

Chapter 2

The Role of Property Rights in the ¹Traditional Subsistence System

2.1. Importance of Natural Resource in Rural Livelihood:A Theoretical Overview

There is a general perception that poor depend more on forest resources than the rich (Reddy and Chakrabortyⁱ, 1999.). According to FAOⁱⁱ (2002), 80% of the rural population of the developing world use non-timber forest products (NTFPs) for health and nutritional needs. The contribution of NTFP's to household income varies from as low as 10% to as high as 60% (Cavendish, 2000; Reddy and Chakravarty, 1999). Also, studies undertaken by Jodha (1986), Beck and Ghosh (2000), Fisher (2004) and Adhikary (2005) do not show a consistent trend between overall household income and natural resource dependence. In a seminal study, Jodha (1986) found that resource dependenceⁱⁱⁱ decreases with increase in income, but it does not convincingly allow us to conclude that the amount of natural resources used by the poor households is more than the relatively richer households (Adhikari, 2005). In another study by Fisher (2004), it was observed that the dependence on high-return forest activities (e.g. timber extraction and charcoal production) increases with increase in income, while the low-return forest activities (e.g. NTFP collection) decreases (Narain^{iv}, U. *et al*, 2008), with increase in income.

Traditional dwellers suffer, when local resources are degraded beyond self-regeneration or when access becomes restricted due to diversion of forest lands for non-forest use or usurpation of resources by the State. These marginalised communities whose livelihood depend on local natural resources, usually do not have any immediate viable alternative employment opportunities, nor migration is an immediate option for them (Dasgupta,). Therefore, the stakes of the rural households are high to manage these resources for mutual benefit. A communal ownership arrangement of such resources helps to mitigate hardships that arise from fluctuation in income through pooling of risks (Dasgupta^v, EPW). It has been found that wages of unskilled workers are higher in villages where the stocks of natural-capital are higher. If we fail to recognise the contribution of natural-capital in human welfare, then irreversible damage may be caused by anthropogenic activity. Such activity may result in a rate of exploitation that far exceeds the rate of replenishment of the natural resource and ultimately lead to depletion of natural resources beyond self-regeneration. The loss of natural resource endowment or natural capital adversely affects the capacity to produce goods and services and thereby human welfare (Barbier^{vi}, 2003). That human welfare is not solely

dependent on the stock of physical and human capital, but also depends on the stock of natural capital seriously undermines our ability to substitute the latter capital by the former two capitals.

Mainstream economics have always assigned less attention to challenges imposed by natural capital scarcity. They are of the opinion that output will continue to grow unhindered because of possibilities existing for unlimited substitutability between natural capital and man-made capital. Recognising the limits that natural-capital imposes on growth, the relation between natural-capital and man-made capital is rather complementary (Daly^{vii}, 1992). Wrong categorization of the relationship between these two capitals thus undermines the serious implications of declining natural resources.

Rural communities depend on natural resources such as land, forests, water and their products, animals and fisheries for living (Bromley & Cernea, 1989; *cf.* Singh, 1994)^{viii}. Not only do they depend on natural resources and livestock for their livelihood and sustenance, they also spent as much as half of their energy for collection of fuelwood, fodder, animal care, grazing, and fetching water. The well being of rural community thus depend on their ability to collect free of charge, firewood, crop wastes, cow dung, weeds, dry leaves, poles, straw, herbs, fibres etc., from the neighbourhood repository (WRI, 2005). These resources are either held in common or people have open access to them. The ownership of these resources therefore shape their management system and also the sustainability of their use. It is therefore important to identify factors that would enable us to suggest how management of natural resources can be improved so as to increase the flow of benefits from such resources to the poor rural dependent communities.

However, communal ownership of such resources has been seriously questioned because of the paradox that involves CPR management, where individual rationality does not necessarily lead to socially desirable outcome (“tragedy of the commons”). As an alternative the only two options available to avoid the tragedy is either privatisation (“invisible hand”) or state control (Levithian) of the resources. Yet there were enough instances of local institutions that have used a mixture of both private and public practices to manage these resources successfully for centuries.

