintis, 1998)

The conclusion of these studies shows that a co-operative equilibrium may exist, though it may be precarious.

Section 2.3: Underlying Frame of Ostrom's Theory

Starting from the late 1970s scholars in various disciplines have focussed on the sustainability of CPR regimes. They have examined the conditions for the emergence of collective action based on an integration of game theoretic models with the Institutional Analysis and Development (IAD) Framework used by

institutionalists[4], and on an analysis of various CPR regimes[5]. Their work has been collectively referred to as "CPR Theory" (Steins, Edwards & Rölling, 2000). This approach stems from the works of Ostrom, of which the most representative is Ostrom (1990). In this chapter, we will summarise the basic tenets of CPR theory based upon Ostrom (1983, 1985a, 1985b, 1990).

Ostrom argues that there are two reasons why the game theoretic approach is inadequate to explain the evolution and sustainability of CPR institutions. Firstly, game theory assumes a single level of choice – the level of appropriation from the stock of resource. However, actual resource users face different sets of choices – whether to over-exploit the resource, whether to monitor others, etc. This adds to the complexity of the game. The structure of the game, and its equilibrium, becomes contingent upon the values of parameters. These parameters are the size of the resource community, the costs of monitoring, the benefits from stealing, the punishment received on being detected while stealing, the rewards for detecting an offender, etc. No single equilibrium solution, therefore, is possible.

Secondly, appropriators must shift between arenas and levels of analysis. Ostrom distinguishes between three levels of analysis – operational level, collective choice level, and constitutional choice level. At the operational level, the resource community interacts with the physical environment given certain rules and physical and technological constraints. This interaction takes the form of resource appropriation and provision, production, exchange, etc. At the collective choice level, the resource community considers the options available to change the institutional, physical and technological constraints. This level is concerned with the formation of rules. At the third level, the concern is with metarules - the process of changing rules, or "rules for making rules"[6].

Ostrom, therefore, suggests the integration of game theory with institutionalist theory for a complete explanation of the emergence of CPR institutions. Such a theory must explain three things – Why do resource users commit themselves to conforming to

[4] For discussions of the IAD Framework, see V. Ostrom (1988), V. Ostrom, D. Feeny & H. Picht ed. (1989), and E. Ostrom, in E.T. Loehman & D.M. Kilgour ed. (1998).
[5] While most of theoretical works on CPR have used a game theoretic structure, Chopra et al (1990) have used cluster analysis to analyse the conditions leading to the emergence of co-operation in Sukhomajri, Haryana.
[6] Ostrom (1986), p. 19.

rules? Why do resource users monitor the activities of other persons? Why do resource users supply themselves with institutions?

Ostrom begins her study by analysing several cases of “successful” communal management. These studies are based on the framework of analysis suggested by Oakerson (1985). This framework focuses on four sets of attributes or variables that can be used to describe typical CPRs[7]:

1) Physical attributes of the resource and the technology used to appropriate its yield.

a) The relative capacity of the resource base to support multiple users at the same time without congestion and without diminishing the aggregate level of benefit.

b) The degree to which exclusion is possible.

c) Physical boundaries of the resource.

2) Decision making arrangements (organisation and rules) that govern relationships among users.

a) Operational rules regulating use of the CPR.

b) Rules establishing conditions of collective choice within the resource community.

c) External arrangements linking the resource appropriators to the external community.

3) Mutual choice of strategies and consequent patterns of interaction among decision makers.

4) Outcomes or consequences.

[7] This methodology is based on Oakerson (1986, 1990).

Section 2.4: Ostrom's Design Principles

These case studies indicate that operational rules of CPR institutions may vary from one institution to another, but there are certain design principles that are common to each 'successful' CPR organisation. By design principles, Ostrom refers to the conditions that must exist for the CPR regime to be successful.

"By "design principle" I mean an essential element, or condition, that help to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of the appropriators to the rules in use."[8]

These design principles are:

1) The presence of clearly defined boundaries. The set of individuals or households who enjoy the right to appropriate from the resource stock must be clearly defined. Clear demarcation of the boundaries of the CPR is also necessary.

2) Congruence between appropriation and provision9 rules and local conditions. Appropriation rules defining the time, place, technology and amount of resource that can be withdrawn should be related both to local conditions and to provision rules requiring contribution of labour, time and financial resources to maintain the resource.

3) The existence of collective choice arrangements. Most individuals affected by the operational rules can participate in modifying the operational rules.

4) Undertaking of monitoring activities. Monitors who actively audit CPR conditions and behaviour are accountable to the resource community, or are themselves resource appropriators.

5) The presence of a system of graduated sanctions. Those members of the resource community who violate operational rules are likely to be sanctioned by other resource appropriators, by officials accountable to the community, or both. The sanctions are graduated according to the seriousness and context of he offence. This ensures quasi-voluntary compliance.

[8] Ostrom (1990) pp. 90.

6) Conflict resolution mechanisms exist. The resource community has rapid access to low cost arenas to resolve conflicts among appropriators or between appropriators and officials.

7) There is a minimal recognition of rights to organise. External governmental authorities do not challenge the rights of the resource community to devise their own institutions.

8) For CPRs that are an integrated part of larger systems, nested enterprises are present. Appropriation, provision, monitoring, enforcement, conflict resolution ad government activities are organised in multiple layers of activities.

Ostrom argues that these design principles constitute a credible explanation for he persistence of CPRs and their related institutions. This is because these design principles affect incentives in such a manner that appropriators agree to commit themselves to conform to operational rules, monitor each others' commitment, and replicate the CPR institutions over generations (with modifications, if necessary).

Ostrom then proceeded to examine the related isue of institutional provisioning. Why could some communities provide themselves with institutions, while others failed to do so? The answer to this problem was obtained from a cost-benefit analysis of the process of institutional change. Ostrom argues that there is no valid ground to distinguish between institutional change and institution creation. Both denote an incremental process of change from an initial set of status quo rules (the only difference being qualitative – in the case of institution creation, there are no rules, while in the case of change, there is an initial set of rules) to an equilibrium configuration of rules. If the costs of effecting the change is greater than the benefits, then this leads to a collective action failure; on the other hand, if benefits from making the change are greater than costs, successful institutional provisioning occur. Ostrom then proceeds to provide a (frustratingly) long list of factors which influence the costs and benefits of institutional change.

[9] "Provision refers to the work necessary to ensure that the resource is available and maintained." (IFAD, 1995), pp. 10.

Section 2.5: Ostrom's Influence on Subsequent Writings

Ostrom's work strongly influenced subsequent works on CPRs. Ostrom's framework has been used in both theoretical and empirical research on the commons to extend her analysis.

Initially, CPR theorists were reluctant to label design principles as necessary and sufficient conditions for the successful management of commons. For instance, Ostrom (1990) "is not willing to argue that these design principles are necessary conditions for achieving institutional robustness in CPR settings," but is willing to speculate "… that after further scholarly work is completed it will be possible to identify a set of necessary design principles and that such a set will contain the core of what has been identified here." (page 90). Accordingly, the original list of design principles has been further extended by later writers. Table 2.3 gives an overview of these principles.

Table 2.3: Design Principles for Successful Collective Action

Wade's conditions for successful CPR management (1987)
1. Nature of the resource
2. Costs of exclusion technology
3. Relationship between resources and user groups
4. Characteristics of user groups
5. Noticeability of cheating
6. Relationship between user and State
Hanna, Folke & Maler's design principles of property rights regimes (1995)
1. Definition of legitimate interests in the CPR
2. Articulation of rules for user participation
3. Congruence of rights and responsibilities
4. Incentive structure of rules reflect long run sustainability of CPRs
5. Congruence of boundaries
6. Distribution of decision making boundaries
7. Provisioning of monitoring, sanction and enforcement mechanism
Pinkerton & Weinsten's basic criteria for fruitful collective action (1995)
1. Accountability
2. Effectiveness
3. Representativeness
4. Adaptability

Adapted from Steins (1999) page 16.

Over time, however, there has been a revision of attitude towards the design principles. These design principles are increasingly being considered to be necessary and sufficient requirements for the organisation of collective action. It is now accepted that if CPR institutions satisfy these requirements, they will be successful in managing the resource sustainably. CPR theorists have recommended that "*(design) principles can be taught as part of extension programs … to learn more from one another about how successes have been achieved or how to avoid*

some kinds of failures"[10]. This has granted prescriptive status to the design principles. They are being adopted by multi-lateral lending agencies such as the World Bank and the FAO, national governments and NGOs as tools for crafting sustainable CPR use.

Section 2.6: Some Recent Criticisms of Ostrom's Theory

Steins, Edwards and Rölling (2000) have argued that there are three problems related to these design principles. Firstly, the CPR school has focused on studying the workings of the common from the view point of the resource community. There has been no attempt to take a view of the commons from a standpoint located outside the community - CPR theory has not attempted to link the collective action arena to the external world. Instead cases of "success" are described and attributed to the internal characteristics of the management regime. CPR theorists ignore the role of contextual factors – dynamic remote factors outside the control of the community - in moulding collective action at various institutional levels. This is a serious shortcoming, as the resource community will base their actions not only upon alternatives embedded within the CPR system, but also upon alternative options present in the external world. The perceptions of the resource community about the dynamics of the external world will have a strong influence on the management outcome. Similarly, dynamics of the external world can consciously or unconsciously initiate changes in the community. However, most of the CPR literature either has ignored external factors, or have treated them as sources of uncertainty responsible for degradation[11].

The lack of contextual analysis is partly because of the eagerness of CPR theorists to rebut Hardin's paradigm. In their attempt to bring forward evidence to show that resource users are able to manage CPRs sustainably by creating institutions on their own, CPR theorists have lost sight of their basic objective. Instead of examining the process of creating CPR and the constraints to this process, they have shifted away to merely describing institutional successes. Consequently, the further development

[10] Ostrom , E. (1995), "Design Complexity to Govern Complexity". In S. Hanna & M.Munasinghe (1995), pp. 33-46.

of CPR theory is in a stasis. This stasis persists despite repeated criticism that CPR theory does not adequately explain why regimes have changed over time. For instance, CPR theory fails to suggest how CPR regimes should be adapted to the commercialisation of the resource.

Secondly, the focus on design principles runs the risk of generalising them as blue prints for successful CPR management. The emphasis on design principles is so strong that they appear to be necessary and sufficient conditions for the success of resource regimes. However, this overlooks certain problems. What may be a design principle in one case is not necessarily so for another. Furthermore, categories that one analyst constructs may be interpreted and constructed differently by other analysts. Finally, by using *a priori* categories, analysts may attribute the same weight to each principle on the list. This may lead to the analyst overlooking some factor that is crucial in the collective action process, but is not in the list. Therefore, as we shall see latter on, even institutions satisfying these design principles may fail to conserve resources. In fact, our comparative research shows that even if we have *identical institutions* for the *same resource***,** one institution may fail (in Purulia), while the other succeeds (in Burdwan). Therefore, "*it is essential to acknowledge that in research and policy programs such design principles should, with due action, be used as a heuristic tool to formulate research questions rather than as prescriptive guidelines for development.*"[12]

Third, the classification of CPR institutions as "successful" and "failures" raises questions related to the criteria employed in judging success. The emphasis on design principles leads to the adoption of criteria at variance with the objectives of the resource community. This point is especially important, as CPR regimes may have hidden meanings. As an example, Steins and Edwards (1999c) report the case of a communally managed oyster bed set up ostensibly to improve income opportunities for local fishermen. The actual objective, however, was something quite different – creating property rights to parts of the local bay to prevent a salmon farm from expanding its fishing grounds. Once this objective was attained free riding

[11] Kanchan Chopra pointed out that we usually treat CPRs as "islands" isolated from the external environment. Private communication to Prof. R.N. Bhattacharya.
[12] Steins & Edwards (1999c) page, 553.

increased. This leads Steins et al (2000) to conclude that "*Judgements about 'success' and 'rational behaviour' are thus socially constructed, not only by the stakeholders involved, but also by CPR analysts. By focussing on pre-defined categories, analysts will never be fully able to appreciate how the distinction between 'success' and failure', and indeed these notions themselves, are constructed and used.*"

Section 2.7: Beyond Design Principles - Contextual Factors

In recent years, the rapid process of socio-economic change has led to the following inter-related changes:

1. Rapid demographic expansion;
2. The destruction of the self-sufficiency of local communities;
3. An erosion of traditional sanctioning forces based upon norms and social ties;
4. The inter-linking of the formerly isolated local communities with the national economy;
5. An increase in the importance of commercial forces in the functioning of the local economies; and,
6. The spreading of centralised political authority to local communities.

The result of these changes is that the cost-benefit analysis of institutional provisioning is increasingly being affected by factors that are external to the community and lie outside their control. Such factors are called contextual "factors". These factors are not only determining the success of the regime at a particular point of time, but also affecting the dynamics of institutional changes. The increasing importance of such factors necessitates their inclusion into an analysis of the creation and functioning of CPR regimes. This, in turn, calls for a modification of the traditional framework of analysis.

In the succeeding chapters we will, along with other variables define, identify and examine the importance of contextual factors in shaping the course of the CPR regime. How, and to what extent, these contextual factors interact with other factors in the process of evolution of the CPR regimes and the resources that underlie those regimes will be one of our focal issues.

CHAPTER 3: FOREST CONSERVATION: TWO CONTRASTING EXPERIENCES

Section 3.1: Forest Resources

Forests and forest products are linked to household livelihood systems in a variety of different ways: supplying fuel, fodder, food, building and manufacturing materials, shade, medicinal and other minor forest products. Arnold (1997) has summed up the primary contribution of forests as follows:

1. *Food Security and Health:* Forests add variety to diet, improve palatability and provide essential vitamins, minerals, protein and calories. Forest foods are also used to supplement household supplies during seasonal shortages (occurring in the pre-harvesting period). During crisis periods, forests may also act as a buffer. Medicinal use of forest products tend to overlap with that of forest foods; indeed some items added to food both improve palatability and act as health tonic or prophylatic.

2. *Cultural and Social Values:* The role and use of the forest and particular forest products can be subject to cultural and mystical values, reflecting a society's history, religion, art and other socially final aspects. For instance, individual fauna/ flora species may have spiritual or other cultural significance (totem) and either cannot be used (taboo) or are reserved for special occasions. Particular trees may have ceremonial roles, certain food are reserved for celebration of harvesting and weddings.

3. *Income & Savings:* A significant proportion of rural households in LDCs, obtain part of income from selling forest products. Poverty screws may cause temporary increases in the dependence on forests, as may also seasonal availability of labour, or seasonal changes in demand for forest products. In the long run, the importance of forest as source of income increases as fragmentation and over-exploitation of landholdings and demographic pressures reduce ability to be self-sufficient for food based on personal holdings.

Over time, resource users are facing a decline in the size and quantity of forest resources. Much of this decline is due to contextual factors: growing demographic pressures, commercialization, ready access to markets and growth of consumerism in rural areas, technological change increasing the opportunity cost of retaining forest cover, changes in rural labour demand, etc.

This has serious consequences, especially for the rural poor. Degradation of forest cover is not only reducing employment and income opportunities of poor households, but also generating long term problems, like soil erosion, loss of local bio-diversity, etc. There are also other minor effects. Bromley (in IFAD, 1990) notes that in the absence of forest cover, crop residues and animal wastes are diverted from fertilizing land to use as household energy sources. Exhaustion of forest area may also lead to greater time to collect leaves and other products; this reduces labour time available to cropping activities. Production of minor handicrafts may also be curtailed.

In LDCs, the absence of effective property rights over forest lands have been an important contributory factor to this process. For instance, in India, forests are owned by the State. In a *de jure* sense, they are *res publius* – or State property. However, in reality, the absence of institutional arrangements to exclude potential users have led to the forests becoming de facto common property (the community may have norms governing resource use) or even open access (where such norms may be absent) resources. In recent years, the government has attempted to solve the problem of ineffective monitoring - which has failed to prevent encroachment, illegal felling and poaching – by a process of decentralization. This entails a devolution of power to control access, monitoring and sanctioning to the forest users and legalizing local control through the establishment of Forest Protection Committees. The rights of the resource community to use the forests without degrading it have also been simultaneously recognized by the Government.

In this chapter we will study the contrasting experiences of two Forest Protection Committees in West Bengal. Despite similar socio-economic backgrounds and the introduction of similar institutional arrangements to control exploitation, the experiences of the two sites studied present a marked contrast. This divergent experience constitutes an interesting starting point to our case studies.

Section 3.2: Belemath – A Success Story

The first site studied is that of a success. Belemath is a village in the agriculturally developed, literate and politically conscious district of Burdwan. It is located near the Birbhum border in the forest area called *Jungal Mahal*.

Section 3.2.a: Socio-Economic Characteristics of Belemath

The village of Belemath has a total population of 862, of which 439 are male. The population consists mainly of Muslims (83.06%) and tribals (12.99%). Only 3.94% are Hindus. The village has 212 families with an average family size of 4.06. The level of literacy in the district of Burdwan is quite high. But, in our survey site, almost one-third of the village population (31.55%) is illiterate. On the other hand, the proportion of people who are barely literate is 17.16%, whereas 29.35% people have had primary education (up to class V). A small proportion of population (9.04%)has studied up to the secondary level (class X), whereas the proportion of population with education above secondary level is negligible (up to class XII it is 5, and 7 Graduates).

Regarding the income status of the villagers, the average income is Rs. 17663.00 whereas the segmentation of this average income shows that the Hindu earns a bit higher (Rs. 4648.12) than the average income of the Muslims (Rs. 4468.66). The tribals have much lesser average income of Rs. 3443.68. We can also analyse the occupational structure of the population of Belemath. A good part of the population is basically unemployed (20.41%). Among the employed, 111 individuals (12.87%) are agricultural workers and 94 (10.90%) are farmers. Out of the total village population 88 (10.20%) are engaged in forest related occupations and 62 (7.19%) are in other occupations. A few people – 32 (3.71%) are engaged in business and 4 (0.46%) in services.

Table 3.1: Land Holdings in Belemath

	LAND HOLDINGS	CULTIVATED AREA	TOTAL LAND
0-1 bigha	21	29	20
1-2 bigha	8	11	7
2-5 bigha	6	40	6
5-20 bigha	9	40	9
Above 20 bigha	80	1	80

The distribution of landholding is not typical of an under-developed country. In LDCs landholding gets fragmented so that small and marginal peasants constitute the dominant proportion of the population. In Belemath, however, we have polarization of land holding, with most of the landowners belonging to the large landowning category. However, the extent of self-cultivation seems to be low. Almost all the large landholders lease out their land. Interestingly, even while leasing out the land, landholding does not seem to have got too fragmented. This is evident from the fact that most of the cultivated land belongs to the 2-20 bigha category (corresponding to middle and large landholding category).

Section 3.2.b: History of Forest Use

Initially the forest areas in the Jungal Mahal area were owned by local zamindars. They were thus privately owned. Respondents reported that the forest was managed sustainably – no one was allowed to encroach. Not only was forest density maintained but the range of fauna was quite varied – deers, bears, and smaller animals flourished. This was, however, at a cost. The denial of access to the forests deprived the villagers of fuel. We could not obtain information regarding the substitute availed by the villagers, but this was probably by poaching, and by using distant forests near Jalikunda or Bhatkunda which were open access. Sustainability was thus at the cost of equity.

With the abolition of the zamindari system, the forests were nationalized. Theoretically, the forest became a *res publica* resource. In reality, it became an open access resource. Villagers did not have any sense of ownership, nor did they possess any sense of responsibility for conserving the resource. This led to encroachment. Forest guards were present, but their numbers were too low, and incentive too little, to enable effective monitoring.

The villagers used fallen leaves and branches from forests as fuel. These were collected by the women and children of most households during the months of *Chaitra* and *Falgun* (February and March). The fuel was stored in separate huts. Tribals however, collected leaves throughout the year. They also sold leaves to the richer households. These leaves were collected mainly from the *sal* tree which dominated the forest. In addition, *sal* leaves were also used to prepare plates, which were marketed. Tribals also prepared mattresses and brooms from leaves.

Another use of the forest was as a source of wood to make agricultural implements (*isk* - ploughs) and during house building (beams, frames of doors and windows, furniture). In addition some trees were illegally felled and sold for their timber value. But, more serious, was the practice of felling by licensed contractors. The Block Office used to sell felling rights for a demarcated area to contractors through a system of auction. Villagers reported that the contractors used to go beyond the demarcated areas during felling. Respondents reported a sense of guilt for failing to resist such degrading activities. They also referred to the presence of some incentive and institutional constraints to resisting such degradation practices. Firstly, contractors paid a higher wage for felling trees beyond the demarcated area. Secondly, workers who did not agree to fell trees outside the demarcated areas were not engaged in subsequent years.

These practices, coupled with the failure to replant, led to intensive degradation of forest areas. Large tracts of areas became denuded and barren. Villagers and District Officials used a phrase to describe this condition: "*treeless forests*". The respondents noted various indications of degradation.

Table 3.2: Grass-Root Indicators of Resource Related Development (Number of Respondents in Belemath)

Indicators	Increased	Decreased	Unchanged	Uncertain
Number of trees	1	159	48	2
Forest area	1	157	50	2
Time taken to go to forest	37	130	39	4
Time taken to collect leaves	47	120	40	3
Level of Income	123	6	41	40
Income variance	5	62	34	109

We can see that signs of physical degradation were apparent. However, there was no economic impact of this degradation. The villagers were not aware of this problem in other areas. However, they acknowledged:

1. The problem was serious (184 respondents, 87.62%);

2. Degradation was an immediate problem (188 respondents, 89.52%);

3. The villagers themselves were responsible for the problem of overexploitation (174 respondents, 82.86%); and,

4. The problem was a collective dilemma (209, out of 210 respondents).

If we examine the role of different media and agents in generating consciousness about degradation, the role of the Panchayat appears dominant. Public media – like radio, TV, etc. – appears to have had only a limited impact on the environmental consciousness on the community.

Table 3.3: Role of Panchayat in Generating Environmental Consciousness

Response / Income Class	Positive	Negative	Uncertain	Nil
0-10000	28	4	1	0
10001-20000	89	14	5	0
20001-30000	29	4	3	0
30001-40000	14	1	2	0
40001-50000	1	1	0	0
50001-60000	1	0	0	0
60001-70000	0	0	0	0
70001-80000	1	0	0	0
80001-90000	1	0	0	0
90000>	0	0	0	0
Total	**164**	**24**	**11**	**0**

The table above shows that Panchayat plays a positive role regarding the forest use and the forest protection (82%) where as only 12% says that it plays a negative role and a few people replied that they are unaware of the fact.

Section 3.2.c: Dependence of the Community on Forests

The following tables indicate dependence of the community on forests:

Table 3.4: Dependence of Income from CPRs

INCOME CLASS	*PAST*	*PRESENT*
0-10000	35.39	29.73
10001-20000	37.64	29.20
20001-30000	19.96	16.96
30001-40000	14.16	12.98
40001-50000	31.21	20.36
50001-60000	3.06	2.97
60001-70000	0	0
70001-80000	0	0
80001-90000	5.27	5.15
90000>	0	0
VILLAGE AVERAGE	**31.69**	**25.33**

The above table shows that the dependence of income from the forest has been very high, though it has declined somewhat in recent years – indicating the success of attempts to conserve the forest. It is a common finding of empirical studies that the dependence on CPRs is high for poor households and decreases with income. By and large, this is also borne out in our study.

Table 3.5: Item Wise Dependence on CPR in Belemath

Classes	Items	Village Average	
		Past	Present
CONSUMPTION	HOUSING MATERIALS	1.30	0.76
	ROOF	0.42	0.27
ENERGY	LEAVES	13.54	11.19
	BRANCHES	1.15	0.80
INTERMEDIATE	SHAL LEAVES	4.87	2.68
	MATRESS	1.23	1.03

We can see that the dominant form of forest use is for energy purposes (household fuel). The use of *shal* leaves to manufacture plates constitutes another important source of income. We had previously noted that the dependence on forests has declined over time. This decline has not been due to decline in any particular category, but can be attributed to a general fall in forest use in all categories.

Section 3.2.d: Functioning of the Forest Protection Committee

Round about the early 1990s, the Government decided to establish Forest Protection Committees. The clout of the ruling party [CPI (M)] in Burdwan facilitated the political acceptance of this step. But this had a disadvantage also. During our group discussions, it became apparent that local Party members dominated the FPCs and the functioning of these Committees was along Party lines. Meetings, and trial and punishment of rule breaking members were theoretically open, but in practice, not many villagers did attend such meetings and participate in such decision-making.

The operational rules were simple. Villagers were allowed to enter forests and gather fallen leaves or branches. However, no live branches could be cut down. Obviously, felling too was prohibited. Some villagers – mainly from the Scheduled Caste and Tribes - were paid a monthly salary for monitoring. In addition, peer monitoring was used - especially by the FPC members. These members were composed of mainly 100-120 households, from the poorer sections of the village. Membership did not entitle one to special benefits as regards forest use. It only enabled the household to get a share of 15% of the revenue obtained from periodic felling of trees. Villagers who are paid a salary carry out felling. Replanting is carried out in these areas.

This system had certain inbuilt features that encouraged sustainability. These features were:

1. Villagers were given a sense of ownership through the signing of the Green Bonds.
2. They were given a sense of responsibility as they were accountable for conservation and could take some decisions.
3. Villagers were allowed access to the forests. This prevented the creation of a sense of deprivation and injustice.

4. The payment of wages and distribution of revenues from felling amongst villagers reduced the (net) economic costs of co-operation.

5. The resource use pattern had an inbuilt sustainability. The use of fallen leaves for fuel and preparing plates, mattresses, brooms, etc. automatically required that trees should be protected to ensure a continuous supply of leaves.

In addition, there were some social norms prevailing that restricted the incidence of tree felling. Awareness campaigns by the Party members had instilled a sense of environmental consciousness within the resource users. About 78.1% of he respondents acknowledged the role of the CPI (M) in disseminating information about the fact of degradation, the future impact of over-exploitation, the benefits of conservation, and the imperative need for conservation. This led to a change in the attitude of the resource community. Villagers started attaching greater weightage to future income flows, and an attitude favouring conservation emerged. They acknowledged their dependence on forests and were aware of the fact that degradation of the forest would have adverse consequences in the future. While the existence of such norms did not totally prevent rule breaking (see table below), villagers confessed to a sense of shame if they were observed breaking rules. Similarly, the villagers (not many) who felled trees for commercial purposes were disliked and derided for their short-sightedness and greed, which prevailed over environment consciousness. However, there was no active resistance to such villagers. Nor were there any institutional checks to such offences– in the form of restricting *dadan* (informal credit), or employment opportunities.

Table 3.6: Incidence of Defection in Belemath

Activities	Average (per month)
Village average of people breaking rules	20.42
Village average of people who are not caught	12.16
Village average of people who are punished	1.97
Village average of people who are pardoned	1.40
Village average of people who are freed by manipulation	4.88

On the whole, resource conservation appears to have been adopted successfully in Belemath. Positive economic feed backs to villagers in the form of a slight income increase and decrease in fluctuation in income has strengthened initial conservation attempts. The observation that the operation of the FPC has enabled the forest to be conserved – while degradation continues in other parts of Jungal Mahal – too has been important.

However, some features, to some extent, may act as a disincentive towards sustainability in future. For instance, the division of the villagers into FPC members and non-FPC members bred dissatisfaction. Those excluded from the Committee had a sense of injustice and tried to break rules – especially if they were of the opposition political party.

During group discussions, villagers identified the competing use of forest land as a source of fuel (if the forest is retained) and a source of food (if the forest is cleared for cultivation). The extension of irrigation facilities, the diffusion of HYV seeds, the increasing price of food gains – factors that increases profitability of cultivation - will all affect the economic costs of co-operation.

Section 3.3: An Analysis of Collective Action

In this section we shall consider the problem of collective action, and its occasional breakdown in greater detail. We have noted previously that a certain extent of rule breaking is prevalent. In game theoretic terminology this implies that the equilibrium is characterized by the presence of both co-operative players and players who defect. We will examine the class identity of players choosing to defect, the reasons for defection, and the impact of this problem on collective action.

When respondents were asked whether they undertook illegal felling of trees, the majority (134) denied doing so. This is not surprising as respondents are perfectly aware of the legal consequences of their actions. However, over time, as we won their confidence, they (140 respondents) admitted to breaking rules in times of needs. It was difficult to identify the income status of the defectors. About 56% of he respondents felt that it was the poor households who broke rules, while, the rest felt

that it was rich households who were responsible for illegal felling. Not surprisingly, the richer households passed on the responsibility for felling onto the poor households. A large proportion felt that the economic conditions (81%) and reputation (87%) of the defector should be considered before dealing out punishment. Our results, as well as focus group discussions, suggest that the resource users are aware that poor households are unable to subsist without resorting to some amount of felling. So some amount of clemency is desirable. Defection of this type is not a consistent play by the player concerned, it is an immediate response to a short run crisis. Any attempt to retaliate or punish such defection will simply start a run of mutual recrimination and endanger collective action. It is for this reason that players claimed that they would not break rules even if other players did. So a certain level of defection is tolerated. If defection crosses a threshold level, then punishment is meted out. The reputation of the player is important in this context. This result is consistent with the models of Taylor (1976) and Baland and Platteau (1994).

Simultaneously, some rich households break rules deliberately to supplement their income. The power of this group is too strong for any retaliation against them. We can think of this in terms of a coalition of players banding together. Their collective strength prevents punishment.

As Belemath is a village surrounded by forests, it is to be expected that the lives of the people will be entangled with the forests. This can lead to degradation of the forest which will affect the lives of the entire community. The local community is aware of the fact that their use of the forest is strongly inter-dependent and generates ‘strategic externalities” (Negri, quoted by Ostrom, 1990). The respondents (209, out of 210 respondents) acknowledge the crisis to be not their personal problem but one threatening the entire fabric of their community. They also admit the problem to be a serious long-term crisis. The works of social psychologists have shown that prior experience is important in generating a quick response to an environmental crisis. In Belemath, however, such a mechanism has not operated – as the respondents are not very much aware of any crisis in the surrounding areas. The important factor in generating awareness regarding the state of the environment has been the role of the Panchayat and the local Party.

However, merely generating awareness is not enough. Resource conservation usually entails a short-term sacrifice of economic opportunities. The resource community must acknowledge the need to accept this sacrifice and be prepared to make it. In Belemath, the respondents did not have any alternative source of fuel. At the same time, grass root indicators and the Panchayat had made them aware of the imminent problem. So they were prepared to continue with conservations even accepting short run sacrifices in income (203 respondents). The game theoretic underpinning of these observed behaviours will be taken up in chapter 7.

Section 3.4: Matha – A Dysfunctional Regime

From Belemath we move to Matha where we have a similar regime, operating under similar socio-economic conditions. Unlike Belemath, however, Matha represents a case of failure.

Section 3.4a: Socio-Economic Features of Matha

In Purulia district we have chosen Matha village as the survey sight, as it is a typical village of the economically backward district of West Bengal. The total population of the village is 342 among which 197 are male. There are 76 households all total in the village and the average family size is 4.5. Matha is basically dominated by the tribal population (64.32%) and then it is the Upper Caste Hindus (16.08%). Some Schedule Castes (4.67%) are there and the Muslim population is negligible (1.46%). The majority of the population is illiterate (128 i.e. 42.11%). But among the literate people 61 are just literate and more or less same proportion of population are primarily educated (54 i.e. 17.76% which is up to class V) and secondarily educated (53 i.e. 17.43% which is up to class X). A few people are gone up to XIIth standard and there are 3 graduates. The average yearly income is Rs. 23259.00 where as the average expenditure is Rs. 16030.55.Income is mostly generated from agriculture-either in the form of wage income, or from cultivation of owned or leased land. The unemployment is also high (about 40%) of the total population. However this does not mean that they do not engaged in any economic activity. It is possible that most of them are engaged in illegal felling of trees. It is difficult to say that whether it is involuntary or deliberate choice. As the area is economically underdeveloped and

the education level is low, it is more likely to be involuntary. Quite a few households are landless. Only 52 households own land. Farmers mostly belong to the small (22 households) and medium (18 households) categories. Cultivation is in the small (0.678-1.67 hectares) and medium (1.68-6.67 hectares) categories. Cultivation is basically ownership-based – the lease market is not important.

Table 3.7: Pattern of Land Holdings

	Land Holdings	Cultivated Area	Total Land
0-1 bigha	4	4	4
1-2 bigha	1	4	1
2-5 bigha	8	27	8
5-20 bigha	4	15	4
Above 20 bigha	37	2	37

Section 3.4.b: Evolution of Forest Protection Committees

The history of forest use in Matha is similar to that of Belemath. Initially, Zamindars owned the forests and protected them from encroachment. Later on, they were nationalized and brouhght under the control of the State.

Officially, the Government permitted a limited form of forest use through the system of auctioning. This was far below the actual demand for timber. Consequently, trespassing of forests on a small scale occurred. The paucity of forest guards resulted in a failure to prevent such illegal felling. The confidence of trespassers increased gradually. Matters escalated in 1980-84 when mass looting of forests by bands of 200-300 persons started occurring.

The frustration of administrative officials to conserve forests led to suggestions of involving the people in forest management. Individual attempts occurred sporadically. For instance, in the Ichadi Hills of Bagmundi Block, *sal* trees used to be felled for making charcoal. This led to deforestation until, in 1981, the local Range Officer tried to teach the villagers the advantage of replanting. The tribal population initially resisted such attempts – even though they trusted the Range Officer, and

were otherwise on cordial relations with him. But over time they found that the system of cutting shoots to the grounds and replanting of *sal* trees by fast growing *sonajhuri* trees successful, and accepted conservation practices. Later on, these practices were institutionalized under an FPC. Here we find that a personal attempt by an educated environment conscious external agent who was both liked and trusted by the resource community led to a change in the attitude of the resource community and the adoption of conservation practices.

Around 1989 District Officials decided to involve Pachayats in forest conservation and accordingly set up FPCs. The basic principles of the FPCs are the same as in Burdwan. What is different is the actual functioning of these committees and their impact. In contrast to Burdwan, where the Forest Protection Committee was active, such a Committee was virtually non-functional in Matha. There was no active role played by this Committee in promoting environmental consciousness, resource conservation, monitoring, sanctioning, etc.

When we spoke to respondents, they referred to the forest, as a State owned resource. Resource users did not exhibit any sense of possessiveness towards the forest. They realized that the forest was being degraded.

Table 3.8: Grass Root Indicators of Development (Number of Respondents in Matha)

Indicators	Increased	Decreased	Unchanged	Uncertain
Number of trees	0	54	20	1
Forest area	0	28	46	1
Time taken to go to forest	19	10	44	2
Time taken to collect leaves	24	5	34	12
Level of Income	4	27	28	16
Income variance	9	3	17	46

Unlike the responses in Belemath, the respondents of Matha appear to indicate a decrease in the density of the forest, rather than a decrease in area. The economic impact of degradation too does not seem to be have been manifested to a significant degree. One reason for the latter is possibly that, in the absence of other income earning possibilities, physical degradation will simply lead to increase in the time spent to collect the timber. This will prevent the manifestation of degradation in an economic form where the opportunity cost of time is virtually nil.

Villagers acknowledged the following facts:

1. The problem was a joint problem, requiring a co-operative effort;
2. The forest was an important part of their lives;
3. The problem was one of over exploitation by the villagers;
4. The problem had serious immediate consequences;
5. Resource conservation was necessary immediately;
6. Resource conservation was necessary even if it reduced income in the short run.

However, the villagers did not follow resource conservation rules, and resorted to frequent rule breaking (see table below). This was because of the pressure of poverty. In addition, they were uncertain as to whether income would recover in the long run. We saw a large number of villagers cutting down branches. They did not appear to obey any social norm or institutional constraint to defection – only the fear of the Forest officers appeared to operate as a check. During our field survey, there was a raid in which several villagers were arrested.

Table 3.9: Incidence of Defection of Villagers

Activities	No of Respondents
Village average of people breaking rules	33.80
Village average of people who are not caught	7.97
Village average of people who are punished	0.32
Village average of people who are pardoned	0.07
Village average of people who are freed by manipulation	0.00

The villagers reported a higher incidence of rule breaking. Peer monitoring was non-existent, resource users did not feel any shame when detected breaking rules. They openly admitted to rule breaking in normal circumstances (54 of respondents confessed that they broke branches); 64 respondents admitted that they broke rules in a crisis. In the absence of monitoring, the incidence of detection and punishment was very low. Unlike Burdwan, where there was a threshold level of defection, which was enforced by the FPC informally, in Matha, the system was dysfunctional.

Section 3.4.c: Pattern of Forest Use

The villagers were dependent to a significant extent on the forests. Forests provide different resources to the community – fruits, animals, birds, materials to make houses and tools, leaf (used as fuel), etc. The dominant use of the forest, however, is to obtain branches for domestic energy consumption and for sale.

In Matha we found that the basic pattern of resource use was unsustainable. While in Burdwan, the villagers used leaves, so that an in-built sustainability was present, in Matha, they relied on timber. This is because of two reasons. Firstly, it takes less time to collect branches. Secondly, the economic value of branches was high, as they could be sold in Bihar. The extreme poverty of the villagers of Matha forced them to fell trees and transport them manually over a distance of 10-15 kilometers to the district East Singbhum in Bihar to be sold for their timber value.

Table 3.10: Dependence of Income from CPRs

Income Class	**1995**	**2000**
0-10000	113.35	52.39
10001-20000	67.90	42.76
20001-30000	49.07	38.58
30001-40000	101.28	32.99
40001-50000	13.03	12.22
50001-60000	3.21	3.11
60001-70000	0.00	0.00
70001-80000	0.00	0.00
80001-90000	4.57	4.37
90000>	10.53	10.53
Village Average	65.37	38.51

Table 3.11: Item Wise Dependence onn CPRs in Matha

Income Class	Consumption		Energy		Intermediate	
	Housing Materials	Roof	Leaves	Branches	Shall Leaves	Mattress
0-10000	2,00	0,00	0,00	35,32	60,13	0,00
10001-20000	0,00	0,58	1,89	28,87	27,26	0,77
20001-30000	0,22	0,13	0,26	20,03	7,90	1,24
30001-40000	0,00	47,40	20,33	16,95	5,20	0,00
40001-50000	0,00	0,77	0,00	3,24	4,66	0,00
50001-60000	0,03	0,00	0,00	3,19	0,00	0,00
60001-70000	0,00	0,00	0,00	0,00	0,00	0,00
70001-80000	0,00	0,00	0,00	0,00	0,00	0,00
80001-90000	0,06	0,00	0,00	4,51	0,00	0,00
90000>	0,00	0,00	0,00	0,00	0,00	0,00
Total	***0.53***	***4.73***	***2.95***	***24.12***	***21.03***	***0.69***

Empirical studies indicate that the dependence on CPRs will be very high in arid areas. This is borne out in our study – dependence being as high as 38% at the time of our survey. This dependence is particularly high for the poorer households (with income below 40000). This table also indicates a sharp decline in the use of forests. This is probably due to the degraded nature of the resource. This decline has been due to reduced forest use by the poor households. For households with income above 40000 there has been no change in the level of forest use.

It is a common hypothesis in the theoretical literature on the commons that if the resource community is very poor and is dependent on the resource to a significant extent, a sustainable pattern of resource use will emerge. Our experience in Matha, however, is not consistent with this hypothesis. We found a significant extent of defection along with a total absence of any feeling of guilt or shame. The reason for illegal felling is the pressure of subsistence requirements. This has prevented the emergence of institutional constraints on defection. The entire community seems to

be caught in a web of " collective defection". Instead of collective action, we have collective inaction!

The lack of collective failure appears more surprising if we consider the following facts, which have been categorically accepted by the respondents:

1. They acknowledge the importance of the forest in their daily lives
2. Respondents consider the problem of degradation as a serious problem
3. Degradation has been caused by an excessively high rate of exploitation
4. They feel that the problem requires immediate action
5. Collective action is necessary to solve the problem

However, the pressing need of meeting subsistence requirements has prevented resource users from initiating any collective action. Their time preference is heavily biased in favour of present income flows. Unlike Belemath, the role of the Panchayat in changing time preference has been negligible. The only check to illegal felling is the fear of being apprehended and punished by forest officials.

It Is doubtful whether the lack of interest of the inhabitants of Matha can be considered to be a collective action failure. Post-Hardin literature would probably think so. In our opinion, however, it is not a collective action failure. We should distinguish between the capacities of the community, and it's willingness to undertake certain activities. Our study indicates that, in view of the biased time preference, *the resource community does not choose* to act collectively to conserve the resource – instead, it takes a *collective decision to over exploit the resource.*

CHAPTER 4: FISHERMEN'S CO-OPERATIVES IN CALCUTTA

Section 4.1: Importance of Water Bodies

The second type of resource studied by us consists of water bodies. The water body is a unique resource system in several ways. A single community exploits the water bodies studied by us. In some cases, however, we may find that several villages may jointly use the water body. In extreme cases, for example Lake Victoria in Africa we may even find several countries exploiting the same water body! Unlike forests, which is a stationary resource, the extent of inter-dependence increases in these cases. Sustainability becomes a complex issue in these cases as over-exploitation by one group will generate externalities affecting others – while the offenders are beyond the jurisdiction of the affected parties.

Even when a single community exploits the resource, resource use is frequently of a complex pattern. This is because water bodies may generate different types of utilities that are totally unrelated to each other. For example, a water body is a crucial input in pisiculture. Simultaneously, it also performs several functions in the domestic households: providing water for drinking purposes, bathing, and washing clothes and utensils. Water bodies may also serve as source of irrigation. It also helps in livestock farming, as animals drink water and bathe in them. In urban areas, they also serve as disposal grounds for effluents of industries and the sewage water carrying out the wastes of the city. Some of these uses are complementary – for instance, sewage water has been successfully used in pisiculture, with the wastes serving as food for the fish. Other uses may be conflicting – washing and bathing reduces water quality to below levels suitable for drinking purposes; effluents may also affect pisiculture operations.

The issue of property rights becomes complex as we may conceive the water body having different types of resource regimes corresponding to each type of use. This may affect the formation and the dynamics of the property right system in ways not usually seen in the case of other resources.

In our survey we have studied three water bodies. Two of these water bodies are fishermen's co-operatives. One of them also offers additional facilities like boating. The long run definition of sustainability, as we shall see later on, is different for these two organizations – despite corresponding similarities in their experiences, formal structures and functioning. The third water body, reported in the succeeding chapter is also a multiple use resource. It differs from the water bodies studied in this chapter in two ways – the lack of formal structures of control and the co-existence of a wide variety of resource regimes for the same resource.

Section 4.2: Bon Hoghly

The third resource studied by us was a water body (or rather three water bodies) in Bon Hoogly, Calcutta. These water bodies are managed by a Co-operative Society formed in 1974.

Section 4.2.a: Socio-Economic Features of Respondents

At present there are 72 members of this Society, of whom 48 are active. These members perform various duties – there are Managers, Night Guards, Net Repairmen, Maintenance Personnel and Fishermen. Except for the Office Staff – consisting of the Office Manager, Farm Manager, Sales Manager and Peon - the other duties are rotational on a fortnightly or monthly basis. Duties are allotted after mutual discussion between members, with the Executive Committee having arbitration powers.

Most of the members originally hailed from East Pakisthan (currently Bangladesh) – though a handful also came from Mednipore district of West Bengal.

Table 4.1: District of Origin

Country	District	Number of Households
India	Mednipore	5
East Pakisthan (present Bangladesh)	Dhaka	14
	Faridpur	4
	Coomilla	2
	Barishal	5
	Khulna	4
Not stated		3

These households mainly migrated to India over the Bongaon (Benepol) border; though some crossed over at Hilly, Banpur, Darshana, and Petrapol. About half of the households (14 households) had migrated to India before 1960 and the rest after 1960. Of these, 9 households had migrated between 1960 and 1969, while 9 households migrated after 1970. Only two households had migrated before 1947. The main reason for migration was political and communal disturbances (21 households). . A significant proportion was motivated by the search for employment (7 households). Arriving in India, the refugees had initially settled in various parts of West Bengal – Dumdum, Bon Hoogly, Mednipore, Belgachia, Sodepur, Shyamnagar, Baranagar, Krishnanagar, Naihati, etc. Over time, they came to Bon Hooghly for various reasons.