One of the main challenges in addressing CPR problem is the uncertainty involved in assessing the magnitude and rate of loss of the resource. Also added to this is the uncertainty of the loss being detected at all. A very large quantum of resource loss goes unaccounted

simply because, for many natural resources markets do not exist. Markets fail to exist when (i) the costs of negotiation and monitoring is too high to forbid any market transaction (Dasgupta and Mäler^{ix}, 2007), (ii) the nature of such resources may make it difficult to define property rights for those resources. Further, market failure takes place when property rights are ill-defined and difficult to enforce. Existence of non-convexities in transformation possibilities among natural capital would result in market failure. In other words, the institution of market is not sufficient enough to provide an optimal/desirable outcome when the resource under consideration is a natural resource. Alternative institutional arrangements thus need to be explored which will ensure optimal outcome both in the short-run as well as in the long-run.

The recent thrust on decentralised natural resource management has assumed centre stage simply because of the claim that it can ensure optimal outcome encompassing both the short and long-run. This however has not been the conventional view of our natural resource policy, but rather a centralised ownership justified on the basis of Malthusian argument has been the cornerstone of all our past policies in India. The Malthusian argument in brief implies that rising demographic pressure and the corresponding limited carrying capacity of natural resource base and lack of self-restraint results in inability of the local community to manage natural resource without state intervention.

The neo-Malthusian position on population growth and resource depletion has been seriously challenged by proponents of “historical-cultural ecology” scholars. Their argument is that the large-scale loss of natural resources is directly embedded in key historical events like colonial exploitation, destruction of community ownership rights (common property rights) and supplanting it with state control. Population growth is not solely responsible for resource degradation, in fact, increase in population induces innovations not only in production technique but also in community arrangement in natural resource management (Boserup, 1965). Their argument is reinforced by the fact that rural communities have evolved managerial practices to successfully manage natural resource over centuries.

The third view advocates decentralisation and participatory management system and is popularly known as “new-traditionalist” (Sinha *et. al.*, 1997) draws heavily from “historical-cultural ecology” school. This populist group contend that local communities are primarily based on egalitarian social principle, and their collective awareness precedes the phenomenon of state usurpation of forest. Therefore, the management of the forest should be entrusted with the traditional keepers of the forest.

2.2. Access to Natural Resources and Livelihood Security of the Poor

Let us ask ourselves who is a poor? The answer to this apparently simple question is quite tricky and may range from criteria like low expenditure as in India or low income as in many Latin American countries. The question that we generally confront is; how low is this “low” (poverty line)? Its answer leads to more complex issues rather than solving the problem of poverty itself. Moreover, neither reported income nor reported expenditure reveal the true extent of natural resources that poor people may have acquired from the local commons. This is because, the traditional subsistence economy which is basically natural resource dependent is largely non-monetised. Instead Dasgupta^x (2007) suggests an intuitive definition to identify the poor:

“...people are poor if they have very limited access to the resources they need to be able to function.”.

Therefore denial or restricting access of the rural people to the commons forces them to live in poverty. The much hyped claim about high economic growth by economic policy makers does not reveal in any manner at what cost it has been achieved. If it has been achieved through increased rate of exploitation of the natural resources, then the gains from increased income may not compensate the loss of the poor especially in an economy where the distribution is unfavourably skewed against the poor. The loss is not just borne by the present generation only, but is also shared by future generations to come. Moreover, the much acclaimed well-being indices have failed to accommodate the ecologist concern for loss of environmental resource base under changing demographic matrix and increased demand for output (Dasgupta^{xi}, 1997). It is true that if the development indices have failed to accommodate apprehension about environment, most of the sustainability index has surprisingly remained silent about current well-being (Neumayer^{xii}, 2004).