Table 4.2: Reasons for Coming to Bon Hooghly

Reasons	Number of Households	Percentage
Riots	2	5.41
Education	2	5.41
Land for housing	6	16.22
Employment	8	21.62
Presence of relatives	6	16.22
To join co-operative	4	10.81
Contacts	1	2.70
Not stated	8	21.62

About 10 households settled in Bon Hooghly between 1960 and 1970, while 15 households settled after 1970.

Section 4.2.b: Evolution of the Co-operative

The traditional occupation of the migrant households varied – but a dominant section (16 households) was traditionally fishermen. These traditional fishermen mostly settled at Arjunpara, Dumdum and used to catch fish by throwing nets (*khabla jal*) in small ponds. A few of them came to Calcutta and settled in Noahpara-Bon Hooghly

areas. They used to catch fish individually in a lake in Noahpara. Unfortunately, local anti-socials used to extort and harass these fishermen. Around about 1972, Jamuna Bhowmick, wife of one of these fishermen, Gobinda Bhowmick, heard a radio program extolling the benefits of fishing co-operative established at Mudiali in the western fringe of Kolkata. The program so impressed her that she told her husband and Biren Sarkar, tutor of their children, about the program. Gobinda Bhaumik and Biren Sarkar talked the issue over with other refugees – Bidhusekhar Mondal, Sukumar De, Chitta Sarkar, Rakheswar Biswas, Dasrath Biswas, Dhruba Narayan Pal and Sauti Poddar. It was decided to form a co-operative based on three water bodies. One of them was the lake at Noahpara, where these refugees traditionally caught fish; the other two were adjacent lakes at Bon Hooghly, near the Indian Statistical Institute. These members felt the urgent need to supplement their meager income. In addition, since quite a few of them were traditionally connected with fishing, they did not have to adapt themselves.

The State Government owned these lakes. Therefore, Gobinda Bhowmik – who was a gardener at the Indian Statistical Institute (ISI) – contacted Rani Mahalonobis (wife of Prasanta Chandra Mahalonobis, the founder of ISI), with whom he had cordial relations, and sought her help. She, in turn, contacted P.N. Haksar, PA to Mrs. Indira Gandhi, the then Prime Minister of India. It was found that the ponds were under the Refugee Relief & Rehabilitation Department. Bhaben Rai Chaudhuri, erstwhile P.A. to the Commissioner, helped Gobinda Bhowmik to lease in the lakes at the rate of Rs. 3,740 per annum. The Co-operative was set up in 1972 after taking a loan of Rs. 11,000 from the Government of West Bengal under the name of Bon Hooghly Motshojibi Somobay Samiti (Bon Hooghly Fishermen Co-operative).

Initially the catch was low as most of the members lacked the skill. Therefore, the members contacted traditional fishermen who had settled in Arjunpara and Bongaon and invited them to join the co-operative. The total number of members was 78, of whom 6 have died. Membership is inherited; or, they can be transferred to nominated family members. No new members from outside the community can be inducted into the society. Some of the original members have grown old and are no longer active. Some of them have even settled elsewhere[13]. Their membership has

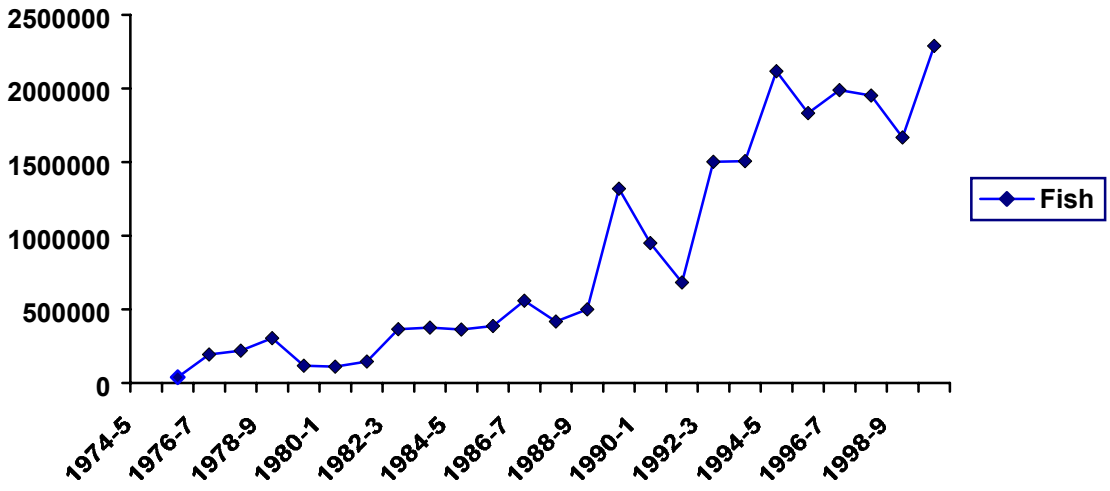
[13] Most of the current members stay at the Noahpara Fishermen Colony.

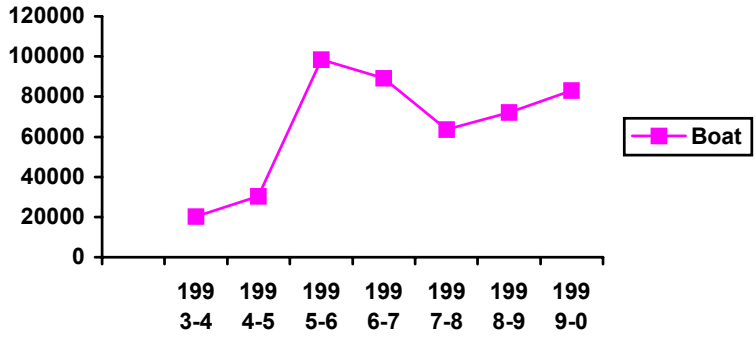
not been terminated out of sentimental reasons. Therefore, 48 members out of 72 members are still active.

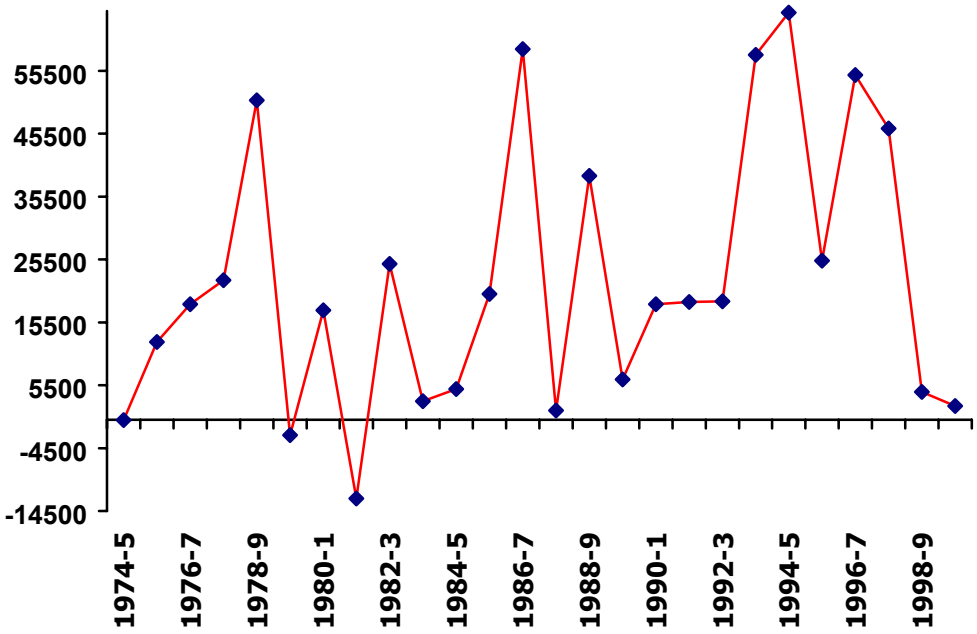
Initially, the co-operative was concerned only with fishing. In the early 1990s, the WBCS Officer supervising the Co-operative, Mr. Mukut Roy Chowdhury, suggested the introduction of boating facilities in the Bon Hooghly water body. The members who were uncertain of the effects of diversifying their activities resisted this. However, Mukut Roy Chowdhury convinced them that paddling would have a favorable effect on growth of the fish stock, and would also supplement their income. All the respondents recognised the benefits of paddling in diversification of income while simultaneously promoting fish growth through better oxygen circulation and fast movement of the fish.

In the figure given below we have given the figures relating to revenue obtained from boating and fishing, and Net Profit. Revenue from fish sales have increased steadily, specially from the late 1980s. Though there was a decline in 1997-8 and 1998-9, revenue again picked up in the last financial year (1999-2000). Boating also provides steadily increasing returns. The Co-operative has operated at a profit except for three years. From the early 1990s, Net Profit has been high. However, in the last two financial years, the level of profit has shown a steep decline.

Figure 4.1: Revenue and Net Profit from Pisiculture and Boating Activities







The overall satisfactory profitability of the society has enabled them to undertake other social functions – like road maintenance, organization of blood donation camps, etc.

The primary activity is, as said before, fishing. This is carried out in three lakes. The first water body is a small one and used as a nursery. The second lake is used for fishing and for paddling. The third lake, at Noahpara, is reserved for fishing only. The labor allocation is as follows:

Table 4.3: Allocation of Duties and Associated Salaries

Position	Number of men	Monthly salary (Rs.)
Farm Manager	1	1435 per month
Office & Sales Manager	2	1415 per month
Peon	1	1255 per month
Fishermen	7	Rs. 53 per day
Net mender	8	Rs. 53 per day
Miscellaneous	18	Rs. 43.43 per day

The miscellaneous group has to undertake various responsibilities – as night guards, as day guards, operation of paddleboats, etc.

The duties of each member are allocated at either weekly, or fortnightly or monthly intervals. In addition, a W.B.C.S. (Executive) Officer supervises the functioning of the co-operative.

Initially workers were paid a commission on daily revenues. But Mukut Roy Chowdhury introduced a system of differentiated wages. Members are paid a salary on the basis of days worked depending upon their allotted duty. Only the Office Staff (Managers, Accountant and Peons are paid on a monthly basis). In addition, co-operative members also get a bonus out of profits accrued during the year.

In addition to wages and salaries, members get post-retirement security in two ways. On one hand, they receive a one-time gratuity of Rs.10,000, or a monthly pension. Simultaneously, the co-operative has opened a monthly recurring deposit in the names of each member. Each member has to contribute Rs.20 (deducted from his salary), while the co-operative contributes Rs.50. This is equivalent to a Contributory Provident Fund Scheme.

Members also get some benefits like educational aid for their children, medical allowance, advances, discount on fish purchase (normally, at the rate of 10%; but

this is increased to 25% in the case of a ceremonial need[14]). For instance, the Co-operative pays the tution fees of the children of members and also provides them with books. Monthly scholarships are also given from the Higher Secondary level – Rs.150 to Higher Secondary students, Rs.250 to Under-Graduate students and Rs.350 to Post-Graduate students. Interest free advances up to Rs.20,000 are made to members in case of ceremonies or emergencies. This has to be repaid in 10 equal monthly installments, which are deducted from his salary.

Table 4.4: Benefits from Co-operative

Year	Wages & salaries	Indirect Benefits			
		Medical Aid	Education	Advance	Miscellaneous
1990-1	536873	-	2000	2997	-
1991-2	349498	447	6510	10600	-
1992-3	623688	166	2925	15820	-
1993-4	659120	860	2960	60000	-
1994-5	696018	2115	12707	17500	-
1995-6	639238	2413	5190	28200	-
1996-7	752585	1687	7824	28000	15300
1997-8	738878	1127	9842	28000	-
1998-9	682532	4111	12382	20000	-
1999-0	682532	3978	14957	48440	82940

These indirect benefits contribute a minor, but steady portion of the total benefits enjoyed by co-operative members (on an average 6.32% of total benefits). The steep increase in the ratio of indirect benefits in the last year is, however, an outlier. This break is due to an increase in expenses on the occasion of the Silver Jubilee celebrations of the Co-operative. If we exclude this figure, the average indirect benefit falls to 4.86%.

[14] This rule gives rise to an interesting practice. Neighbors requiring fish in large amounts satisfy their requirements through co-operative members who pretend to purchase the fish for themselves. This facility is not extended to all neighbors, but to only those with whom they have links i.e. such relations form part of a broad social network).

Table 4.5: Direct and Indirect Benefits to Members

Year	Personnel Cost (inclg. Bonus)	Indirect Benefits	Total Benefits	Percentage Share of Indirect Benefits in Total Benefits
1990-1	536873	4997	541870	0.92
1991-2	349498	17557	367055	4.78
1992-3	623688	18911	642599	2.94
1993-4	659120	63820	722940	8.83
1994-5	696018	32322	728340	4.44
1995-6	639238	35803	675041	5.30
1996-7	752585	52811	805396	6.56
1997-8	738878	38969	777847	5.01
1998-9	682532	36493	719025	5.08
1999-0	682532	150315	832847	18.05

Members also derive utility from various activities organised by the Co-operative. For instance, the Co-operative provides recreation facilities, members organise Puja, annual picnics, cultural programmes, etc. This provides members with psychological benefits. The sum of all the benefits – direct, indirect and psychological - is therefore quite significant.

We had seen that the founder members were motivated by the objective of earning a secure income. Later entrants too had the same objective. Among latter entrants, 28 (75.68%) were unemployed and joining the fishery represented the only means of earning income. However, the income of the members remains inadequate. Consequently, these members have to take up part time jobs elsewhere. Respondents were reluctant to reveal their part time jobs and income from them. While we felt that most of the respondents had part time jobs, only 17 persons admitted this fact. They performed different jobs – accountant, tutor, football coach, grill mechanic, daily labourer, etc. One person even purchased fish from the co-operative and sold it in the local market. In surveys, there is generally under reporting of income. Since, the wages from co-operative could be easily verified,

respondents revealed their actual income from co-operative. However, they under-reported their income from secondary jobs by about 50%.

Table 4.6: Relative Importance of Income from Co-operative

Income Class	Number of Individuals	% Share of Wages from Co-op in Total Income earned by the individual	% Share of Wages from Co-op to Family Income
1000-1250	3	100	94.80
1251-1500	8	100	94.73
1501-2000	10	81.30	69.63
2001-2500	5	76.19	55.68
2501-3000	4	74.11	45.77
3001-3500	3	61.25	39.00
3501 and above	4	63.90	18.10

Concerning the system of functioning and decision making of the co-operative, we concentrated on two aspects: sustainability of the operations, and method of conflict resolution. The latter, in turn, has two dimensions – among the co-operative members, and between the society and the neighborhood.

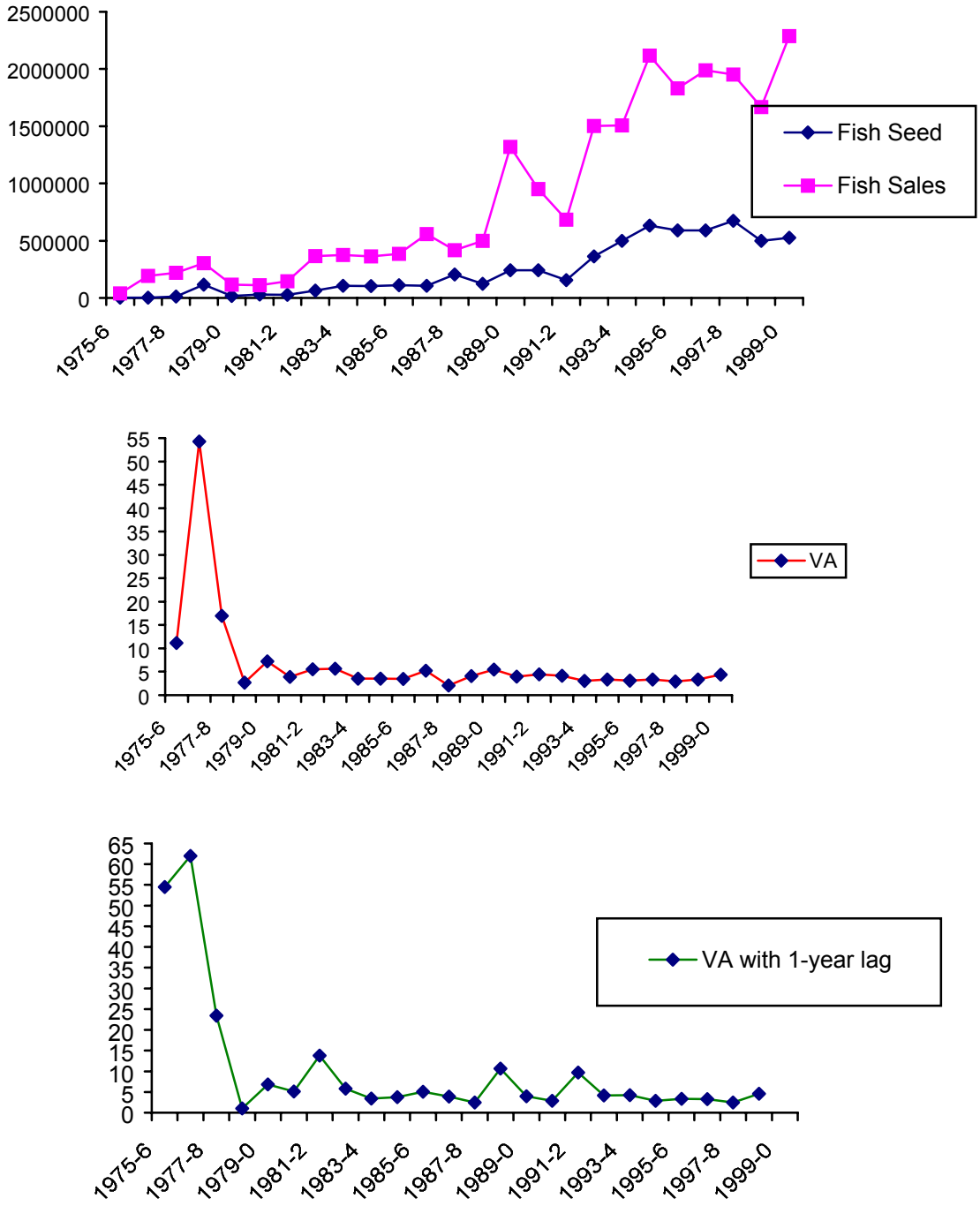
Section 4.3: Ensuring Sustainability

The society members used to fish on a rotational basis in the two lakes. In recent times, however, the society is closed on Saturdays. Fishing is carried out from about 2 A.M. in the night. From the records of the fish variety caught in the last cycle, plans are prepared determining the variety of the fish to be caught. Sustainability is ensured in two ways. Direct observation by fishermen of the condition of the fish caught provides one indication of over catching. The fish exhibit signs of injuries, eyes are opaque, etc. In that case, the fishermen shift to the other lake. This year (March, 2000) the society used to catch fish in two shifts. Heeding signs of over

exploitation, they stopped fishing completely for a fortnight allowing the fish time to recoup.

Simultaneously, based upon past records, the society decides on the type of fish to be restocked and the type of fish to be caught to ensure that a variety is not exhausted. The main variety, however, is bata and laylantika.

Figure 4.2: Trends in Seed Purchase, Fish Sales and Value Added



In a closed water body, restocking of fish is an important activity. In the figures given above, we present trends of purchase of fish seed, revenue from fish and value added. The value added is the ratio between revenue from fish sales and purchase of fish seed, and is an index of productivity[15].

Both fish sales and purchase of fish seed have risen overtime. Note that this is in value terms. So this increase can also represent an inflationary trend, rather than an increase in quantities of fish seed and fish caught. However, price of fish and seed has not increased rapidly in this period. So the price effect can be discounted.

Another point that should be noted is that the rising trend is only up to 1994-5. Thereafter, a declining trend can be observed – though there has been a sharp increase in the last year. Value added, however, has been constant – with an average of 10.3640. Fluctuation around this average is not very high as can be seen from the value of variance - 4.0984. If we omit the first three years, then the average and variance are 4.0225 and 1.2454, respectively. Since it takes about 7-9 months for the fish seed to grow, a more appropriate formula for VA might be the ratio between revenue from fish sales and the previous year's purchase of fish seed. We have defined this as Lagged Value Added. However, this measure is also constant over time, with a mean of 10.9321 – though its fluctuation is slightly higher. (represented by a variance of 15.5863).

Sustainability requires that restocking be strongly correlated with fish catching. We have drawn a regression equation relating purchase of seed to revenue from fish sales. The results are given below.

Table 4.7 Results of OLS Regression of Fish Sales on Fish Seed

Dependent variable is SEED (25 observations used for estimation)

Regressor	Coefficient	Standard Error	T- Ratio[Prob]
Intercept			
Revenue from Fish Sales	**.28378**	**.010356**	**27.4036[.000]**

[15] Note that the multiplicative factor – the index of productivity – can also be high because of an increase in price of fish. However, there has not been any sharp increase in price during the period studied.

R-Squared **0.93328**	R-Bar-Squared **0.93328**
S.E. of Regression **59291.3**	F-statistic **335.71223**
Mean of Dependent Variable **241650.5**	S.D. of Dependent Variable **229534.5**
Residual Sum of Squares **8.44E+10**	Equation Log-likelihood **-309.7187**
Akaike Information Criterion **-310.7187**	Schwarz Bayesian Criterion **-311.3281**
Durbin Watson statistic **1.5696**	

The results indicate that purchase of fish seed is strongly related to fish catch. Based on the principles stated earlier, the Co-operative members replenish the fish stock annually. While this may not exactly correspond to the environmentally sustainable level, the Society uses ad hoc estimates and grass-root indicators to obtain a rough estimate of this level. The Co-operative, therefore, appears to operate on a sustainable principle.

Now another index of sustainability is the Closing Stock. A declining closing stock of fish would normally mean that the resource is being over exploited. While we do have figures of closing stock, we feel that these figures are dubious. For one, the figures are rounded figures, which raises doubts about their reliability. The method of accounting used to obtain Closing Stock is obviously ad hoc, thereby reducing the relevance of Closing Stock as an index of sustainability.