2.2.1 Quantitative vs. Qualitative Assessment of Economic Well-Being

Ever since the publication of Smith’s seminal work, *The Wealth of Nation* (1776), economists have emphasised the role of capital accumulation as a means of economic growth and development, the importance of which was accepted by Marx as well. However, Malthus, Ricardo, Mill, and others have recognised that the finite supply of natural resources may impair the possibility of unabated growth in output. Later, Engels^{xiii} (1844) had dismissed such scepticism in favour of scientific and technological progress to overcome the constraints. Most neoclassical models till 1970s considered physical capital and human

capital to be the main determinants of production and believed that natural capital were unlikely to pose a serious challenge to economic growth (Alauddin & Tisdell^{xiv}, 1998). The rationale for high rates of natural resource exploitation has generally been associated with the favourable effect on the welfare level brought about by increased economic growth. But a high rate of extraction of natural resources does not allow for replenishment of the resource, thus, shrinking the resource base over time. The rapid loss of the natural resource base adversely affects those whose livelihood depends on the availability of such resources (Pasha, 1992; Jodha, 1986, 1990; Iyengar, 1989, 1997; Beck, 1998; Beck and Ghosh, 2000; Agarwal, 1995, 1997; Singh et al., 1996; Cavendish, 2000)^{xv}.

This brings to the fore an important question, whether it would be possible to take care of human well-being in perpetuity by neglecting natural capital. The Kuznet proposition is that the initial burden posed on the natural capital can be adequately compensated in later period through increased economic growth and development (Barbier, 2003). Will it then be correct to conclude that the transformation of natural capital into ordinary good is reversible? The answer is no, since most of the technology used in this transformation is asymmetric that gives rise to irreversibility. The benefit (value) of a natural resource like forest is best described as in Table 2.1.

Table: 2.1. Classification of total economic values for forest ecosystems

Use Value		Non-Use Value
Direct use values	Indirect use values	Existence values, Bequest values
Timber, Fuel, Fodder, Grass, Thatch, Leaf litter, Medicinal Herbs, Edible Fruits, Edible Roots, Seeds, Leaves, Honey, Wild resource, Genetic material, Recreation, etc.	Flood control, Storm Protection, Water retention in soil, Carbon Sequestration, Moderates Agro-climatic conditions, Protects top soil erosion.	Biodiversity, Culture, heritage and identity, Greenery.

The economic value of any natural resource ecosystem is broadly divided into two, namely, use-value and non-use value. The latter refers to the stream of benefit that is received just

because of the fact that the resource exists *in situ*. Use-values are identified with some degree of human interaction unlike that of non-use values (Barbier, 2000).

It is quite obvious that use of a resource today will mean use foregone in the following periods. A fall in resource availability in future may be contested for two reasons; (i) the future generations would bear the penalty of a decision taken today to which they were never party to it, and (ii) loss of biodiversity would limit their right to exercise option as to how natural capital may be best put to use for increasing the well-being of the society. That sustainability of resource use is limited to the extent of substitutability of natural capital and other forms of capital becomes obvious from the following CES production function:

$$Q(K, N, L,) = \alpha_1 K^{(\sigma-1)/\sigma} + \alpha_2 N^{(\sigma-1)/\sigma} + (1 - \alpha_1 - \alpha_2) L^{(\sigma-1)/\sigma} \dots \dots (1)$$

where $\alpha_1, \alpha_2, 1 - \alpha_1 - \alpha_2 > 0$, and $\sigma > 0, \sigma \neq 1$, K stands for physical capital, N for the flow of resource used in production, L for the labour capital, Q for the final net output. Those who consider that $\sigma > 1, Q(K, 0, L) > 0$; the natural resource is not essential^{NVI} for production and the stock of natural capital does not affect sustainability of economic well-being. If on the other hand if we $\sigma < 1$, the average product of the resource is bounded from above owing to the low degree of substitutability between N and K or L ; therefore, if the resource stock is finite, it can only support a finite amount of output and, for infinite time, the only sustainable level of consumption is zero (Baland & Platteau, 1996). As a natural corollary from the second assumption, natural capital and other reproducible capitals are considered as imperfect substitutes, a depletion of its stock at present period implies irreversible loss which threatens future well-being of the society. This makes a strong case for keeping essential natural capital for posterity.

The question that we face now is *who can best manage natural resources for posterity?* Traditionally in economics, the issue of management was exclusively reserved for either private ownership or the state was assigned responsibility to manage on behalf of the people for common good. Alternative forms of management like community ownership never received importance nor were considered as a viable alternative to manage natural resources. We must enquire how property rights have evolved in the first place and then how such rights are assigned and enforced. The nature of natural resource extraction in general and of forest in particular depends on how the property rights are assigned for such resources. We will first enquire how property rights are assigned and enforced; and under what conditions enforceability of rights threatened.

2.3. Emergence of Property Rights.

The theory of property rights shows that it is “scarcity”, particularly social dimension of scarcity, which is a prerequisite condition for property right to emerge. Property rights specify rules governing access and control over resources that help to resolve the problem of allocation (Waldron^{xvii}, 1988: 39). But for property rights to emerge the gains from internalisation of externalities must exceed its cost (Demsetz^{xviii}, 1967). However, such propositions on the emergence of property rights as pointed out by Annen^{xix} (2006) fails to justify how such rights are assigned once they emerge. Political philosophers took up the challenge to explain assignment of such rights. Nozick^{xx} (1974) refers to Locke’s theory of acquisition of resources through labour that assigns property rights based on the principal of grandfathering which is established in accordance with past usage of non-scarce resources. Rawls (1971) solves the preliminary assignment of property rights through a vote under unanimity rule. Besides assignment of property rights may originate from legal or constitutional authority. However, a property rights regime is successful only if individuals agree to accept these rules and later follow it. There is nothing to suggest so far, that such rules is individually rational, in other words, individuals’ may find it profitable to deviate from the rules due to implementation constraint involved with any such assignment mechanisms. But if property rights are assigned by conflict then it is free of such constraints, though it may lead to “tragedy of the commons”.

Unabated conflict cannot be the way-out to assign property rights, since fighting for resources has an opportunity cost, which is given by the foregone opportunity to produce. Following game theoretic terminology, we consider that players are aware of the outcome (payoffs) of such conflict. As a result they agree on an assignment rule, which is founded on ethical codes and social norms (Sethi and Somanathan^{xxi}, 1996). Such mutually acceptable assignment rules is the basis of common property resources, which depicts a different social behaviour from “tragedy of the commons” (Ostrom^{xxii}, 1990). This naturally increases the welfare of the individuals since they can now commit all their effort to production.

2.3.1 Protection of Property Rights

Enforceability and protection of property rights is not automatically ensured, rather, it depends on policy choices and social institutions (Levine, 2005; p.61). In this context, North *et. al.*^{xxiii} (2000) rightly observe that a government strong enough to define and enforce property rights is equally strong enough to usurp those rights. Security of property rights can

be ensured only when a fine balance between a strong government that enforces property rights, favour private contracting, and applies the law fairly well, *vis-a-vis* a government constitutionally/legally restrained so that it cannot resort to any coercion and expropriation (Levine^{xxiv}, 2005). In addition to the explicit rules and formal legal agencies responsible for defining, protecting and clarifying property rights, such rights are also shaped by the “moral and ethical” norms determining human relations.

The point is, what factors shape the enforceability of property rights in various societies. The two views are (i) first, the ‘law view’ that traces this difference in protection of property rights in legal traditions that has evolved in the imperial country and its spread in the colonies through conquest; and (ii) second, the ‘endowment view’ which consider this difference to be the manifestation of heterogeneity in environmental conditions, institutions, and needs of the population that has constantly shaped and moulded property rights (*ibid*; p.62).

2.3.2 What constitutes Property Rights?

Property rights may be broadly defined as the set of laws and customs, or formal and informal rules, that determine how individuals or groups may gain access to resources and the range of possible uses they may make of them (Saleh^{xxv}, 2004). Such rights may be *de jure* or *de facto* with right to partially bar or even completely exclude others from using the resource (Grafton, 2000). Reeve (1986) summarises the definition of property as a relation between owner *A* and property *P* as follows:

It may be defined as

- (i) *A* has the right to use *P*;
- (ii) *A* may exclude others from using *P*;
- (iii) *A* may transfer rights defined by rules 1 and 2 to others by consent.