Section 4.4: Conflict and It's Resolution

Coming to conflict resolution, we note that there are two dimensions – internal (among the co-operative members) and external conflict (between co-operative members and the neighbours). We summarise the main issues of conflict and the method of resolving them below:

1) *Internal conflict:* Conflict can occur among co-operative members in two ways.

a) *Allocation of work:* Since the wages paid and responsibilities of each category of work are different, there is a possibility of conflict between members over allocation of work. By and large, respondents were reluctant to reveal signs of

conflict; however, 14 of the respondents admitted that there was conflict over the allocation of work. Specifically, as the pay of fishermen was highest, co-operative members generally wanted to be allotted to fishing. Rotational allocation of work does reduce the extent of conflict. In addition, arbitration by the Executive Council helps to arrive at a decision. Nevertheless, some amount of bitterness remains. Economic pressures and the absence of any alternative source of employment and income, however, prevent dissidence from breaking up the co-operative[16].

2) *Shirking:* Conflict can also emerge if co-operative members tend to avoid carrying out their allotted responsibilities (shirking). According to 83.78% of the members, shirking is negligible or absent. This is because of supervision of activities and group monitoring[17]. At the same time, the pressure of part time jobs does affect the ability of the members in supplying effort. Members, and even the supervisors, admitted this fact. It is generally felt that this sort of shirking could not be avoided. Hence, the load of secondary jobs is taken into account while allotting duties. We can argue that this corresponds to a threshold level of defection. As long as members do not shirk their duties up to this limit, allowance is made for them. If shirking crosses the critical level, then the mutual tolerance breaks down and measures are taken against the erring members.

3) *External Conflict:* Conflict can occur between the co-operative members and neighbouring residents and factories in three ways.

a) *Poaching*: Local residents may secretly catch fish from the lakes. Realizing this possibility, the co-operative arranges for night guards and day guards to patrol the lakes. In spite of this, there is some amount of poaching during the monsoon when the water overflows from the lake.

b) *Use of the lake:* The local residents used the lake for bathing and washing (of clothes and utensils) purposes. This will affect the quality of the water and reduce

[16] 35 respondents admitted that they would never be able to leave the co-operative even if its functioning detoriated, as they did not have any alternative source of steady income.
[17] Activities are organized in groups, and not individually. Shirking by one member will increase the load of other members. On the other hand, if all members of the group shirk together, their output falls noticeably, and draws the attention of the Executive Council.
[6] In an attempt to understand a possible indirect positive impact of the neighbourhood (which enjoys some positive externalities) on the conservation and maintnces activities of the co-operatives, we under look rudimentary CVM exercise to elicit the (rough) value that the neighbourhood assigns on the resource managed by the co-operative. Since the exercise is a rudimentary one with certain loose ends we report it in an Appendix.

growth of fish. On the other hand, excluding them from using the lake would generate conflict. So, the co-operative has gone in for a technological solution. Periodically, the co-operative cleans the lake by adding lime. In addition, the di-calcium phosphate added to the fishmeal also helps in purifying the water.

c) *Effluent:* Effluents from the neighbouring factories are washed into the lake. In particular, the effluent of a battery factory at the Noahpara has made fishing impossible at the lake. The co-operative is attempting to obtain a Government loan to build a purifying tank.

In addition, there was a period in the early 1970s when local anti-socials used to prevent the co-operative members from fishing or used to try to take away their catch on the grounds that it was an open access resource. This led to physical resistance from the co-operative members. Frequent fights used to occur. Over time, as the Co-operative has demonstrated its viability and survival capacity, the rights of the fishermen over the lakes has been recognized and accepted by the neighbourhood.

Therefore, we see that some of the activities of the neighbouring individuals generate negative externalities for the co-operative. Such externalities can be resolved by excluding them from access to the ponds. The cost of this will be immense, given the legal structure and practical realities – this is a case of a Pareto irrelevant externality (Buchanan & Stubblebine,1962). Therefore, the co-operative members accept this damage and pays for it in the form of adopting cost-effective abatement technology.

On the other hand, the activities of the co-operative generate positive externalities for the neighborhood. Firstly, of course, the purification program adopted by the co-operative keeps the water clean. Secondly, neighbors can purchase fish at a low price. Third, the co-operative offers recreational benefits (in the form of paddle boats and morning and evening strolls). Fourth, the co-operative organizes socially beneficial activities like blood donation camps, and also repairs the banks of the lake and roads. The co-operative, thus earned social acceptance and respectability.[6]

Section 4.5: Changing Dimensions of Sustainability in the Long Run

To sum up, the Bon Hooghly Fishermens Co-operative was formed by a group of refugees from East Pakisthan. Riots and political disturbances had forced them to leave their homestead; in India, most of them faced severe economic problems. At the same time, their economic straits had made them desperate and enterprising. Based on a small group of educated persons and persons with some contacts, they managed to organise themselves into a collective group. Under the existing institutional environment, this group had to take the form of a co-operative. The main incentive – the cementing factor – was the economic compulsion to earn a steady income. This stimulated them to clear the pond and conserve the fish stock. Resource conservation was, therefore, an instrument whereby they could achieve their primary target of earning a supplementary income.

Over time, an interesting development has occurred. Paddleboats have been generating a steadily increasing flow of revenue. In fact, it is becoming the dominant source of income. This can be seen from Table 4.8. What is specially important is that if we exclude rent from boats from Net Profit, then we get a negative figure. The resultant figure is actually surplus from boating plus expenses on boats. Since the latter is an insignificant figure, we can ignore it. In that case, the resultant figure gives the surplus from boating. Except for 1993-94 and 1994-95, fishing activities leads to deficits. What is interesting is that previous to the introduction of boating fishing was profitable (see figure 4.1). The introduction of boating, therefore, has converted a previously profitable line of activity to a loss making line.

Table 4.8: Relative Importance of Fishing and Boating in Generating Revenue

Year	Ratio of Net Profit to Revenue from Fish Sales (%)	Ratio of Net Profit to Revenue from Boating (%)	Ratio of Revenue from Boat to Revenue from Fish Sales (%)	Surplus from Fishing (=Net Profit – Revenue from Boating)
1993-4	3.85	35.08	1.35	37663
1994-5	3.06	46.73	1.43	34483
1995-6	1.38	388.48	5.37	-73015
1996-7	2.76	162.38	4.18	-34208
1997-8	2.37	72.66	3.27	-17422
1998-9	0.27	1632.10	4.33	-67734
1999-0	0.10	3775.50	3.62	-80714

One possible implication of this trend is that the co-operative may shift its attention from fishing to boating. While this will increase the profitability of the co-operative,

the environmental impact of this will be uncertain. On one hand, less care will be taken to maintain the stock of fish. On the other hand, boating will require a change in the pattern of use of the surrounding areas. The banks of the lake will have to be beautified. This will increase the recreational benefits from the lake. While this will have a positive impact, the development of commercial establishments and pollution due to improper disposal of waste materials, may generate negative externalities.

Thus, over time, if an inconsistency develops between the primary target and resource conservation, the co-operative may become dysfunctional – in terms of its overt objective of fishing. At this moment, however, it is not possible to conclude whether such a trend is being manifested. One indication of this danger will be a drop in the fish catch and revenue. While, there has been such a drop in revenue from fishing over the last few years, we are unable to judge whether this is a long run trend, or merely a temporary decrease.

Section 4.6: A Note on the Chachharia Fishermen's Co-operative:

We also investigated (on a sample survey basis) another fishermen's co-operative society functioning at Chachharia in the heart of the East Calcutta Wetlands. Structurally and functionally this society resembles the Bon Hooghly Fishermen's Co-operative Society and is performing, if not with equal success, at least satisfactorily[18]. However, its origin, course of evolution of the property regime, and resource characteristics exhibits some distinctive feature. We briefly note them here.

Section 4.6.a: Origin of the Co-operative

The original owner of the land where the water body (*bheri* in the local vernacular) is situated was the Mallicks - a *zamindar* family of north Calcutta. In 1980-81 dispute arose regarding lease-rights on the water body. After the settlement of the dispute one Sri Jayanto Mallick leased out the land. But after his death the land with the water-body turned almost into a free-access property. A minister of the Government of West Bengal Mr. Abdul Razzak Molla suggested to Mrs. Suraiya (Jaya) Mallick,

[18] Before comparing the 'success' of these co-operatives, we should keep in mind the different objectives of these two co-operatives and the different contextual factors surrounding these two resources.

widow of Sri Jayanto Mallick, that she could lease out the water body to Chachharia Fisherman's Co-operative (an offshoot of the local Bheri Mazdoor Union) for its use and management. She agreed to that proposal. The co-operative started in 1991 (though the formal registration was obtained in 1999). The members of the cooperative are the ex-*bheri* mazdoors (workers) under the leaseholders. Here CPI (M) and its mass organization Bheri Mazdoor Union played the crucial role of a catalytic agent to transform a private resource turned free access resource to a CPR.

Section 4.6.b: Characteristics of the Harvesting Process

The water bodies where fishes are grown obtain water from the municipal sewages flowing through the stream adjoining the area. This local technology of sewerage fishing is unique as it enables purification of the sewage water. The process of production converts a public bad (the sewage water) into a public good (purified water), and thus draws wider public approval.

Section 4.6.c: Impact of the Resource Regime

The CPR regime here converted erstwhile fishermen working as labourers into co-owners. This benefited by them in various ways: assuring secure employment and a steady flow of income throughout the year. This is of particular importance in view of the acute poverty of the resource community and the lack of any viable alternative means of livelihood open to them. It also ended the long history of exploitation of these fishermen in the hands of various lease owners.

Section 4.6.d: Influence of Contextual factors

In the case of Chachharia the influence of political factors have been of great importance in shaping the mobilization and formation of the co-operative. Taking advantage of the sense of oppression and exploitation of the *bheri* workers, the CPI(M) became the dominant political force in that area. In subsequent periods, when the resource faced danger of being over-exploited and degraded as an open access resource in the 1980s, it was this party which introduced a property regime and enabled the conservation of the resource. The party, on one hand, persuaded the legal owners to lease out the water body to the workers; on the other hand, it mobilized the workers to form the co-operative. During the period of our survey we

found that the party retained tight control over the functioning of the organization. Most of the members were also members of the CPI (M); the members holding the administrative posts were also Party functionaries. The role of the party in generating consciousness of the possibilities inherent in a sustainable pattern of resource exploitation is reminiscent of the experience in Belemath.

CHAPTER 5: A COMMUNITY OWNED WATER BODY IN HAZAMDIHI

Section 5.1: Background of the Resource Community

Hazamdihi is a small village inhabited by about 150 households in the district of Bankura. It is about 6 kilometers from the Block Office of Khatra, which in turn, is about 60 kms from the district headquarter Bankura Town. The villagers are Hindus, of which two castes dominates – the Bauris (SC) and the Mondol (OBCs). There are also a few houses of Upper Caste Hindus. The total population of the village is 616 consisting 330 male and 286 female.

Table 5.1: Caste Profile of Population

Caste	***Households***		***Individuals***	
	Number	**Percentage**	**Number**	**Percentage**
Upper Caste	9	9.57	57	9.25
SC/ST	47	50.0	262	42.53
OBC	38	40.42	297	48.21
Total	94	100.00	616	100.00

Basically the houses of the community are typically village houses and the roofs of the houses are made of straw for majority of the population (65%). The roof made of *tali* and *tin* counts there after both of them having a percentage of 14% and 11% respectively. Only 7% people have houses of their own which have concrete roof. Radio is available to 22% of the people where as 75 % of them have no radio of their own. In case of T.V., only 5% people have it, but the majority of them have no T.V. in their houses. Cycle availability is a common feature in the village area and our survey sight is not an exception. Majority of the population has their own cycles (69%) and 28% people have not any cycle.

Table 5.2: Distribution of Population According to Income

Income	Number of households	Average income	Percentage
Less than 10000	17	6340	17.17
10001-20000	33	15413	33.33
20001-30000	17	25267	17.17
30001-50000	12	38920	12.12
50001-80000	12	64309	12.12
More than 80000	8	196278	8.08
Total	**99**	**38938**	**100**

Table 5.3: Population Engaged in Different Occupation

Occupation	Main Occupation	Secondary Occupation	Total Respondents
Farm Worker	100	12	112
Farmer	73	17	90
Milkman	17	14	31
Business	14	8	22
Service	12	1	13
Fisherman	0	0	0
Forest related activity	0	0	0
Other Occupation	0	0	0
Total	216	52	268

Section 5.2: Evolution of the Resource Management System

The resource studied by us was a water body in this village. The history of the water body is an interesting one. The earliest inhabitant who can be traced was a Santhal (tribal) named Hazam Majhi[1]. He had settled down near the water body that had

been granted by the King of Khatra to his Gurudev (*Gosai*). The settlement that developed was called after his name as *Hazamdihi*[2]. The present settlers, however, were not related to Hazam. They were descendents of one Bauridas Mondol, an inhabitant of Khichka who had arrived in Hazamdihi via Bhadura in search of livelihood. He acquired the water body from Hazam. Bauridas had 5 sons, of whom 3 remained in Hazamdihi, while the other 2 settled down in nearby Domnashole. Bauridas had 12 grandsons from the 3 sons who had remained in Hazamdihi. The present inhabitants are descended from these 12 Mondols. In addition, these Mondols had hired-in agricultural labourers from outside (they belonged to the *Bauri* caste). They form part of the present population. Finally, 7 households of Tantubayees migrated to Hazamdihi. The models extended over generations from the co-owners of the water body.

Initially, the water body was used for the following purposes:

1. Bathing of humans and cattle;

2. Washing of clothes and utensils; and,

3. Fishing.

Since the owners of the water body are not traditionally fishermen, they used to hire Santhals from Domnashole to catch fish for a share in the total catch. This was sold in nearby Khatra and the proceeds used for financing community Pujas (Swaraswati, Kali), and *jatras* (folk theaters). There were some *khejur* (dat palm) trees on the banks of the water body. The *ras* (juices) from these tees were also collected in the winter and sold. The proceeds were used as before. This indicates that the water body is not an isolated resource but part of a *resource system*.

Over time, there have been some changes in the resource use pattern. The Government has constructed a canal, which has divided the water body into two parts. This canal is supposed to bring water from the Kangsabati River to the fields. This has increased the possible benefits from the resource system.

Section 5.3: Property Rights and their Changes

The most important aspect of the system is the co-existence of multiple property rights for the same resource. In this context, we should clearly distinguish between common property resources and common pool resources. Common pool resources refer, as we said before, to resources whose consumption is rival, and for whom exclusion is not feasible. In this case it is the water body, which is the common pool resource.

Now as pointed out by Ostrom (1990) a resource resembles a pool, from which resource users appropriate units from a steady flow of resources. Property rights are means of enforcing claims on these resource flows. In the case of pure common property, the rights to the resource will be shared equally within a well-defined group of resource users (resource community). However, property rights to the benefits flowing from the resource can also be owned by the State (State property) or by individuals (private property). In these cases, while tradable rights to the resource is owned by the individual/State, rights to use some benefits may be allocated to groups of people. For instance, while standing harvest and private land is private property, rights to collect gleamings after harvest are often common to the villagers. Similarly, private landowners will allow others to access their land for grazing and foraging purposes in the period between harvest and sowing. Similarly, open access situations can also exist. Resources cannot be neatly classified into categories of property rights as Ciriacy-Wantrup and Bishop (1975) suggests - the reality is more complex. We may have a large number of resources for which different types of rights may co-exist. Furthermore, dynamic changes within the resource system as well as contextual factors may lead to evolutionary changes in the property right system attached with each usage.

The water body offers different types of benefits to the resource community. Depending upon the nature of the benefit and the costs of exclusion, different systems of property rights have evolved for each usage. This has been summarised below:

Table 5.4: Resource Use and Associated Property Rights

Resource Use	**Property Right**
Water for bathing	Open access
Water for washing	Open access
Irrigation water	Open access
Fish	Community based
Ras (juice)	Community based
Income from felling trees on the banks of the water body	Community based

Over time there has been some changes in the property rights system. For instance, as transaction costs have increased there has been a shift in the property rights to fish. A few years previous to the survey period, fishing rights were leased out to private individuals. Respondents stated the reasons for this change. Since they were not traditionally fishermen they had to bear some costs in hiring *Santhals* to catch the fish – contacting them, negotiating with them, supervising their activities, etc. This yielded an uncertain income. On the other hand, leasing out of fishing right resulted in a stable flow of income to the community fund. Such behaviour reflects risk aversion on the part of the community. Outside opportunities of some (particularly of educated and skilled) members also increased. As a result, for those members, opportunity cost of time to be devoted to the management of the resource increased appreciably. Simultaneously there was the pressure of an immediate need. At that time, funds were urgently needed to repair the school building and add an extra story to it. The Panchayat had not released the necessary funds. Leasing out the pond thus offered an easy solution. In later years, realizing that transaction costs would be lowered the system of property rights was permanently changed in all three water bodies.

This marks an evolution in the form of property rights from common property to private property for fishing rights. Such a transition bears out the truth in Eggertson's (1990) statement:

"There is no general solution to the problem of maximizing net yield of the resource. No system of property is universally ideal. Depending upon the characteristics of

costs of production, exclusion and governance, the optimal system may be open access, communal, intermediate plots or exclusive plots."

We can find similar cases of changing property rights in literature. Steins (1999) has presented an interesting case of changing choice in property rights in Cowes Harbour. This Harbour is situated on the River Medina on the Isle of Wight, United Kingdoms. The river provides a variety of benefits: recreational, cargo movement and oyster fishing. While the forms of use have been regulated by the Cowes Harbour Commissioners (CHC), oyster fishermen have been left on their own. This is because revenue from issuing oyster licenses yield only 70 pounds annually, while the costs of monitoring their activities are much less. In other words, it is not economically feasible to bring oyster fishing under the fold of the CHC. Consequently, oyster fishing has traditionally operated under an informal common property regime within the national regulatory frame-work for such fisheries. Fishermen respected these informal rules and there were no violations reported. At the same time, the CHC theoretically regulated fishing. Fishermen granted Oyster Fishing Licences by the CHC were permitted to fish only for one hour on each side of the low tide in periods when all buoys were cleared for winter maintenance. Further, only three boats could fish at the same time. However, the oyster fishermen frequently violated the navigational rules of Cowes Harbour.

As traffic increased with time, this created navigational hazards. It was also felt that oyster fishing was reducing bio-diversity and harming the seabed. Increasing traffic was also affecting oyster fishing: in the form of increased water pollution and accumulation of waste in the seabed, but this was ignored by the CHC. It was finally decided to close down oyster fishing. This led to intensive negotiations between the CHC and the fishermen. Finally, a settlement was arrived at. Under this settlement, the rights of the fishermen to fish in the waters of the Medina were accepted by granting them a Several Order. This gave them "*exclusive right of propagating, dredging, fishing for and taking shellfish of any description to which the Order applies*"[4]. To utilise this Order, the oyster fishermen decided to abandon the traditional informal system of property rights – despite its success – and privatise the oyster beds. Accordingly, in August, 1996 they formed the Medina River Oyster Company Limited.

During our survey we heard of another similar instance from our respondents. In Jitpur, another nearby village in Bankura, feuding between members of different families prevented timely decisions with respect to the water body. The increased transaction cost of arriving at a decision acceptable to members implied that the property right system was no longer feasible. The solution was again privatisation – leasing out fishing rights to the *bandh* (water body).

In both cases (Cowes Harbour and Bankura) we see an abandonment of a successful communally managed system and transition to a private property regime. There are two differences between Steins's case and the *bandhs* of Bankura. Firstly, in the case of Cowes Harbour, the decision to change the property rights was in response to contextual factors outside the control of the oyster fishermen – the decision of the CHC to close down the fishery. In Bankura, however, it was increasing risk aversion of the villagers and increasing opportunity cost of time, which caused the change. In Jitpur, however, it was demographic factors - the extension and growth of the family – which increased costs of arriving at an agreement, and led to the change in property rights.

Section 5.4: Political Economy of the Management System

Management of the use of the water body was undertaken by a group of 12 members. These members were nominated by each branch of the 12 grandsons of Bauridas Mondol. Membership in this committee continues until a member was removed by the branch to which he belongs. The Committee was a stable body – for instance, at the time of our survey, the current Committee had been serving for about 7-8 years. The Committee was responsible for conserving the banks of the pond, guarding against theft by neighbouring villagers, hiring Santhals to catch fish, and utilisation of the proceeds from the water body. The members of the current Committee are as follows:

Krishnapada (President), Dhirendranath[5] (Cashier), Ranjit (Secreatry), Bhaktipada, Prafulla, Nepal, Mahadev[6], Tulsicharan, Shaktisadhan, Gorachand, Kamal.

There are two interesting features about the water body. One is its persistence of the existing system for over 6 generations. This has led to fragmentation of the ownership of the pond. Ownership therefore dissipated to almost the entire village. Or, to be more precise, it dissipated amongst each Mondol household. Fragmentation has occurred to such an extent that legal ownership has become virtually irrelevant. In fact, most of the members were unable to state their current share. As a result, legal ownership does not translate into a marketable right – as it is difficult to identify one's share. Simultaneously, it does not enable any member to appropriate a corresponding share of the proceeds from the water body. Instead, the proceeds are utilized on community projects to avoid discord.

Only three shares (of the original 2) had not been fragmented – these were owned by Tulsi, Sahadev and Bimal. The case of Bimal Mondol constitutes an exception as he is the only outsider to own a share in the pond. Bimal's originl name was Bimal Dibar. His sister was married to a Mondol who died soon after. In the absence of any male heir, the widow requested her brother to settle in Hazamdihi and look after the property. This allowed Bimal Dibar to obtain a share of the pond. Probably to increase his acceptability he changed his name to Mondol.

It may be noted that ownership of both land and the water body is through inheritance – and therefore is affected by the degree of fragmentation. The distribution of ownership of both these resources roughly parallels each other.