Property generally includes a bundle of rights like rights of usufruct, exclusivity, and alienability which is enjoyed by an individual entity or shared by multiple entities (Carruthers and Ariovich^{xxvi}, 2004). If property rights refer to some sphere of “rights” holder’s activity for enjoyment of those rights, then the sphere of activity must not be raided by others (Harris^{xxvii}, 2002). This means that others have a *duty* to refrain themselves from acting in a manner that may impinge upon one’s rights. Bromley’s^{xxviii} (1991) definition that property is a stream of benefits generated from a resource implies that entitlement to such benefits reflects a certain type of social relation being observed. Under the strict-correlative sense of right, any confusion as to what constitutes the relation between economic agents under an

assigned property rights can be best expressed as four distinct pairs of correlative, namely- right/duty, no-right/privilege, power/liability, and immunity/disability^{xxx} (Hohfeld^{xxx}, 1919; *c.f.* Harris, 2002: p. 111).

It naturally raises a question, from where do such social relations find its legitimacy? Property rights literature generally ascribe that the mandate is derived from the state. It is neither sufficient nor necessary to have a piece of legislation in defining the property rights relation (Baltzer^{xxxi}, no date). There are many instances in natural resource literature from around the world where property rights for such resources exist without any formal recognition. Bromley's definition of property has two implications. First, the agent does not necessarily have to be in physical possession of the property to enjoy the benefit accruing from it. Second property is not tangible object rather streams of benefit flowing from assets. Now it is obvious that from the same asset different types of benefit may flow whose rights may be vested with the same agent or different agent. Thus right to forest produce (e.g. timber, fuel, fodder etc.) may not be entirely vested with the state only. It is also possible to compartmentalise the rights into various elements (*ibid*) as mentioned below:

- *Use rights (ius utile)*: The right to derive benefit from the asset.
- *Management right (ius fruendi)*: The right to decide who shall be permitted to use the asset and under which conditions.
- *Income right (usus fructus)*: The right to derive income from the use of the resource.
- *Capital right*: The right to consume, destroy, and transform the asset.
- *Transfer right (abusus)*: The right to sell, give away, or bequeath the asset.

In addition to the above, two more rights can be identified, namely, *right to exclude (ius excludendi)*, *right to alienate (ius disponendi)*.

The term *usufructuary* rights as used in the present thesis means the legal right to use and derive profit or benefit from a property, the right of ownership for which is vested in others. The *usufructuary* right is enjoyed as long as no damage is done to the property. The term has originated from civil law and is derived from the Latin phrase *usus et fructus*, meaning "use and enjoy". In Roman law, usufruct was a type of obligation or *ius in re aliena*, a right in another's property. It never implied possession of the property but only an *in rem* right to the property itself. In India and elsewhere, most tribal society held natural resources including land in common and families enjoyed only *usufructuary* rights to use a certain tract of land.

The families were never owners of the land but had right to till as long as they followed rules framed by the tribal society.

The manner in which property rights evolves depend to a large extent on the individuals and groups who not only compete for resources but also makes attempts to reconcile in order to enhance flow of benefit and also to reduce risk involved in investment^{xxxii}. However, there is no reason to believe that property rights regime that emerges in any society shall always be wealth maximising. Standard portfolio management theory tells us that a trade-off exists between wealth maximisation and risk reduction. The two cannot be achieved simultaneously and as a result private ownership of property may make possible to achieve a higher level of wealth but corresponding risk may increase. On the other hand, reduction of risk not only involves distribution of shares but also diversification of portfolio and making insurance. It is only certain type of property rights which promote a new social relation that may be associated with a new distribution of power and wealth. The new distribution may be vigorously opposed by those who may fear loss of authority and wealth under the new regime. It may be economically correct to introduce new rules on the ground of Pareto-superiority but not always the correct option because of the high political transaction costs involved in it (Eggerston, 1990; North, 1990). Institution in general and property rights institution in particular are mixed-bags of rules, some that increases productivity and others that decelerate growth and distort distribution of wealth and income (Salah, 2004).