Table 5.5: Land Holding Distribution

Land holding categories (in bighas)	**Number of households**	**Percentage**
0-1	38	38.38
1-2	8	8.08
2-5	23	23.23
5-20	25	25.25
20+	5	5.05
Total	99	100

We see that a good percentage of local people have small holdings, where as the land holding distribution is clustered around medium (2-5) and semi-large (5-20) holdings both of them holding 235 and 25% respectively. Only 5% people have large land holdings.

Table 5.6: Relation Between Caste and Land Holding

Land holding (in bighas)	**Caste**		
	Upper caste Hindu	**Mondal**	**Bauri**
0-1	0	33	4
1-2	1	5	2
2-5	5	7	11
5-20	1	3	21
20+	2	0	3
Total	9	48	41

Mondol holds most of the lands. Mondol land used to get the irrigation water regularly. On contrary, Bauris could not get the irrigation water and hence their agriculture were rain fed agriculture. Among the Mondols, three have pump sets of their own and in winter when the water levels are low they used to take water from the irrigation canal with the help of the pump sets.

Interestingly, the three families with the major share in the water body and land holdings also had greater political clout. Though they were not directly connected with the local organizations (the Panchayat, the *sholana*, and the committee to look after the water body), they influenced decision making in each of these bodies. For instance, in the latter body, they used Krishnapada Mondol as their representative. However, this greater say was not used to appropriate the financial gains but to increase their political power. Part of the financial gains (from leasing out the pond, for instance) used to be given to their recommended agents – the remaining was distributed amongst the community members.

In the case of some of the benefits of resource uses, the share is not equitably proportioned. For instance, irrigation water from the canal can be used only by the farmers with land below the height of the banks of the canal. In the winter, when water level in the canal falls further, the water can be appropriated only through pumps. This further affects the extent of distribution of benefits from the resource. Some members also allege that they do not feel at home at social occasions, or are not invited at all – "they (the festivals) are for them." The children of some villagers do no go to the school that is maintained out of the community funds.

What is interesting about the distribution of the benefits is that they accrue, in general, to the Mondols. It is the Mondols who own the land below the banks of the canal and obtain the water overflowing from it. During winter it is the Big Three Mondols who have the pump set necessary to draw water from the canal. The Bauris feel unwelcome to the jatras and pujas. And it is the Mondol children who are enrolled in the school. Distribution of the benefits is, therefore, far from being equitable – the major share of the benefits are appropriated by the Mondols. This outcome follows from the fact that the Mondols alone have access to all the six uses of the resource. In time of our survey maximum number (60.6% of respondents) of people responded that they have no access of the date juice, where as 15.2% gets it. Also there were almost 24% of respondents who have no idea about the date juice, as they do not obtain it ever. Similarly, in case of jatras and pujas participation, 75% of the people, basically Mondals participate in jatras and pujas where as 24% of the respondents basically Bauris had no right to join in the festival.

Table 5.7: Pond Use According to Caste

USE/CASTE	**UCH**	**SC/ST**	**OBC**	**TOTAL**
Pujas/Jatras	3	21	8	32
Family Work	7	23	21	51
Irrigation Work	6	6	25	37
Fish available at a cheap rate	2	12	13	27
No benefits	0	4	2	6
All the uses	2	3	2	7
Total	20	69	71	160

Economic value of the pond (irrigation) is monopolized by the Mondols. Other uses are more or less equitably distributed.

Table 5.8: Pond Use by Different Income Groups (Into Percentage)

Income /uses	Pujas/Jatras	Family Work	Irrigation	Fish at a cheap rate	No benefit	All benefits
Less than 10000	33.33	40	20	13.33	20	13.33
10001-20000	28.13	50	21.88	25	6.25	6.25
20001-30000	18.75	75	37.5	37.5	6.25	0
30001-50000	33.3	50	83.33	58.33	0	0
50001-80000	58.33	50	50	16.67	0	16.67
More than 80000	57.14	71.43	71.43	28.57	0	14.29
Total	34.04	54.26	39.36	28.72	6.38	7.44

Decision-making by the community is not very democratic. Mondals are given priority. News after decision is obtained mainly by the Mondals – news obtained fairly quickly.

Table 5.9: Information Received According to Caste

Caste/ Information	As members	Provided by committee	From the members	From the people	No response	Total
UCH	1	4	3	1	0	9
SC\ST	2	3	3	10	29	47
OBC	9	7	15	5	4	40
Total	12	14	21	16	33	96

Section 5.5: Resource and Villagers

Villagers use the ponds in various ways (described earlier). The system of legal ownership and administration of the water body has also been described. In this section we shall analyses why the resource user adhere routes – the costs and benefits of conservation: The main reasons for following the rules relating to pond use are:

i) Benefits in the form of schooling, *jatras*, pujas (27 households)

ii) Norms and penalties (24 households)

Inspection of the records kept by the Solana does not indicate that a significant portion of the funds goes to social development projects. The exact utilization of the funds is not clear which castes doubts on the validity of the first reason. This is also supported indirectly by the fact that 19 households (20%) claim to be unaware of pond rules. When asked whether they would obey rules even if it reduced their economic welfare villagers claimed that they would maintain rules. The main reason therefore appears to be fear of getting punished.

The life of the community has traditionally revolved around the water body and the resource flows from it. While the resource users are not totally dependent on the water body, they derive substantial benefits – both economic and psychological – from the resource. In recent years, the water body has assumed a new role as a source of development funds, which enables the community to be independent of the Panchayat. In such cases we would expect that the resource community would be aware of the resource condition. However this does not seem to be so.

Table 5.10: Awareness of the Resource Conditions

State of Resource	Aware	Unaware
Pond	20	51
Fish	33	38
Trees	23	48
Other water bodies	3	67

Note: There were other open access water bodies, which were not properly preserved.

CHAPTER 6: COMPARING BETWEEN INSTITUTIONS: A FRAMEWORK

Section 6.1: Looking Back

In the earlier three chapters we have examined the evolution of CPR institutions and their functioning. We have also tried to identify the reasons for their inefficient performance. In this chapter we shall integrate the case studied and undertake a comparative assessment.

We shall start by re-analyzing our four case studies (we leave out *Charcharia* - though we may refer to it in passing) using a common framework. This will enable us to comment on the validity of our main and sub-hypotheses and pave the way for linking them to the theoretical developments in game theory. This will also enable us to recommend appropriate policy alternatives in the next chapter.

Section 6.2: A Common Methodological Framework

Early skeptics of the Harding's Tragedy of Commons paradigm had stressed on refuting his gloomy predictions using empirical evidence. These studies used different methodologies. As a result their results and conclusions could not be compared easily. In a Workshop held by the Workshop of Political Theory and Policy Analysis, Indiana University, Oakerson (1986), therefore, recommended use of a common methodological framework to document case studies.

Oakerson focuses on four sets of attributes or variables that can be used to describe typical CPRs:

1. Physical attributes of the resource and the technology used to appropriate its yield.

a) The relative capacity of the resource base to support multiple users at the same time without congestion and without diminishing the aggregate level of benefit.

b) The degree of which exclusion is possible.

c) Physical boundaries of the resource.

2. Decision making a arrangements (organisation and rules) that govern relationships among users.

a) Operational rules regulating use of the CPR.

b) Rules establishing conditions of collective choice within the resource community.

c) External arrangements linking the resource appropriators to the external community

3. Mutual choice of strategies and consequent patterns of interaction among decision makers.

4. Outcomes or consequences.

In the next sections we briefly examine the features of each aspect to be studied and reanalyze our case studies on the basis of these aspects.

Section 6.2.a: Technical and Physical Attributes of the Resource

All CP problems are rooted in some set of constraints given either in nature or inherent in available technology. These constraints can be analyzed against three concepts drawn from literature.

i. *Jointness*: This refers to the degree of subtractability arising from consumption (Samuelson, 1954). It ordinarily applies to simultaneous use, but it can be also used in the context of serial use. While utilization of the resources by our

individual does subtract from the welfare of others, within limits all users can derive benefits jointly. The analyst should be concerned with delineating the limits to which such non-rival consumption is possible.

ii. *Exclusion*: This refers to the ability (of provider to exclude potential users from using the good or services unless they pay for it. Whether exclusion can at all be applied or not, and the degree to which it can be applied, depends on the physical nature of the resource and the technology available to exclude it.

iii. *Indivisibility*: This refers to the ability to partition the resource. In other words, it refers to the optimal scale of holding of the resource. In some cases it may not be feasible partition the resource. In such cases the problem of delineating the resource becomes important.

Now let us see to what extent the resources studied satisfies these features.

In the case of forest reserves consumption is non-rival except in very rare situations when degradation has reached acute levels. However, future resource users may be affected. Further, we found that the users in both Matha and Belemath were quite aware of the jointness of consumption. Similarly, the legal arrangements under which the water bodies were held in Bon Hoogly and Charcharia resulted in the derivation of joint benefits. In Hazamdihi, on the other hand, it is difficult to conclude whether consumption in rival or not. This is because the water body in Bankura is a multiple use resource. The Oakerson framework, however, is not meant for multiple use resources, but for single use resources. In Hazamdihi, some users are rival (irrigation), while others are non- rival (water for bathing, organizing of festivals and folk theatres out of returns from harvesting of fishes etc. from the water body).

Exclusion is difficult in forests. This is because of the geographical spread of the resource. On the other hand, use of the water body in Hazamdihi can be easily monitored and excluded because of the physical nature of the resource (their static nature). Technology also is important - in areas like irrigation. There are, some problems in excluding Charcharia because of the terrain. As a result there are attempts to poach by outsiders. This requires monitoring by the co-operative. This was also a serious problem in Bon-Hooghly in the early 1970s. But this had died out in recant years as the co-operative has become viable and makes its presence felt in

the locality. In addition and importantly the poachers (who were basically anti-socials, and not fisherman) lacked the necessary skill to evade monitoring. However, it is difficult to exclude the local factory and bathers who pollute the water of the water body in Bon Hooghly. The transaction costs involved in this operation will be too costly.

Unlike forests, water bodies are not divisible. In the case of the forest the problem is that the boundary of the resource cannot be easily delineated.

Section 6.2.b: Decision Making Arrangements

The second component of the model consists of rules - the rules that structure individual and collective choices with respect to the commons. This component refers to the institutions or organizational arrangements of the commons. Such arrangements can be divided into three components: first, the rules that establish conditions of collective choice within the resource community; second, operational rules regulating resource use; and, third, the nature of 'nesting' of the local organization with external institutions.

In the first two cases (forests) this component is identical. Conditions for making collective choices are ensured within the framework of the Forest Protection Committees. The villagers themselves establish these committees for each village. The jurisdictions of each Committee, their responsibilities, their rights, etc. are determined under the existing legislative arrangements. Thus we can say that the State provides the basic institutional vehicle for organizing collective action. This is also true for the Fisherman's Cooperatives in Bon Hooghly and Charcharia. The Government ensures an environment in which the resource users can organize themselves to manage the resource.

In Hazamdihi, on the other hand, the system was spontaneously evolved. It did not emerge as a result of Government intervention. Nor are the limits to this domain defined by legislation. The establishment of the Mondal family Hazamdihi and their fragmentation over time generated the need for collective action. The environment in which this collective action takes place is basically a family based system.

Regarding the second sub-component, viz. the operational rules of the system, we again note that there is a similarity between the first two cases - Belemath and Matha. In both of them, the resource is the same and collective choice conditions are the same. This has resulted in the adoption of identical operational rules for both these resources. What is striking is that though the operational rules - or what Mark Sproulet - Jones would say, the rules - in - *form* - is same, the de-facto rules - the rules-in-use - is totally different and represents a sharp contrast to each other. In Belermath, there is a convergence between rules-in-use and rules-in-form. On the other hand, in Metha the two diverge. This contrast is of particular importance in view of the focus of CPR theorists on rules-in-use. The standard explanation for such contrasts lies in different socio-economic conditions. This cannot be accepted in this case. We had seen clearly that the villages of Belemath and Matha match each other which regard to economic prosperity (or rather its lack), extent of dependence on forests, literacy, cultural backgrounds, occupation structure, etc. the only difference lies in religious and ethnic composition of the population - while Belemath consists of mixed population, Metha has predominantly a tribal population. But again, literature would suggest that a tribal populated village is more likely to conserve their natural resource base. Obviously, we will have to seek an explanation elsewhere.

A possible explanation of this is the difference in contextual factors operating in both villages. In Belemath the conditions *within the community* are similar to that of Matha. But there are differences in the bio-physical environment and in the resulting economic environment. The harsh climate of Purulia - which is an arid zone - renders agriculture a low-paying occupation. On the other hand, Belemath is more suitable for agriculture. The scarcity of water for rice cultivation in winter is solved by the canal irrigation system. The yields may not be very high - but they are stable and represent a secure flow. Further, there are employment opportunities in the surrounding area. The survival of the community, therefore, is not contingent on over-exploitation of the forests. This is precisely the root of the problem is Matha. The absence of any secure alternatives embedded within and outside the community forces the community to under-value future income flows. This leads to the deliberate choice of a rate of exploitation that will degrade and ultimately destroy the forest.

Turning to the co-operatives we find that both Charcharia and Bon Hooghly are similar in their historical context. In both cases we have an economically distressed community desperately seeking alternative means of livelihood. The causes of the distress are, of course, different. In Charcharia it was economic oppression by the *zamindars* occurring in an economic environment bereft of any alternatives to the oppressed class. In Bon Hooghly, on the other hand, it was the distress caused by a large-scale migration after the Partition of Bengal and the ensuing aftermath. The basic historical experience, however, is the same. This has led to a similar *level of convergence* between rules-in-form and rules-in use in both cases.

In Hazamdehi, on the other hand, the historical context is the fragmentation of the Mondol family. The fragmentation reduces the individual holdings of each family to such a small size that no individual holding can generate enough returns to justify assertion of individual rights. This has led to the adoption of operational rules within the Mondal caste. However, the extended Mondal family consists of only part of the village. The remaining villagers consist of Upper Caste Hindus and lowly placed Scheduled Castes (Bauris). The latter are excluded from access to the water body - or rather from of its uses. The operational rules therefore define the resource community in away that does not correspond to the geographical domain. This has interesting effects for equity as we shall see later on.

Regarding nesting of local arrangements with external enforcements we find a similarity between the first four cases. In each of these, the local decision making body is formal unit explicitly recognized by the external authorities. The granting of legitimacy by external authorities has an important effect.

Traditional societies are founded on behalf in established, timeless order. Such orders, rooted in the past, and legitimate by such association, are highly authoritative. This means that these reforms, conventions, beliefs, practices cannot be questioned, modified, or revised in the light of any utilitarian or rational exercise. The individual, therefore, has no scope and incentive to exercise autonomy. Further, given that thought is directed in terms of others, the order is basically communal and encourages co-operation and other socio-centric activities.

But, over time, social and economic processes will undermine the sacred or authoritative properties of cultural narratives. Technological changes, population expansion, opening up of the society through linkages with distant (regional or global) market, greater mobility of individuals - these processes will introduce diversity within the previously unified cultural realms. And, as cultural acquires of fragmented, variegated and pluralism nature, conceptions of what is sacred will loose credibility. People will acquire the opportunity to stand back, critically examine, and loose faith in the traditional order of beliefs and way of life. The balance of authority will shift from society (or community) to the individual. Individualistic exercises - rational, or utilitarian will - become the driving force behind action.

These changes may pose challenges to the socio-cultural legitimacy of the resource management authority. The state will have a role to play in the new order of things. The informal CPR regimes of traditional communities draw their strength and legitimacy from belief in the traditional socio-centric forces. But, with the increase in importance of individual optimization exercises, this belief in the inviolable nature of the tradition will be challenged. The loss in social authority will have to be compensated by the granting of political legitimacy. In the future, the concepts of co-operative management will have to become increasingly relevant on the management of local natural resources. The state should delegate its power through a process of political decentralization to resource users and resource management institutions.

This is exactly what happened in the case of Belkemath, Charcharia, and Bon Hoogly - and attempted in Matha. In all these communities we find an absence of pro-social norms controlling resource use, or even strengthening resource management institutions. In their absence proper nesting has provided the FPC in Belemath and the Fisherman’s Co-operatives in Bon Hooghly and Charcharia the authority to control and direct action successfully. Matha, on the other hand, does not represent a failure to link organization with external authorities (executive, judicial and legislative); it represents a failure to integrate local needs and conditions to the institutional structure. The policy makers have created an institution directed towards meeting perceived concerns of the community - but they fail to realize that contextual factors have created totally different kind of demand in Matha.

In Hazamdihi there is a total lack of nesting. This is facilitated by the nature of the resource. It is locale nature and does not generate any externality or benefit outside the community. Nor is access easy from outside the community. The issue of using the resource, controlling its access, distributing the benefits and resolving conflicts is exclusively confined within the community. The absence of nesting is, thus, quite consistent with Ostrom's design principles which require nesting only for resources whose use has implications outside the community, or where management affects individuals outside the community.

Section 6.2.c: Patterns of Intersection within the Community

Given the technical and physical features of the resource and decision-making arrangements relating to it's use and management, the next question concerns behavior: what patterns of intersection characterize the behavior of users and other decision in relation to the CPR? Obviously the pattern of intersection will be interdependent. However, we have to examine the nature of interdependence.

One explanation is in terms of private benefits and costs (Singh, 1994). Singh argues that an important prerequisite for successful and sustainable collective action is that the expected net benefit to every, or most of the members of the group must substantially and consistently exceed the expected the net private cost to every members (Singh 1994: 69). Ostrom (1990) herself has suggested that such a discounted cost-benefit is important for individual commitment to collective action. She also provides a frustratingly long list of variables that enter into such an analysis. While economic cost and benefits are important, we should note that these concepts are abstract (Oakerson, 1996). Both cost and benefits are perceived obstacles and inducements. Individual choices therefore derive from mental images of obstacles and inducements in one's environments. Patterns of interaction cannot be understood excepts in terms of these elements of choice.

The basic pattern of intersection on which successful joint use of commons depends is reciprocity. In a pattern of reciprocity, individuals contribute (through mutual action or mutual forbearance) to each other's welfare, but without the interposition of an immediate quid pro quo. Instead, reciprocity depends on mutual expectations of positive performance (Oakerson, 1983). In the absence of reciprocal feeling, we will

have free riding. Free ridings will not only act as an inducement to 'defect' - to use parlance from game theoretic models - but it will act as a disincentive to contribute. The fear of being duped can be, according to Oakerson, a predominant concern for resource users.

In the case of the two forest reserves, the degree of interdependence is a single period of time is not very significance. Strategic interdependence is not of the type usually depicted in game theoretic interpretations of the Common Problem. Interdependence is manifested, as mentioned previously, only in the long run - i.e., the problem is not one of intra-generation interdependence, but of inter-generation interdependence. However, interdependence is important in the short run when we consider efforts to conserve the resource. The reduction in forest use by any one member will affect not only future users - as the longevity of the resource increases – but it also encourages other to join the movement (sort of bandwagon effect). Such sort of effects is particularly important in the absence of institutional constraints to defection. In Matha, however, attempts of free riding are triggering off a policy of collective defection – with *all* the users maintaining their rate of exploitation even in the face of depletion of the resource. Economic factors – in the form of returns from periodic felling – do not seem to be very important in Belemath. In Matha, collective defection by the villagers implies that this return has been sacrificed by them in order to ensure their immediate income flow. In Matha, the issue does not seem to be a cost – benefit calculation but simply an extremely narrow capability set – a subsistence constraint. In Belemath, on the other hand, contextual factors have defined a broader capability set. This permits them to undertake action, which may have immediate adverse consequences on their economic security.

In Bon Hooghly and Charcharia economic returns from the co-operative are important components of the family income of the members. Once again contextual factors have resulted in a situation where they have to rely on the co-operative to secure a stable and certain income flow. Further, the pattern of interaction dictated by the technical nature of resource withdrawal (fishing is a joint activity) is such that reciprocity acts as an important force compelling all members to devote at least a minimal effort without free riding.

Interdependence is possibly most strongly manifested in Hazamdihi. As mentioned earlier excessive fragmentation has rendered individual holding infeasible and uneconomic. Further, inheritance has become so tangled that it may be difficult to dispose of one's share. Any utilization of the resource has to be undertaken jointly. However, the transaction costs of collective action have increased significantly – particularly in recent years. This has led to changes in the form of the property regime. Fishing activities are no longer carried out under the supervision of villagers; instead the water body has been leased out to a single owner, while the sum so obtained is used for collective purposes. In the case of other activities like bathing, washing, etc. the nature of reciprocity is much less. In the case of irrigation, interdependence is potentially high, especially during the winter when water in the irrigation canal is low. In reality, technical factors – the absence of pump sets to withdraw water from canal – reduces interdependence to manifest within a few members (the Big Three Mondols) only. There is thus no competition between the villagers for irrigation water – and no question of interdependence or reciprocity.

Section 6.2.d: Outcome of the Resource Regime

The particular pattern of interaction generated within the community around the resource produces outcomes. These outcomes have to be evaluated using certain criteria. Oakerson (1986) suggest the use of efficiency and equity as a appropriate criteria.

Considerations of efficiency in the use of CPRs generally relate to the overall rate of use. Technical and physical attributes dictate some optimal rate. Excessive use leads to resource depletion and degradation of the resource benefit.

We can use different criteria for this purpose. In the case of forests one option was the use of official data to examine the rate of forest depletion and regeneration. However such data was available only for the entire area of Jungal Mahal, and not for the specific area surveyed by us. Another option available to us was the use of data generated by sophisticated techniques like GIS. Such data is very reliable and can give very precise data. However, our budget did not permit us to use this method. As a result, we had to rely on a crude method. We based our conclusions regarding the sustainability of the resource consumption pattern based on visual

observation and discussion with both villagers and officials. These indicated that a satisfactory level of forest regeneration had occurred in Belemath. In comparison to some parts of Jungal Mahal where the forest area had become denuded, a dense forest cover existed in the area around Belemath. On the other hand, forest officials in Matha and the concerned villagers both admitted that the forest was being over used. We could see large tracts of land where the forest cover had thinned appreciably.

On the other hand, in the case of he fishermen's co-operative in Bon Hooghly, the sustainability centered around two issues. The first issue relates to the quality of the water body. As pointed out earlier, sewage water is used to cultivate the fish. The water entering the water body contains municipal wastes. These provide nutrients to the fish. Thus the production process is joint – it uses a public 'bad' in combination with other inputs to produce fish and a public 'good' in the form of clean water that flows out of the water body. The wastes are a substitute for fish food. This externality is an interesting aspect of sewage fishing.

Simultaneously, we have to consider the stock of fish. In this context, we should note two points. Firstly, the species in the water body are not rare, but are of common varieties. Hence they can be depleted without loss of bio-diversity. Secondly, replenishment is not biological but artificial – i.e. through re-stocking. Thus the question of whether the rate of catch is sustainable or not, or attempts to relate it to the Optimal Sustainable Yield (as in standard neo-classical models of fish extraction) is not very relevant in this case.

In this case, as also in the case of both Charcharia and Hazamdihi, sustainability can be maintained by simply replenishing the fish stock by releasing adequate amounts of fish seed. In the case of Bon Hooghly we had access to the data on fish catch and seed released. Statistical tests indicated that (see Chapter 4) that the two were strongly co-related. However, as we had noted, the increasing importance of boating may lead to a shift in the focus of the co-operative. This may affect the sustainability of the outcome in the future. In Charcharia, our study was preliminary and we did not try to study the sustainability or efficiency of the outcomes. In Hazamdihi, the change in the form of the regime was recent and there was not sufficient data to come to any conclusion about the sustainability of the regime.

A related issue is that of equity. The presence of equity problems can generate conflict within the community leading the economy away from an efficient equilibrium, or even leading to the disintegration of the CPR regime. The extent of equity depends upon the initial distribution of endowments. The extent to which the system is equitable is thus a major concern for CPR analysts. A priori, we expect that the more homogenous a community is, the more equitable is the community, and the CPR institution.

Regarding Matha, the structure of the community was fairly homogenous. This can be seen from the distribution of income and land. In Belemath, on the other hand, the community is slightly more heterogeneous. There are some members who are either politically or economically dominant. Theory would suggest, therefore, the emergence of an equitable outcome in Matha, rather in Belemath.

In reality, however, we observed the converse. In Belemath we found that the presence of a dominant group acted as a catalytic agent generating environmental consciousness and investing in the process of creating and sustaining the regime. Not surprisingly, they appropriated the major share of the benefits from the regime – though not necessarily in the form of higher financial returns. Bromley (1994) has mentioned such a possibility. Specifically, the dominant group were interested in increasing their political clout. In Matha, on the other hand, the absence of any dominant elite implied that the absence of attempts to create the regime or operate it.

In Bon Hooghly and Charcharia, on the other hand, the members came from a common background and possess similar endowments. This prevented any member dominating decision-making and contributed to an equitable outcome.

The presence of a dominant group was also observed in Hazamdihi. The Mondol caste dominated the Bauris, while - within the Mondol caste – there was a dominance of three families. This dominance was manifested in various ways:

a) The Bauris were deprived of access to the irrigation water from the water body during the kharif season.

b) The Bauris did not benefit from the developmental and religious and cultural programmes financed from the funds from using the water body.

On the other hand the elite Mondol families enjoyed a disproportionate share of the benefits through:

a) Appropriation of irrigation water during the rabi season.

b) Increase in their clout within the village and using it to extend their interests outside the village.

In the latter context an interesting possibility is the emergence of a situation where the outside interests of these Mondols become more profitable to them than alternatives within the community. The question arises: will they still retain their interest in coordinating decision-making with regard to the water body in such an eventuality.

Note that though the role of the 'Big Three' Mondols did play a major role in coordinating the process of decision-making, the dominance of the Mondol caste apparently did not contribute to the efficiency of the regime.

Thus, homogeneity acted as a disincentive in Matha and as an incentive in Bon Hooghly and Charcharia. This is in line with the contested role of heterogeneity in CPR management (Varughese & Ostrom, 2001).

In Matha the structure of the community is fairly homogeneous. This can be seen from the distribution of income and land. In Belemath on the other hand, the extent of homogeneity is slightly less significant. There are some members who are either economically or politically stronger than other villagers. These would suggest the presence of an equitable and efficient solution in Matha, and the absence of such a solution in Belemath. Reality however is different.

In Belemath, the presence of dominant villagers has facilitated the organization of collective action. This group has acted as a catalytic agent to foster collective action. These groups has attempted to increase environmental consciousness amongst the villagers, playing a key role in peer monitoring and used their political or economic power and acumen to make the regime acceptable to the community.

The success of the regime in ensuring sustainable use of the forest is visible. Official data is available for the entire Jungle Mahal area – and not for the micro area studied. We were there fore forced to rely upon reports provided by the local users. This was supplemented by our visits to the adjoining forest areas. While we found large-scale denudation of forests in other areas, the forest cover in Belemath was visibly quite thick. We also found evidences of replanting.

Section 6.3: Testing our Hypotheses

Our proposed work was supposed to focus on the evolution of CPR institutions. Our central hypothesis was that the awareness of the problem of resource degradation would generate processes leading to collective action and the emergence of sustainable communal management systems. This means that we are interpreting the emergence of sustainable CPR regimes as a collective response to the degradation of the environmental resource base. This collective action is manifested through the supply of institutions.

We had decomposed our central hypotheses into several sub-hypotheses as follows. The conditions for the emergence and persistence of a CPR institution were as follows:

11. The resource appropriators perceive that the resource is being degraded and this can lead to disaster;

12. The resource appropriators acknowledge their role in creating this crisis, i.e. they acknowledge that outcomes are jointly produced and can be avoided by changes in their existing behavior;

13. Pro-social norms directed towards arresting the process of degradation and activated;

14. Economic cost of cooperation are low;

14.a. The private discount rate is low (i.e. there is limited availability of alternative income substitutes) and is allowed to converge to a lower collective discount rate;

14.b. The reduction in individual output / income is low;

14.c. The information and enforcement costs of CPR institutions are low;

15. Social and economic conditions of agents are more or less uniform and recurrently shared (i.e. agents have mutually consistent expectations);

16. The expected flow of net benefit is an important determinant of the institutional form of the property regime;

17. Another determinant of the institutional form of the CPR regime is the physical characteristics of the resource in question;

18. The feed backs to resource conserving behavior are positive;

19. Situational factors, like a temporary fall in income may lead to defection;

20. Such defection will be tolerated up to certain limits without punishment. However, the contingent fulfillment of the threat will have to be credible.

Based on the results of our field surveys integrated within the Oakerson framework, we shall now attempt to examine the validity of our central hypothesis and the sub-hypotheses.

Section 6.3.a: Central Hypothesis

Our central hypothesis was that the awareness of the problem of resource degradation would lead to the creation of the regime. Initially we had focused on the resource as the endangered component – we had assumed that the degradation of the resource was the main problem. This is an assumption common to most models in environmental economics. This assumption has been criticized in recent years. For instance, it may not be the resource that is endangered but the access of the community to the resource (Steins et al, 2000).

In our case we found that only in the case of Belemath and Matha was there any appreciation of the environmental implications of their action by the users. Even then it is only in Belemath that the appreciation that degradation was occurring led to

collective action institutionalized in FPCs. In Matha, this realization failed to evoke any corresponding response.

On the other hand, in both Bon Hooghly and Charcharia it was the resource community that was threatened. In Charcharia it was a common local group; in Bon Hooghly it was a group dispersed over a large geographical area united only in their history, traditional occupation and present crisis. If we think of the resource in terms of the water body, the original users in Bon Hooghly (the local community) were totally disinterested in the state of the resource. In Charcharia, too, litigation had converted the water body into an open access resource. Political intervention by the CPI (M) members led to the emergence of the realization that local fishermen could restructure their precarious capability set based on the water body.

In Hazamdihi there was no crisis – either of the resource or the community. The creation of the property regime was basically a response to the indivisibility of the resource and changing transaction costs of alternative regimes.

Therefore, it is difficult to accept the hypothesis as a general truth. It is partially true only in the case of forests. It is not born out in the case of the water bodies. This implies that realization of a threat to a resource is neither necessary (as shown by the water bodies) nor sufficient (as exemplified by Matha) for the creation of CPR regimes. We should not, therefore, treat the evolution of CPR institutions as an exclusive phenomenon relating to environmental economics.

Section 6.3.b: Testing Our Sub-hypotheses

Our central hypothesis had been divided into several components. We analyse the validity of each of these sub-hypotheses below.

11. We have seen that the emergence of CPR institutions is not always linked to degradation issues. Our first sub-hypothesis is therefore invalid. This will affect the other sub-hypotheses that were linked sequentially to each other.

12. Outcomes need not always be joint. Further, interdependence may be manifested across generations – especially in the case of forests. However, as we have observed, some amount of reciprocity is needed to foster co-operation.

13. We found an absence of normative or institutional constraints to free riding attempts in all our case studies.

14. Low economic costs of co-operation were significant in explaining success in Bon Hooghly, Charcharia and Hazamdihi. In the case of Belemath, the reduction of benefit from co-operation was low. In the case of Matha, the high costs of co-operation appeared to significantly inhibit co-operation.

4.1 The discount rate appears to be important in Matha and Belemath in explaining the failure and success of the respective regimes. However, they appear to be less important in the other regimes.

4.2 Contextual factors appear to define the limits to the alternatives available to resource users in our survey areas. The presence and absence of alternatives appeared to be significant in explaining institutional success. However, the impact varied depending upon the exact situation. In Charcharia and Bon Hooghly the lack of alternatives forced the co-operative to rely on the water body; in Matha it prevented conservation attempts. Again in Belemath, the presence of alternatives enabled the resource users to reduce their rates of exploitation. In Hazamdihi, contextual factors appeared to be of minor importance.

4.3 Low information costs and enforcement costs characterize the cases of Belemath, Matha and Hazamdihi. In Bon Hooghly the social costs of restricting access leads to a Pareto irrelevant externality (see chapter 4); the monitoring costs in Charcharia are also quite high.

15. Homogeneity of the agents was an important factor in explaining the success of the regimes in Bon Hooghly and Charcharia. In Belemath, on the other hand, it was the presence of dominant agents that ensure the success of the regime. In Hazamdihi, heterogeneity led to inequity between the resource users. Finally, in Matha, homogeneity or shared recurrent experiences does not seem to have played a role.

16. The surplus from the resource has determined the *choice* of the regime in each case – though it has not affected its efficiency. Changes in the form of the regime in Hazhmdihi have been dictated by changes in the expected flow of income from the

resource. Water body, regular financial flows and heritage of common occupation and skill of are compatible to co-operative type of regime; while in sustaining a multiple use forest resource, where use in kind rather than in cash seems to be compatible with JFM / FPC type of regime.

17. From our discussion of the application of the Oakerson Model to our cases we can see that the physical feature of the resource is an important factor explaining the form of the regime. It may not have determined the exact form – which is affected by expected benefits - but the range of possible forms of regimes is set by the nature of the resource.

18. Feedbacks either in the form of visible restoration or stable income flows has appeared to play an important part in the success of the regimes in Belemath, Bon Hooghly, Charcharia and Hazamdihi.

19. Despite the success of these regimes, we found that transgressions of the rules were also present. Such violations were due to temporary fall in income. A seasonal pattern of defection was observed in both Belemath and Matha.

20. The community that did not normally take any action tolerated such violations. However, reputation was used to judge whether such behavior was temporary or a manifestation of deviant behaviour. Only in case of the later, sanctioning was implied.

Our hypotheses relating to the evolution of the regime appears to be invalid. Economic costs and contextual factors played important role in determining the evolution of CPRs. Heterogeneity appears to be a contested factor in literature – this fact is also born out in our study. In contrast, we were, however, more successful in anticipating the factors influencing choice of the institutional form and the response to transgressions.

Section 6.4: Collective Action and Its Constraints

Our research proposal intended to study how CPR institutions evolve. But there are some constraints to such process. We shall seek to identify from our case studies the constraints to collective action and the creation of CPR regimes. Based on this

analysis we shall seek to address the long-term objective of our project proposal, viz. to identify the appropriate areas of intervention in the creation of CPR institutions – whether by the state, or by external agencies, like NGOs. This will help in appropriate policy formulation to prevent resource depletion based on modifying or creating local institutions and without unduly disturbing the local social and cultural environment.

Below are listed the main impediments to the creation and management of local CPR regimes that can be derived from the empirical observations of our study areas.

1. In the context of conservation – depletion dilemma, people are usually reluctant to participate in local CPR management efforts if they do not expect to receive some short-run and adequate compensation for the sacrifices to be made for conservation. These sacrifices may be in the form of restraint in using the resource or of investing in resource-conserving and generating activities.

2. Theoretical insights (especially from game theory as will be discussed in the next chapter) as well as our field experience suggest that collective action is more probable with small face-to-face user communities living close to well-delineated CPRs and when the users can develop simple and understandable rules in their own way to confront a common challenge. Absence of closeness and failure to develop simple rules to be followed aborted the evolution of CPR in many instances (like Purulia).

3. When there is an elite group that holds a strategically superior position in the CPR that enables them to by-pass collective endevour and mutual vulnerability the success of a CPR is less probable.

4. Decentralized punishment mechanisms may not be always enough to ensure co-operative behaviour. External sanctions may often be needed to complement internal punishment schemes. Absence of well-accepted mediators to settle conflicts and absence of transparency and non-discriminatory use of sanctions may impede CPR formation and it's survival. Failure to provide monitors with right kind of incentives and ensure their accountability generates further problems.

5. Communities not inheriting any past experience of successful collective action and trust formation may confront a baffling situation when faced with a collective action problem in the form of generating and maintaining a CPR regime.

6. Absence of enlightened and farsighted leaders to mobilize and motivate enough co-operators may spell doom on the demand for and supply of CPRs.

7. Growing consumerism, increasing market influence, and outside opportunities hinder sustenance of cooperation and CPRs.

CHAPTER 7: GAME THEORIES, EVIDENCES AND POLICIES

Section 7.1: CPR Use as a Collective Action

Multiple-person interactions as we observed in the case studies on managing local CPR often give rise to games and strategic situations in communities that in the most general form concern problems of collective action. We have seen instances where the aims of the whole community or collective could be best served if individual members had taken some particular action or actions, but these actions were not in the best private interests of those individuals. We have also seen instances where improvements could be achieved upon such unsatisfactory Nash equilibrium. Thus, to comprehend these diverse experiences, and to understand the conditions for and against sustainability of local co-operation and thereby of the CPRs we need first to understand the nature of such games. They generally come in three forms or may appear in some hybrid forms of the three forms (Baland and Platteau, 1996). The three forms we are talking about are the prisoners' dilemma (PD), chicken (CG), and co-ordination/ assurance (AG) games.

Consider a two-person game and suppose that (in a CPR setting) cooperation (C) on the part of only one person yields benefits b_1 to each person and imposes costs c_1 on the cooperator, while mutual cooperation by both has benefits b_2 and costs c_2 for each. When both defect (D), both receive 0. Then the general payoff structure is as shown in Table 7.1.

Table 7.1: General Form of a Two-Person Collective Action Game

Strategies of Players I and II		**Player II**	
		Co-operate	*Defect*
Player I	***Co-operate***	$(b_2\text{-}c_2, b_2 - c_2)$	$(b_1\text{-}c_1, b_1)$
	Defect	$(b_1, b_1\text{-}c_1)$	(0,0)

The above game is a prisoners' dilemma (PD) if

$b_1 > b_2-c_2$, $0 > b_1-c_1$, and $b_2-c_2 > 0$.

The first inequality implies that the best response to C is D, the second implies that the best response to D is also D, and the third says that (C, C) is jointly preferred to (D, D).

The game is one of chicken (CG) if :

$b_1 > b_2-c_2$, and $0 < b_1-c_1$

These inequalities indicate that each player wants to defect/ shirk when the other cooperates and cooperate when the other shirks.

For both the PD and CG cases, it is socially optimal for both of them to play C if

$2(b_2-c_2) > 2b_1-c_1$

Finally, the game is one of assurance (AG) if

$b_1 < b_2-c_2$, $0 > b_1-c_1$ and $b_2-c_2 > 0$.

Here the inequalities say the C is the best response to C, that D is the best response to D, and that (C,C) yields higher payoffs to both players than does (D,D). The assurance game (AG) above implies that

$2 (b_2-c_2) > 2b_1 > 2b_1-c_1$,

and hence it is socially optimal for both to cooperate.

We, now, extend our arguments to a situation in which a population of N players must each decide whether to cooperate. If n of them cooperates, each of the participants incurs a cost c that depends on the number n, so we write it as a function c(n). Also each person in the population, whether a cooperator or not, enjoys a benefit from the sustainable use of the resource that is also a function of n: b (n). Thus each cooperator gets for participation the payoff p(n) = b(n) – c(n), while each shirker, gets the payoff s(n) = b(n).

Suppose player i is contemplating whether to participate or to shirk. His decision will depend on what the other (N-1) individuals in the population are doing. In general,

player i will have to make decision when the other (N-1) players consist of n participants and (N-1-n) shirkers. If I decides to shirk, the number of cooperators is still n, so i gets a payoff of s(n). If i decides to participate, the number of cooperators becomes n+1, so i gets p (n+1). Thus player i's final decision depends on the comparison of these two payoffs; i will participate if p (n+1) > s(n), and will shirk if p(n+1) < s(n). This comparison holds true for every version of the collective action game (Dixit and Skeath, 1999). Differences in behaviour in the different versions arise because the changes in the payoff structure alter the values of p (n+1) and s (n).

Following Dixit and Skeath (1999) we can use the payoff functions p(n) and s(n) to construct a third function showing the total payoff to community as a function of n, which we write as T(n). This payoff to community consists of the value p(n) for each of the n participants and the values s(n) for each of the (N-n) shirkers:

$$T(n) = n\,p(n) + (N-n)\,s(n)$$

To get a better understanding of what allocation of people between participants and shirkers maximizes the total payoff T (n), we rewrite T (n) as,

$$T(n) = N\,s(n) - n[s(n) - p(n)]$$

We can interpret this T (n) as if every one of the N people got the shirker's payoff, but then the shirker's extra benefit [s(n) – p(n)] was removed from each of the n participants. We normally expect s (n) to increase as n increases; therefore the first term in the expression, Ns (n), also increases as n becomes large. If the increase in the second term is not too fast with increasing n, then the effect of the first term dominates the value of T (n); T (n) increases steadily with n in this case and is maximized at n = N. However, this is not a general result. T(n) can be maximized for some n<N. This implies that community's aggregate payoff may be maximized by allowing some shirking. We will encounter such situations in our subsequent discussions.

Following Dixit and Skeath (1999) again, we use graphs of the p (n+1) and s (n) functions to indicate the type of the game, its Nash equilibrium, and its socially optimum outcome. We simplify by drawing p (n+1) and s (n) functions as smooth lines to bring out the basic issues.

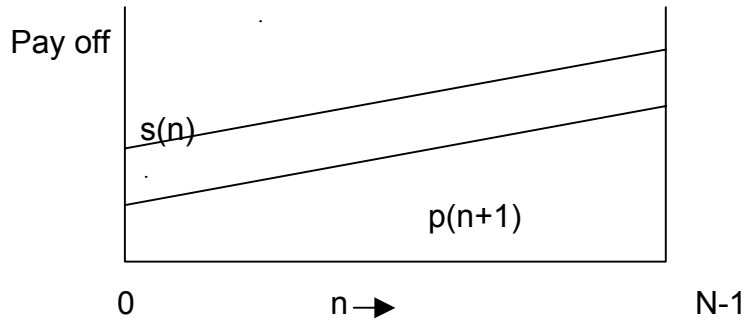


FIGURE 7.2: MULTIPERSON PRISONERS' DILEMMA

Figure 7.2 illustrate the case of PD where s(n) lies above p(n+1) everywhere. But the left intercept of the s(n) curve is below the right intercept of the p(n+1) curve, i.e. s(0)< p(N). This implies that if every one including i shirks, i's payoff is les than if everyone including i participates. However, in PD situation it is not automatic that T(n) function is maximized when n is as large as possible. If the gap between s(n) and p(n) widens sufficiently fast with the increase in n, then the negative impact of the second term in the expression for T (n) outweighs the positive impact of the first term as n approaches N. this suggests that it may then be best to let some person to shirk, that is to have n<N. Here of course, shirkers get more than the participants and to resolve the PD this additional dimension of the dilemma needs to be taken care of.

Figure 7.3 shows the case of chicken. Here for small n, p (n+1)> s (n). Thus i chooses to participate if few others are participating; while for large n, p (n+1) < s (n) and i's choice is to shirk if many others are participating.

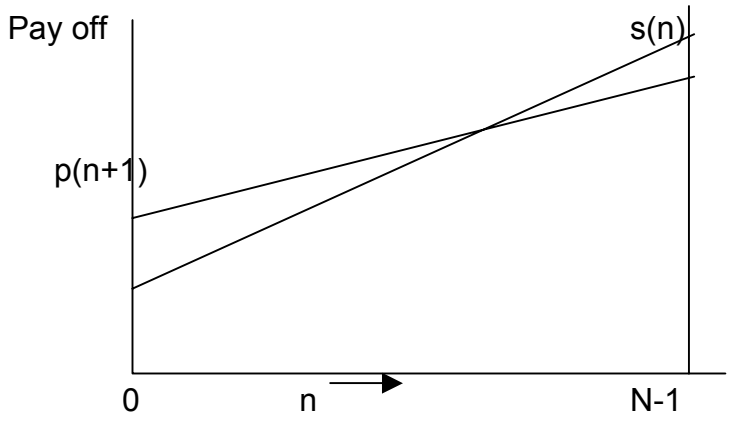


TABLE 7.3: MULTIPERSON CHICKEN

If the two curves intersect the Nash equilibrium number of participants could be at an integer value of n. Otherwise, strictly speaking the game has no Nash equilibrium. The important feature of this game is that when there are few people taking one action, it is better for any one person to take that action, and when there are many people taking one action, it is better for any one individual to take the other action.

In this CG if each participants payoff p(n) is an increasing function of n, and if each shirker's payoff s(n) does not become too much greater than p(n) then the total social pay off is maximized when every one participates. But more generally it may be better to let some shirk. Of course, the resulting unequal distribution of pay offs may make it harder to implement the optimum.