2.3.3 Economics of Property Rights

The absence of well defined property rights which is synonymous to open-access (entry and exit is free under this regime) in natural resources has been generally held responsible for widespread destruction of natural resources. This naturally draws our attention into the proximate causes for such failure in natural resource management. Exploitation of any resource entails cost and open-access natural resources are no exception. The extent of resource exploitation depends on the cost-benefit of resource extraction. Benefit from resource extraction may be the financial gains accruing to the agent, or it can also be the subjective gains derived from direct consumption by the agent, or both. The cost of extraction of a renewable natural resource has two components: the direct cost and an indirect cost which is nothing but the unobserved opportunity cost, or the value of the resource *in situ* better known as user cost. User cost implies that a unit of resource exploited today is not available in the next period. The loss is more in case of a renewable natural resource since it also results in a loss of that part which otherwise would have been added from the growth of

that unit. The current value^{xxxiii} of unharvested resource depends upon rate of discount, future market of the resources, technological progress, biological growth rate of the resource etc. (Kooten and Bulte^{xxxiv}, 2000). If we now consider that the property is in the hands of a private owner whose sole objective is to maximise profits then he will obviously attempt to maximise the discounted value of this rent and consider this resource as an asset. This may prevent the owner from over-harvesting the resource once the owner is assured of his share in future. Both private and state ownership of resources in absence of externality may result in a conservative harvesting policy (Fisher^{xxxv}, 1981, *c.f. ibid*: p.87).

However, under an open-access system none will have an incentive to conserve the resource by delaying harvest because any postponement of harvest will only increase the opportunity for others. A rational decision-maker will have the incentive to manage the resource sustainably and decide about their consumption and investment decisions accordingly only when they are certain of being the principal gainer from such decisions (Fuchs^{xxxvi}, 2003). It therefore may appear that when decision-makers are not mere “users” but also “owners”, they will have more incentive to manage natural resource sustainably. Such generalisation appears to be too simplistic especially when there are instances where both private as well as state ownership has been guided by more immediate economic priorities as against of long term health of the natural resource. It is not just enough to assign ownership of resources but to identify a certain type of ownership of resources in particular context that fares better in resource management (Hanna, Folke and Mäler^{xxxvii}, 1996).

2.4 Property Rights and its Dynamics

As mentioned above, the *in situ* value of a resource makes a private rational owner more conservative. This does not mean that other property regimes shall not be successful. The essence of this rationality argument laid on the fundamental neo-classical paradigm that the behaviour of the decision-maker was shaped under a well defined institutional structure. Institutions were generally assumed to be disciplined and never deviate far from what was considered to be optimal. Hence, under the neo-classical framework, institutions were relegated to a position of less academic research. Perhaps it is Ronald Coase (1960) who can be credited for drawing attention to the relevance of institutional structure in economic analysis. This opened two new avenues for economic research: (i) appraisal of economic performance under different property rights regime, and (ii) enquiring why different property rights regime came into existence in the first place and how economic optimality under the different regime is associated with its corresponding transaction cost (Libecap^{xxxviii}, 1999).

The first of the two research areas is interesting as it attempts to explain why economic achievement of societies differs even when they are blessed with the same resource endowment. The general hypothesis was to trace the effect of different property rights system on economic performance. Poor economic performance was usually correlated with weakly defined or poorly enforced property rights. As a result the generally prescription for such underperforming economies was to strengthen their property rights. At the local level some success was achieved by following property rights prescription like individual transferable quotas to arrest unmindful harvesting of valuable species. As mentioned earlier, transforming property rights regime is more easily said than done as such transformation gives rise to friction in the society, thus raising stiff resistance to block any change.