We now consider the assurance (AG) case. In Figure 7.4, s (n) > p(n+1) for small n and p (n+1) > s (n) for large n. the former inequality implies that if only few others are participating, then individual i wants to shirk too. The latter inequality says that if many others are participating, then i wants to participate too. This game has two pure strategy Nash equilibria at the two extremes: \either every one shirks or every one participates. When both the curves are rising (as we have assumed) the right hand extreme equilibrium (where each person is better off if more people participate) is clearly better one for society. The question is how to bring it about.

When N, the total number of people in the group we are considering is very large then p (n+1) is almost the same as p (n). Since p (n) = b (n) – c (n) and s (n) = b (n), p(n) is always less than s(n), and hence even if the game has a AG structure, individuals will always want to shirk when N is very large. Collective action in a large

group manifest themselves as PD. However, this outcome is not necessarily true for small groups.

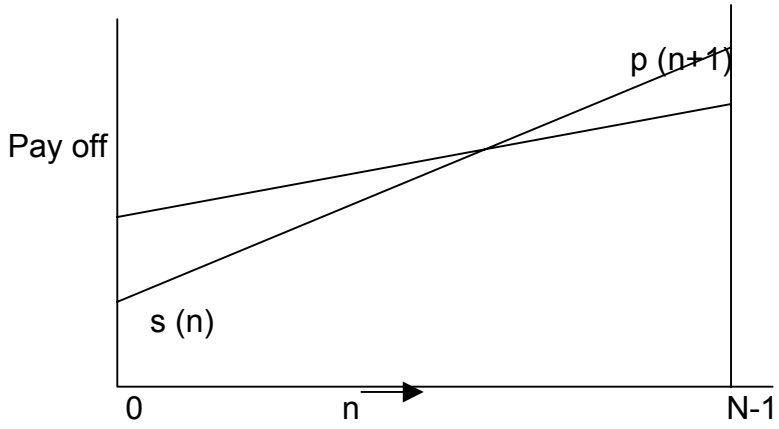


Figure 7.4: Multiperson Assurance Game

Collective action problems, moreover, in the context of rural communities in particular, generally cover a broader range of activities and issues than that of participating in the management of a CPR only (we will come back to this point again). Hence, in general, we need to allow for a broader interpretation of the payoffs p (n) and s (n); we need to allow p (n) and s (n) to be any functions of n. Then there is no automatic presumption about which of the two payoff functions is larger and all three kinds of games – PD, CG and AG and hybrid variants of them deserve our attention. In the most general case, p (n) and s (n) may not even be straight lines and can intersect many times and there can be several equilibria (Dixit and Skeath, 1999).

The feature (in collective action problem) common to all three types is the need to induce individuals to act cooperatively.

Section 7.2: CPR Games and Co-operation

Collective action problems come in diverse forms, and there is no uniquely best solution to all of them. However, it has been observed that groups or societies generally devise various means to cope with them. Human societies usually rely on purposive social and cultural customs, norms, incentives and sanctions in inducing cooperative behaviour from their individual members. These methods are generally conscious, deliberate attempts to design the game in order to solve the collective action problem. The nature of the problem and it's solution methods, thus, need to

be approached from the perspective of the type of game being played. However, as we shall see that a unique type of game may not be able to capture the nature of the problem in it's entirety.

While sociologists and anthropologists look at social norms and codes of conduct in understanding cooperative behaviour as a solution to collective action problem, economists usually emphasize incentives and penalties (Bardhan and Udry, 1999). In the literature the problems raised by common property are usually represented by the formal framework of the repeated Prisoner's Dilemma. In the context of repeated PD, it is shown that cooperative equilibria can be sustained spontaneously by the long run interests of foresighted self-interested individuals. The possibility of cooperation depends, of course, on the future payoffs not being discounted too heavily, and/ or short-run benefits to defection not being too large. The latter, of course, will depend on the punishment that other people can impose on the potential defector.

The force of external penalties of sanctions, or the internalized ones of norms is more likely to emerge and be sustained through repetition. To put it in formal terms, let us consider the two-player PD case. We have for PD in our example in Figure 7.1,

$$b_1 > b_2-c_2,\ 0> b_1-c_1 \text{ and } b_2-c_2 > 0.$$

For a repeated PD suppose the discount factor is $\delta<1$. Then, provided

$$b_1- (b_2-c_2) < \delta\ (b_2-c_2)/(1-\delta),$$

there exists a retaliation strategy, say a tit for tat strategy (TT) which consists of playing D for a finite number of period in the event that the other player has played D after an agreement to cooperate, and which ensures that the other player is no better off from defection. Let T be the lowest integer such that

$$b_1- (b_2-c_2) \leq \delta\ (b_2-c_2) + \delta^2(b_2-c_2) + \ldots. + \delta^T\ (b_2-c_2)$$

Then T is the smallest number of periods for which each player must threaten to retaliate in order for the threat to sustain cooperation credibility. If, on the other hand, it happens that

$$b_1 - (b_2 - c_2) \geq \delta (b_2 - c_2)/(1-\delta),$$

then there exists no finite T, and as a result no retaliatory strategy can sustain cooperation.

The retaliatory strategies should not merely make it sufficiently costly for the defector, but to be credible they should not be too costly for the punisher. But therein lies a second order collective action problem, since punishment is costly to the punisher, while the benefits are distributed diffusely in the community (Bardhan and Udry, 1999). Moreover, detection and punishment are never easy. In real situations, very often payoffs are not entirely determined by the player's actions, but are subject to some random fluctuations. Inflicting severe punishment on a player without being sure of the extent of his guilt is not only morally unjustified; it is counterproductive as well- the incentive to cooperate gets blunted if cooperative actions or temporary non-habitual defections are susceptible to painful punishment by mistake (Dixit and Skeath, 1999).

Society can inflict punishment on defectors (or shirkers) in several ways. One is through 'sanctions' imposed by other members of the group. Sanctions often take the form of disqualification from future games played by the group. Society can also create 'norms' of behaviour that change individual payoffs so as to induce cooperation. A norm changes the private payoff scale of each player by adding an extra cost in the form of shame, guilt, or dislike of the mere disapproval of others. Society establishes norms through a process of education or culture. Compliance of norms crucially depends upon the extra cost. In this sense norms differ from custom. Norms also differ from sanctions in that others do not have to take any explicit actions to hurt the offender who violets the norm; the extra cost gets internalized in the payoff scale of the offender (Dixit and Skeath, 1999). *This phenomenon of internalization rather than explicit actions finds evidence in our study of Burdwan (Belemath) where we saw visible expressions of feeling of guilt on the part of norm-violators. Perception of society's general adherence to norms reinforces norms. However, they loose their force if they are frequently seen to be violated. This is what we observed in the case of Purulia.*

Successful solution of collective action problems, however, hinges significantly on success in detection and punishment. As a rule, small groups are more likely to have better information about their members and their actions. They are, thus, more likely to be able to detect cheating and organize when inflicting punishment of whatever form on a cheater. However, under imperfect observability threats to deter opportunistic behaviour, in equilibrium may have a positive expected cost (they may have to be carried out even though nobody defected) and an expected benefit. Sometimes sanctioning system may be so costly and complex that people usually prefer to devise their own mechanisms to deter opportunistic behaviour. *FPCs in Burdwan (Belemath) and night-guard system in Bon-Hooghli are such mechanisms. An external enforcer of cooperation, as an alternative, may not be able to detect cheating or impose punishment with sufficient clarity and swiftness. Of course there can arise situations, for example in the case of Purulia (Matha), where both kinds of enforcements may fail.*

To ensure cooperation in the repeated PD, however, the benefits of cooperation in the future must themselves be sufficiently probable too to act as an incentive to cooperate in the present. This needs the game to be infinitely repeated, or sufficient uncertainty must prevail about how many times it will be repeated. These requirements are to avoid the standard problem of breakdown of cooperation through backward induction in finitely repeated games.

Section 7.3: Beyond Prisoner's Dilemma

A model suggested by Bendor et al. (1994) seems to be interesting in the context of many CPRs supporting mostly poor users. It is grounded in the 'satisficing' principle and presumes a bounded rationality characterized by limits on information gathering or cognitive abilities. In this model, as characterized by Baland and Platteau, (1996), players make strategy revisions after every interaction based on a comparison between a given 'aspiration level' and the payoff actually obtained in the current period. Here the state of any player at any stage t is represented by a probability vector over his set of pure actions where these probabilities can be seen as reflecting his relative inclination to select different actions. Such a state is updated in

the following manner: if the realized payoff from the chosen action at t exceeds an aspiration level, that action will assume a larger weight at the following stage, with compensating adjustments in the weights on other available actions. The converse will occur if the payoff falls short of the aspiration level. Bender et al. have shown that in such repeated games with feed back effects, stable long run outcome (ie., equilibrium with consistent aspirations) need not be Nash equilibria of the one-shot game. Here feedback effects operate in a manner that resembles 'punishment' imposed on unilateral defection in repeated games.

Initial aspiration level in the above 'satisficing' model of strategy learning will determine the nature of equilibrium. Suppose that in a two-player game the agents' aspiration is near the (mutual) non-cooperative payoff instead of being near the (mutual) co-operative payoff. Also suppose that player I experiments with C at stage t. Since player II continues to defect, player I obtains a payoff lower than his aspiration, thereby making him inclined to defect at t+1. As for player II, he ended up with a payoff above his aspiration at t and this make him also more inclined to defect at t+1. Thus, after a cooperative (C) random move of one of the two players at stage t, they will both receive their aspiration pay off at t+1. As a consequence, players will have no incentive to return to co-operation at subsequent stages. The satisficing model has a 'self-fulfilling' property (Baland and Platteau, 1996): if members of a given society have initially, a low aspirations- say, because of an unhappy, experience in a previous game – they will be inclined to repeat this negative experience in the present. *Our field study in Purulia where we found large-scale defection, to an extent, resembles this kind of game. The experience of Hazamdihi reflects the opposite picture. Shared experiences or beliefs and inherited patterns of behaviour may have played a role in such settings.*

Many contributors in the literature on CPR, particularly in a small-group settings have suggested that the constellation of the relevant p(n) and s(n) of collective action are often a kind that is not of PD type. The pay off structure may be more favourable to the possibility of co-operation, particularly when p (n) and s (n) are interpreted broadly. Small groups or communities are generally characterized not only by the repeated interactions but also by multilevel interrelationships among their members. This is a feature, which follows from the socially 'embedded' nature of many micro-

societies (Baland and Platteau, 1996). Social lives in which individuals interact have many levels. These plural interests may at times be so intertwined that their interactions in relation to the CPR management may not be represented by an isolated game – and that too by an isolated PD game. CPR problem becomes part of a larger game (of which, as we shall see, AG may be one) corresponding to many social and economic activities at the local level.

An important class of problems that arise in connection with the management of CPRs requires symmetric and coordinated actions. Even in a one shot AG (Assurance/coordination game) it is in the interest of the players to cooperate provided they can be assured that others (or in a multiperson setting a sufficient number of others) will do the same. This is something that the static PD game with it's dominant strategy of defection for each player does not capture. The payoff structure of AG, however, allows three possible equilibria (two in pure strategies and one in mixed strategy), and the actual outcome will depend on the prior expectation of each individual's action. In the case of CPR mutual expectations of cooperation may be facilitated by pre-play communication and the opportunities for mutual reassurance.

In many cases coordination is fruitful only if the numbers of cooperators attains a critical size. To explore such kinds of situation following Baland and Platteau (1996), let us, consider an N-player AG. Let us assume that a given local public good (say, the maintenance and management of a local forest or water-body) yields individual benefits to each member of a community equal to b (n), where n is the number of voluntary cooperators (contributors to the local public good). Each cooperator incurs a fixed cost of c units and, hence, the total cost for the community is equal to cn. Player i's choice, then, is as follows:

Table 7.5: Pay-off to Co-operation with Different Numbers of Co-operating Players

		Payoff to player i if the number of other cooperators				
Player I	*Strategy*	n -1	n -2	n-3	…	0
	Cooperate	b(n)-c	b(n-1)-c	b(n-2)-c	…	b(1)-c
	Defects	b(n-1)	b(n-2)	b(n-3)	…	0

Let us assume that $b^{/}(n) > 0$ and $b^{//}(n) > 0$, implying increasing returns to the provisions of the public good. We assume also that b (1)- c <0, so that if none else cooperates and contributes to the public good, player i also chooses not to contribute. Even then, there exists a critical number n* such that b(n*) – c > b(n*-1) or c < b(n*) – b(n*-1): once a certain number, n*, of other players agree to cooperate, player i has an incentive to do the same since the cost of individual cooperation is less than the marginal individual benefit of that cooperation. Since $b^{//}(n)>0$, if b (n*) – c > b (n*-1), then b (j) > b (j-1) + c, for all j > n*. Therefore, as long as at least n* other players contribute, player i prefers to cooperate rather than free ride.

In the game depicted above, there are two Nash equilibria in pure strategies. The first equilibrium is characterized by universal defection: given that no one else cooperates by contributing, player i has no incentive to undertake the collective action alone (we are thus not in a CG). In the second equilibrium everyone contributes and the collectively optimal level of public good is provided. To avoid the 'bad' equilibrium, a subgroup of players may decide to undertake the collective action in concert, regardless of what the others do. In such games there lies an important role for leadership and the function of leadership consists of mobilizing a sufficient number of cooperators and set the assurance process rolling. The initial leadership may not necessarily come from within the community. External agents like a political party, an enlightened individual or group of individuals or local panchayats playing the role of a catalyst may also serve the cause. *We have reasons (based on our field studies) to believe that this is what happened in Burdwan, Bon-Hooghli and Chacharia and this is what failed to evolve in Purulia. However, in all the cases contextual factors (defining the state of nature) played an important role in the emergence and non-emergence of leadership.*

When returns to scale in the provision of public good is subjected to decreasing returns to scale, $b^{//}(n) < 0$. Here again, there exists a critical number of cooperators, n*, below which no individual player has any incentive to contribute. However, there now also exists an upper critical size, say n*, beyond which the individual $b^{/}(n) < c$. Here the two Nash equilibria in pure strategies would imply: a bad equilibrium in which everyone defects (does not contribute) and a 'nice' equilibrium in which just n** players contribute while the others defect or, possibly, as in the case of Bon-

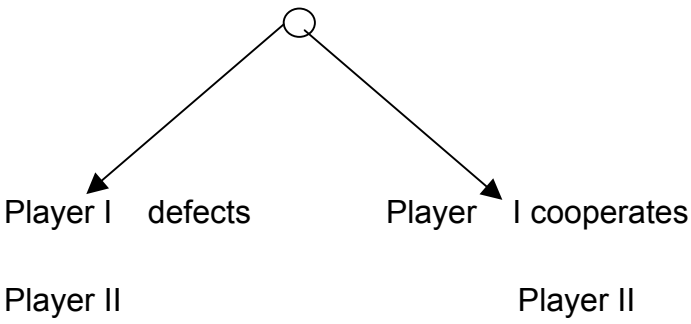
Hooghli, all the N members may put in less effort and shirk only partially. As long as the size of the community is small and N < n** we have the 'nice' equilibrium. However when N > n**, a sub group of players does not contribute in equilibrium and free ride on others' efforts. The problem facing the players here resembles that of an N-player CG, in which Nash equilibrium would be sub-optimal.

In a community setting the community may try to overcome such free riding by resorting to a coordinated solution by rotating overtime the burden and / or benefit of cooperation among the various agents. The community may also look for multiple use of the resource to generate additional benefits to make co-operation more attractive. Bon-Hooghli and Chacharia in our case studies have been experimenting with such kind of solutions with some success.

From our discussion thus far, we understand that it is one thing to identify a potential collective action problem and another to find a formal model that captures it best. It is important to understand the context in which a particular set of interactions take place.Usually, the small, free-standing game is viewed as the game being played when often the free-standing game is actually embedded in a much larger game (Daird et al.,. 1994). Hence, before we can be sure that a simple game captures the dynamics of a collective action problem or any other complicated interaction, we need to understand the extent to which it can be isolated from the context in which it arises.

Let us consider an AG. Standing alone it does not have a unique solution. However, it does have one when it is part of a larger game. We consider such a game in a two player setting. The game shown in the figure below embeds both a PD and the AG. Let us assume that, in this larger game, player I makes an initial move.

Table 7.6: Pay-off to Nested Assurance Games



Player I	Strategies	C	D		Strategies	C	D
	C	2.5,2.5	1.5,3		C	6,2.5	0,0
	D	3,1.5	2,2		D	0,0	1,3

In initial move player I cooperates (C) or defects (D). After D, player I and player II confront a PD; after C, they confront an AG. Player II knows whether player I chose C or D before moving. In stage two player II does not know whether player I playes C or D, but player II should not expect player I ever to play D after having played C in the initial move. Player I receives a maximum pay off of Rs.1 by playing C and then D. Player I should not play this strategy given that another strategy (playing D and then D) has a payoff Rs.2.

Any time player II sees that player I plays C, player II should believe that player I will then play C again. For this reason, player II plays C in response to player I's initial move of C. Because player II believes that player I will play C after playing C, player II ensures a pay off of Rs.1.5 rather than Rs.0 by playing D. Player I has two beliefs: First, that player II is rational and, second, that player II believes that player I is rational and therefore does not play dominated strategies. Hence, player I infers that player II plays C. For this reason, player I adopts the strategy of first playing C and the again C. By doing so, player I enjoys a payoff of Rs.6 instead of payoff of Rs.2 that player I would earn from playing D initially.

This AG, even though standing alone does not have a unique solution, it does have one when it is part of a larger game. If either of a sub games that begin after player I makes the initial move were free-standing, there would be either an inefficient outcome (in the case of PD) or an indeterminate one (in the case of AG). However, when theses games are part of a larger game the outcome may be totally different. In the above game the possibility of facing a PD situation actually helps the players to attain the outcome that is in their joint interest. Games may be misidentified when the small, free-standing game is viewed as the entire game. An isolated PD is a problem; an embedded PD may solve a problem (Daird et al., 1994). Relationship with each other or in a multiplex interaction setting defining broader notion of s(n)

and p(n) or any common third party may come to help and avoid the PD outcome. *A common third party like CPI (M) in the case of Burdwan, Bon-Hooghli or Chacharia, could generate among a section of the community a concern for sustainability of the resource. This section possibly could foresee the possibility of the existence of the PD and to avoid that took the initial move towards cooperation in an embedded game that culminated to an AG with a (C, C) equilibrium.*

Baland and Platteau (1996), discuss interesting hybrid cases of payoff structures where players with a payoff structure characteristic of the AG interact with player with a payoff structure characteristic of the PD or CG. In particular, when group size is small and when PD players coexists with AG players, it may be in the interest of the former to conceal their free rider type by cooperating till the last (few) stages of the game. Clearly, situations, which can arise/ evolve in field setting and contextual factors operating there are of much wider variety than what the tragedy of commons implies. Depending on the characteristics of the resources concerned as well as various features of user groups- their social and historical background, size, their time preference and the importance of their subsistence constraints, their exit possibilities, quality of community leadership, presence of third party catalytic agents, existence of other areas of social interactions, etc, problems of resource exploitation may or may not be appropriately described as PD games. Such problems of resource management, thus, may well lead to AG or CG situations, or a mixture of different payoff structures, or may assume the characteristics of embedded games. Moreover, the type of game itself may undergo change overtime.

This is the perspective that we adopt here. This perspective emphasizes human encounters in a CPR setting involving problems of trust, mutual vulnerability, group identity, homogeneity of group members, leadership, and co-ordination among group members. Co-operation in general, but not always, works better in small groups with similar resource needs and close interactions, shared norms acting as focal points and coordinating mutual expectations, and patterns of reciprocity. In such community monitoring is easier, ‘common knowledge’ assumption of models of strategic decisions is likely to be more valid, incentive dilution is less of a problem, chances of pre-play communication and learning about one another’s intended plans of action are better, and social sanctions are easier to implement through reputation

mechanisms and multiplex relationships of face-to-face communities. *Bankura, Burdwan, Bon-Hooghli and Chacharia are the cases in point. Absence of many of such traits exemplifies Purulia.*

Migration and outside opportunities leading to mobility possibilities work against cooperation and sustainable resource use. Contact with outsiders and exit options reduce effectiveness of social norms, and prolonged repetition of the game also becomes more uncertain, raising incentives for short-run opportunism (Bardhan and Udry, 1999). Sometimes, as in the case of Purlia (Matha), owing to the survival constraint and contact and proximity of market, the discount rate of future incomes of the resource users seems to be infinitely high and free riding behaviour (mining the forest) appears as a natural weapon in the mutual struggle for sheer subsistence. With receding regular opportunities for income and employment, the poor tend to make up for the loss of income by exploiting CPRs more intensely with ever increasing risk of degradation of the underlying resource base. Local level management is much more problematic when, as attested by the Purulia experience, a market develops for resource (forest) products thus giving rise to over harvesting for sale by the community members themselves.

Awareness of ecological stress leading to collective preventive actions is likely to develop more quickly in those societies in which prevails a sense of loss and scarcity or dispossession. Moreover, it emerges more easily with respect to localized and visible resources than with respect to resources having opposite characteristics. *In our field studies Burdwan, Bon-Hooghli and Chacharia appear to belong to the first group while Purulia, with dispersed villages to the second. We have seen from our field experience that quite often success of collective action in many cases is additionally associated with effective leadership.* Good leaders (from within the community or as a catalytic third party) perform several critical functions: to help people become aware of the resource condition and the nature and extent of confronting them; to convince them that their long-term interest lies in concerted action; to set before others the good example; to mobilize a sufficient number of them to ensure coordinated efforts; in generating AG environment; and in the designing and enforcing of rules and sanction mechanisms. *Experiences of Burdwan, Bon-Hooghli and Chacharia shows that collective action probably performs*

better when it is led by committed and literate persons who have been exposed to wider world.

Section 7.3.a: Bankura (Hazamdihi): Another Dimension

Bankura (Hazamdihi) stands apart from our studies of other CPRs in several respects. The community of the resource (water body) owners has a long history and is an offshoot of an expanding family tree. The resource has multiple uses and some of which are enjoyed by others (not members of the owner community) as free access resource. However, this access is customary and based on some kind of mutual understanding. Decisions regarding fishing activities belong to the exclusive domain of the owner community. It appears that returns from fishing do not form a part of the subsistence of the individual members, rather they support the provision of some local public goods (like financing local festivals, schools etc). We have seen in the case of Chacharia, how a private resource turned into an open access resource in the first place and then into a CPR. Here we see the transition of a CPR from community based appropriation and provision to a lease-holding partially private appropriation and provision even when legal ownership still lies with the community. Because of the specific characteristic of the resource (in this case surface water) this transition has not undermined the resource base either. How do we then explain this transition?

Collective action problems in the context of CPRs generally have two distinct but independent problems: problems of appropriation concerned with allocating the subtractible flow of an existing CPR and the provision problems which are to do with the process of creating a resource, maintaining or improving it's production capabilities, or avoiding it's destruction (Baland and Platteau, 1996). In Bankura (Hazamdihi) the community initially confronted the second kind of problems, possibly because of the gradual erosion of dependence on the resource and increasing outside opportunities and contacts of the members increasing opportunities and transaction cost of provisoning. This impacted on the first set of problems. Failing to maintain the resource the community tried to solve both the problems by leasing out the resource without abdicating it's ownership right. The decision to lease-out fishing right is a collective decision and as such solved a collective action problem. Here the resource is a kind of durable good that can be used during several periods (without

degrading it's sustainability). Whenever feasible and risk and transaction cost minimizing, the owner community of the durable good prefers to lease the resource rather than operate and sale the proceeds itself.

In fine, we share the view of Bardhan and Udry (1999) that in a situation of strategic interdependence in the management of CPRs game-theoretic models in general give us important insights into the sustainability of cooperation among self-interested agents. However, they point out that at the same time it is instructive to recognize that there are aspects of real-world cooperation in specific contexts which such models may fail to handle adequately. For instance, they cannot usually handle the impact of ongoing interactions among agents in the updating and contingent modifications of the rules of the game. The latter may include, among others, group dynamics of community leadership bringing about endogenous preference changes and reorientation of values in a community.

Again, a single game structure may fail to represent the evolution of collective action problem. The character of an initial game may undergo change and evolution overtime. In a CPR context, as we have observed, situations in a specific CPR may as well reflect nuances of different game structures and as such may not be amenable to a particular form of game to theorize them.

Section 7.4: Looking for a Policy

"Economists have spent much effort on examining the question of the comparative efficiency of various resource management regimes. The insights provided by economists are extremely valuable, even though they do not point to a particular reason as 'the' best solution" (Baland and Platteau, 1996). We also share this view. We have noted earlier that neither privatization nor state ownership in isolation can adequately address the problem of CPRs.

What about the community-based approach to resource management? Our experiences based on the case studies show that in many situations, though not always, co-ordination and leadership problems play a dominant role. When poor people overexploit local natural resources even when they are aware of the ecological impact of their actions, it is often because they face acute subsistence constraints, which lead them to discount streams of future benefits heavily. They

generally need externally provided economic incentives to be induced to conserve their resources. External catalytic role by State via local level institutions can play a significant role here. Even a political party, as we have seen, can act as a catalytic agent. Trust and co-ordination can be created under impulse of catalytic agents who may often come from outside the community.

When resource users face survival constraints In the context of resource conservation (i.e. where there private discount rate are high), and CPR entails a long gestation period (like regeneration of a forest or reclaiming a water body) they need to be adequately compensated (by some form of subsidy or alternative income earning opportunities) to induce them to allow the resource to grow to the level of stock where it can be used sustainably over an infinite planning horizon.

When the community group size is large, smaller units operating under the umbrella of a bigger unit (with a more complex co-operative structure) could be designed to by-pass the problems of large number. The state can help designing such regimes suitable for concerned local conditions.

In the presence of social stratification and unequal capability sets of different members of a community (all having stakes in a resource), simple, just and easy to comprehend collectively designed rules could be designed. This would imply a relatively egalitarian access to local CPRs even when inequality in private capability and political (or otherwise) power prevail within a community. Local elite may even behave as natural leaders to be trusted by others and may play an important catalytic role for the success of collective action. This result is more probable when economic and other inequality does not prevent uniformity of interest in a collective agreement.

Sanctions and punishments to be effective need also to be tolerant for non-habitual subsistence – constrained deviants. These systems must be graduated, flexible and tolerant / forgiving and mix external (e.g. state) and internal mechanisms.

When historical memory of past successful collective action is non-existent, success of CPRs will then crucially depend on external assistance. Where social relations are not too distinct, distant or mutually hostile collective action may be possible. State can play the role of a catalytic agent here too.

Increasing market and market opportunities can lead to opportunistic behaviour (especially in the case of forest resources). Zoning the natural resource base of a CPR by the state and enforcing and monitoring by the resource community in close collaboration with the state may prevent over use of the resource and break down of the CPR.

All these imply that in many situations state intervention could be reshaped to institutionalize collaboration between state administration and local resource users. The state would provide centralized information about the state of the natural resource base and the possibility of successful collective action, an efficient and accessible credit market and certain social securities; while local resource users of CPRs with their indigenous knowledge of local ecology and relative autonomy of decision making would consider the state not as an alian intruder but as a provider of critical minimum help to create and manage CPRs. The precise mode of such partnership will, of course, depend on the specific contextual factors.

The new socio-political concept known as participatory institutions seems to hold some promise in this context. Under this concept the state, people and all other stakeholders are treated to be equal partners in decision-making, implementing and sharing the costs and benefits of a natural resource.

APPENDIX A: STATISTICAL TABLES

A.1: BELEMATH

Table A.1.1: Gender Ratio

AGE	MALE	FEMALE	TOTAL NUMBER OF PERSONS
0-6	50	71	121
7-12	58	66	124
13-18	54	67	121
19-48	216	209	425
ABOVE 49	45	24	69
TOTAL	423	437	860

Table A.1.2: Dependence on CPR (1995)

ITEMS	*CONSUMPTION*		ENERGY		INTERMEDIATE	
INCOME CLASS	**HOUSING MATERIALS**	**ROOF**	**LEAVES**	**BRANCHES**	**SHAL LEAVES**	**MATRESS**
0-10000	0.00	0.27	19.18	0.48	0.36	1.01
10001-20000	0.00	0.63	14.61	1.81	6.95	1.50
20001-30000	2.81	0.18	8.53	0.23	2.98	0.85
30001-40000	0.00	0.00	7.19	0.37	0.00	1.15
40001-50000	0.74	0.00	16.67	0.00	27.40	0.00
50001-60000	0.00	0.00	0.00	0.00	3.06	0.00
60001-70000	0.00	0.00	0.00	0.00	0.00	0.00
70001-80000	0.00	0.00	0.00	0.00	13.57	0.00
80001-90000	0.00	0.00	2.33	0.00	0.00	0.00
90000>	0.00	0.00	0.00	0.00	0.00	0.00
VILLAGE AVERAGE	1.30	0.42	13.54	1.15	4.87	1.23

Table A.1.3: Dependence on CPR (2000)

ITEMS	CONSUMPTION		ENERGY		INTERMEDIATE	
INCOME CLASS	HOUSING MATERIALS	ROOF	LEAVES	INCOME CLASS	HOUSING MATERIALS	ROOF
0-10000	0.00	0.25	15.67	0.45	0.31	0.79
10001-20000	0.00	0.37	11.93	1.21	3.48	1.23
20001-30000	1.61	0.14	7.53	0.18	2.34	0.78
30001-40000	0.00	0.00	6.66	0.33	0.00	1.01
40001-50000	0.73	0.00	11.43	0.00	16.27	0.00
50001-	0.00	0.00	0.00	0.00	2.97	0.00

ITEMS	CONSUMPTION		ENERGY		INTERMEDIATE	
INCOME CLASS	HOUSING MATERIALS	ROOF	LEAVES	INCOME CLASS	HOUSING MATERIALS	ROOF
60000						
60001-70000	0.00	0.00	0.00	0.00	0.00	0.00
70001-80000	0.00	0.00	0.00	0.00	13.57	0.00
80001-90000	0.00	0.00	2.33	0.00	0.00	0.00
90000>	0.00	0.00	0.00	0.00	0.00	0.00
VILLAGE AVERAGE	0.76	0.27	11.19	0.80	2.68	1.03

Table A.1.4: Intermediate Pattern of Forest Items (1995)

Size of Holding *(Bighas)* ***Income Class***	**0-5**	**6-10**	**11-15**	**16-30**	**21-30**	**ABOVE 31**
0-10000	4	1	1	1	0	0
10001-20000	13	6	3	0	5	5
20001-30000	8	2	3	1	2	0
30001-40000	2	0	1	0	0	0
40001-50000	0	0	0	0	0	1
50001-60000	1	0	0	0	0	0
60001-70000	0	0	0	0	0	0
70001-80000	0	0	1	0	0	0
80001-90000	0	0	0	0	0	0
90000>	0	0	0	0	0	0
Village Average	28	9	9	2	7	6

Table A.1.5: Pattern of Forest Items Used as Energy (2000)

Size of Holding **(Bighas)** ***IncomeClass***	**0-5**	**6-10**	**11-15**	**16-30**	**21-30**	**ABOVE 31**
0-10000	1	4	6	4	10	3
10001-20000	8	23	35	23	8	6
20001-30000	2	25	4	1	1	0
30001-40000	3	7	5	0	0	0
40001-50000	1	0	0	0	1	0
50001-60000	0	0	0	0	0	0
60001-70000	0	0	0	0	0	0
70001-80000	0	0	0	0	0	0
80001-90000	1	0	0	0	0	0
90000>	0	0	0	0	0	0
VILLAGE AVERAGE	16	59	50	28	20	9

Table A.1.6: Pattern of Forest Items Used in Consumption (past)

Size of Holding (Bighas) / ***Income Class***	**0-5**	**6-10**	**11-15**	**16-30**	**21-30**	**ABOVE 31**
0-10000	4	0	0	0	0	0
10001-20000	30	1	0	0	0	0
20001-30000	9	0	0	0	0	0
30001-40000	1	0	0	0	0	0
40001-50000	1	0	0	0	0	0
50001-60000	0	0	0	0	0	0
60001-70000	0	0	0	0	0	0
70001-80000	0	0	0	0	0	0
80001-90000	0	0	0	0	0	0
90000>	0	0	0	0	0	0
VILLAGE AVERAGE	45	1	0	0	0	0

Table A.1.7: Pattern of Forest Items Used in Consumption (2000)

Size of Holding (Bighas) / ***Income Class***	**0-5**	**6-10**	**11-15**	**16-30**	**21-30**	**ABOVE 31**
0-10000	4	0	0	0	0	0
10001-20000	25	3	0	2	0	1
20001-30000	7	0	0	1	0	1
30001-40000	0	1	0	0	0	0
40001-50000	1	0	0	0	0	0
50001-60000	0	0	0	0	0	0
60001-70000	0	0	0	0	0	0
70001-80000	0	0	0	0	0	0
80001-90000	0	0	0	0	0	0
90000>	0	0	0	0	0	0
VILLAGE AVERAGE	37	4	0	3	0	2

Table A.1.8: Income wise-Occupation Distribution

Main Occupation	Agricultural Worker	Farmer	Business	Service	Wood-culture	Forest related	Other Occupation	Unemployed
0-10000	28	3	1	0	0	19	8	10
10001-20000	70	42	12	3	0	46	41	81
20001-30000	7	27	13	0	0	17	9	47
30001-40000	6	16	4	0	0	6	3	26
40001-50000	0	4	2	0	0	0	0	5
50001-	0	1	0	0	0	0	0	3

Main Occupation	Agricultural Worker	Farmer	Business	Service	Wood-culture	Forest related	Other Occupation	Unemployed
60000								
60001-70000	0	0	0	0	0	0	0	0
70001-80000	0	0	0	0	0	0	1	1
80001-90000	0	1	0	1	0	0	0	3
90000>	0	0	0	0	0	0	0	0
TOTAL	111	94	32	4	0	88	62	176

A.2: MATHA

Table A.2.1: Time required for going to jungle

Response / Income class	Increased	Decreased	Unchanged	Uncertain
0-10000	1	0	4	0
10001-20000	9	6	24	2
20001-30000	7	2	8	0
30001-40000	2	1	4	0
40001-50000	0	0	1	0
50001-60000	0	0	1	0
60001-70000	0	0	0	0
70001-80000	0	0	1	0
80001-90000	0	1	0	0
90000>	0	0	1	0
Total	19	10	44	2

Table A.2.2: Time Required for collecting leaves

Response / Income class	Increased	Decreased	Unchanged	Uncertain
0-10000	1	0	3	1
10001-20000	14	3	16	8
20001-30000	6	1	9	1
30001-40000	2	0	4	1
40001-50000	1	0	0	0
50001-60000	0	1	0	0
60001-70000	0	0	0	0
70001-80000	0	0	1	0
80001-90000	0	0	0	1
90000>	0	0	1	0
Total	24	5	34	12

Table A.2.3: Consumption Pattern of Forest Items (1995)

Income class	0-5	6-10	11-15	16-20	21-30	Above 31
0-10000	1	1	0	0	0	0
10001-20000	16	0	0	0	0	0
20001-30000	6	0	0	0	0	0
30001-40000	3	0	0	0	0	0
40001-50000	1	0	0	0	0	0
50001-60000	1	0	0	0	0	0
60001-70000	0	0	0	0	0	0
70001-80000	0	0	0	0	0	0
80001-90000	1	0	0	0	0	0
90000>	0	0	0	0	0	0
Total	29	1	0	0	0	0

Table A.2.4: Consumption Pattern of Forest Items (2000)

Income class	0-5	6-10	11-15	16-20	21-30	Above 31
0-10000	1	1	0	0	0	0
10001-20000	15	0	0	1	0	0
20001-30000	6	0	0	0	0	0
30001-40000	2	0	0	0	0	1
40001-50000	1	0	0	0	0	0
50001-60000	1	0	0	0	0	0
60001-70000	0	0	0	0	0	0
70001-80000	0	0	0	0	0	0
80001-90000	1	0	0	0	0	0
90000>	0	0	0	0	0	0
Total	27	1	0	1	0	1

Tables A.2.5: Illegal Felling: Manage without breaking branches

Response / Income class	Increased	Decreased
0-10000	1	4
10001-20000	8	33
20001-30000	5	12
30001-40000	3	4
40001-50000	0	1
50001-60000	1	0
60001-70000	0	0
70001-80000	1	0
80001-90000	1	0
90000>	1	0
Total	21	54

Table A.2.6: Illegal Felling: Break branches of trees in need

Response / Income class	Increased	Decreased
0-10000	5	0
10001-20000	37	4
20001-30000	15	2
30001-40000	5	2
40001-50000	1	0
50001-60000	1	0
60001-70000	0	0
70001-80000	0	1
80001-90000	0	1
90000>	0	1
Total	64	11

Table A.2.7: Item wise dependence on CPR (1995)

Income Class	Consumption		Energy		Intermediate	
	Housing Materials	Roof	Leaves	Branches	Shall Leaves	Mattress
0-10000	2.00	0.00	0.00	35.32	60.13	0.00
10001-20000	0.00	0.58	1.89	28.87	27.26	0.77
20001-30000	0.22	0.13	0.26	20.03	7.90	1.24
30001-40000	0.00	47.40	20.33	16.95	5.20	0.00
40001-50000	0.00	0.77	0.0	3.24	4.66	0.00
50001-60000	0.03	0.00	0.00	3.19	0.00	0.00
60001-70000	0.00	0.00	0.00	0.00	0.00	0.00
70001-80000	0.00	0.00	0.00	0.00	0.00	0.00
80001-90000	0.06	0.00	0.00	4.51	0.00	0.00
90000>	0.00	0.00	0.00	0.00	0.00	0.00
Village Average	0.53	4.73	2.95	24.12	21.03	0.69

Table A.2.8: Item wise dependence on CPR (2000)

Income Class	Consumption		Energy		Intermediate	
	Housing Materials	Roof	Leaves	Branches	Shall Leaves	Matress
0-10000	1.90	0.00	0.00	13.08	22.82	0.00
10001-20000	0.00	0.56	1.45	16.89	15.89	0.48
20001-30000	0.21	0.12	0.26	14.25	6.15	0.80
30001-40000	0.00	7.50	4.37	7.70	3.36	0.00
40001-50000	0.00	0.72	0.00	3.08	4.35	0.00
50001-60000	0.03	0.00	0.00	3.09	0.00	0.00
60001-70000	0.00	0.00	0.00	0.00	0.00	0.00
70001-80000	0.00	0.00	0.00	0.00	0.00	0.00
80001-90000	0.06	0.00	0.00	4.31	0.00	0.00
90000>	0.00	0.00	0.00	0.00	0.00	0.00
Village Average	0.37	1.04	1.24	14.05	11.87	0.44

A.3: Bon Hooghly

Table A.3.1: Collection of Revenue and Net Profit from Pisiculture and Boating

Year	Revenue from Pisiculture	Revenue from Boating	Net Profit	Net Profit from Pisiculture
1974-5			(-)27	-27
1975-6	39548		12397	12397
1976-7	193222		18401	18401
1977-8	220617		22221	22221
1978-9	304597		50810	50810
1979-0	117228		(-)2447	-2447
1980-1	111012		17400	17400
1981-2	146116		(-)12446	-12500
1982-3	365211		24801	24801
1983-4	375468		2956	2956
1984-5	363738		4910	4910
1985-6	385981		19994	19994
1986-7	559111		58942	58942
1987-8	416595		1498	1498
1988-9	499118		38790	38790
1989-0	1319589		6416	6416
1990-1	950189		18390	18390
1991-2	683632		18759	18759
1992-3	1502050		18822	18822
1993-4	1507050	20348	58011	58011
1994-5	2117682	30247	64730	64730
1995-6	1831720	98325	25310	25310
1996-7	1989203	89050	54841	54841
1997-8	1951512		46298	46298
1998-9	1667995	72155	4421	4421
1999-0	2288275	82910	2196	2196

Table A.3.2 : Seed and Sales of Fish

Year	Fish Seed	Fish Sales
1975-6	3547	39548
1976-7	3560	193222
1977-8	13005	220617
1978-9	115159	304597
1979-0	16239	117228
1980-1	28715	111012
1981-2	26439	146116
1982-3	64534	365211
1983-4	106492	375468
1984-5	102822	363738
1985-6	110850	385981
1986-7	107408	559111
1987-8	203985	416595
1988-9	123504	499118
1989-0	241753	1319589

Year	Fish Seed	Fish Sales
1990-1	240989	950189
1991-2	154758	683632
1992-3	363129	1502050
1993-4	498833	1507050
1994-5	632629	2117682
1995-6	591398	1831720
1996-7	591398	1989203
1997-8	674856	1951512
1998-9	497942	1667995
1999-0	527319	2288275

Table A.3.3: Value Added

Year	VA (Rs.)	VA with 1 year Lag (Rs.)
1975-6	11.15	54.47
1976-7	54.28	61.97
1977-8	16.96	23.42
1978-9	2.65	1.02
1979-0	7.22	6.84
1980-1	3.87	5.09
1981-2	5.53	13.81
1982-3	5.66	5.82
1983-4	3.53	3.42
1984-5	3.54	3.75
1985-6	3.48	5.04
1986-7	5.21	3.88
1987-8	2.04	2.45
1988-9	4.04	10.68
1989-0	5.46	3.93
1990-1	3.94	2.84
1991-2	4.42	9.71
1992-3	4.14	4.15
1993-4	3.02	4.25
1994-5	3.35	2.9
1995-6	3.1	3.36
1996-7	3.36	3.3
1997-8	2.89	2.47
1998-9	3.35	4.6
1999-0	4.34	

APPENDIX B: RESULTS OF CVM EXERCISE IN BON HOOGHLY

We had stated our intention of undertaking a CVM exercise to test the extent to which perceptions of non-use community members can shape the evolution of the resource regime and the status of the resource. Mid-way, doubts arose in our minds regarding the efficacy of this method. So we abandoned our CVM study.

We had estimated WTP as a function of caste, gender, family size, literacy, occupation, family income/per capita income, knowledge about the resource and attitude regarding environmental issues. We ran an OLS to estimate monthly WTP per individual to protect the water body. The WTP was surprisingly high – Rs. 594.60! However, the standard deviation was high (2448.3540). We felt that this reduced the reliability of the value obtained for the WTP. The results of our study are presented below, after excluding those who had stated protest bids.

Two different results are given below:

Experiment 1: WTP = -954.1714 + (71.5003) LIT + (0.010227) TFAMINC + (-99.4609) AT3 + (196.0209) AT4

The respective T-Ratios and Standard Errors are

Regression	Standard Error	T-Ratio[Probability]
INT	593.5519	-1.6076[.110]
LIT	30.0275	2.3812[.019]
TFAMINC	0.0020383	5.0175[.000]
AT3	156.4291	-1.2751[.204]
AT4	156.1808	1.2527[.212]

R-Square = 0.19259, R-Bar-Square = 0.16936, Standard Error of Regression = 1874.6, F-Statistics = F (4,139),8.2891.

Experiment 2: WTP = -1358.3 + (69.5457) LIT + (0.0099896) TFAMINC + (144.6698) AT4;

The respective T-Ratios and Standard Errors are

Regression	Standard Error	T-Ratio [Probability]
INT	502.9494	-2.7007[0.008]
LIT	30.0553	2.3139[0.022]
TFAMINC	0.0020343	4.9106[0.000]
AT4	151.5473	0.95462 [0.341]

R-Square = 0.18315, R-Bar-Square = 0.16565, Standard Error of Regression = 1878.8, F-Statistic = F (3,140) 10.4634[0.000].

Note: Here the variables are INT = intercept term, LIT = literacy level of the respondent, TFAMINC = total family income of the respondent, AT1 = Agreeing upon the fact that the India should not pursue any development program that damage environment, AT3 = Disagreeing upon the fact that India should adopt program that increase income and employment rather that protect environment, AT4 = Disagree to the fact that we should not pay to protect a park that we do not visit frequently.

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