Limitation in the first approach has drawn attention to the second line of research, tracing the evolution of property rights and enquiring why the existing regimes are not always Pareto-optimal. Sub-optimality in resource use has often been ascribed to high transactions cost that is involved in private bargaining and negotiation [contracting] for enforcing property rights or modifying them. These studies have therefore focussed on issues like (i) amount of gains to be shared, (ii) size and heterogeneity of the parties involved in contracting, (iii) the nature of distribution of information amongst the parties, (iv) physical nature and value of the asset, and (v) distribution issues in resource use (Libecap, 1999).

The transition from one property rights regime to another is less resisted when there is evolution of property rights regime rather than revolution in property rights regimes. Resistance is more likely to come from individuals who have fear to lose under a new regime with new set of rules. Such apprehensions can be removed by transfer-payments or limiting the rights to be granted and a consensus is reached between the contracting parties. The demand for compensation has been questioned by scholars who alternatively argued that at times such demands may be just a ploy to thwart negotiation to collect extortion, a general rent-seeking behaviour of the contracting parties.

Whatever be the nature of allocation of rights, it is important that they are clearly defined and enforceable. If the components of ownership rights are well defined then there is no divergence between the social and private optimal value, i.e., externality is absent (Libecap, 1999). Thus, when rights are not clearly defined or usurped by the state, it creates a divergence between the two valuations and hence undermines the economic performance in general and that of distribution and production in particular. This does not imply that appropriate changes in property rights can always be subscribed to ensure rational use of

resources and a favourable attitude towards such changes (Basu^{xxxix}, *et.al.* 1987). Negotiations generally tend to fail when the perceived net benefit tends to be lower than the present share as a result of institutional change. Alternatively, Sethi and Somanathan^{xl} (1996) has developed an evolutionary game-theoretic model to explain why common property resource [CPR] can be effectively managed if sufficient trust and social pressure exist within the cultural norms, ideology and societal value system. The threat lies in any failure to comply with the social norms that may result in variety of sanctions. Following Sethi and Somanathan (1996) we consider that there are three distinct stake holders vis-a-vis natural resources like forest, namely, *defectors* (D), *co-operators* (C), and *enforcers* (F). It is assumed that defectors devote high effort e_D to the harvesting process and does not take into account of the negative externality imposed on others by his action. The latter two groups adopt low efforts level e_O , with enforcers sanctioning the defector but co-operators do not. The respective payoffs for these groups are given as:

$$\left. \begin{aligned} \pi_D &= E_D(A) - p_F \alpha n \\ \pi_C &= E_O(A) \\ \pi_E &= E_O(A) - p_D \beta n \end{aligned} \right\} \dots \dots \dots (2.1)$$

where the price of the resource is unity; A is average product of effort and a function of the aggregate effort E ; p_i ($i = D, C, F$) is the proportion of the players belonging to a certain group; α is the cost borne by the defector when punished by an enforcer; and β is the loss in welfare related with sanctioning. Further, it is assumed that enforcer is able to sanction all defectors. Defectors are able to earn higher payoffs than others due to higher effort put by this group, unless that is reduced sufficiently due to sanctions. Co-operators do better than enforcers since the latter bear the burden of cost for sanctioning if there is defection. The following equation then best describes the dynamics of group size:

$$p_i = p_i(\pi_i - \bar{\pi}) \dots \dots \dots (2.2)$$

where $\bar{\pi}$ is the average payoff of the players. A steady state solution to equation (2.2) is possible only when all groups earn equal payoffs, i.e. $\pi_i = \bar{\pi}$. Such a steady state is possible only when all are defectors. As evident from equation (2.1) in presence of defectors, enforcers are worse-off than co-operators; with only defectors and co-operators, the former's pay-off will always exceed that of the latter. If only the penalty imposed is sufficiently high to negate any benefit from possible defection that a set S of steady state is achieved with a corresponding set of co-operators and defectors only. The existence of steady state is

conditional and its continuity depends upon the “norm of restrain” as mentioned below (Kooten, and Bulte, 2000; p. 202):

- (i) The intensity of the local sanction declines as integration of the fringe community with the mainstream increases, in-migration, incursion by outsiders and also due to population growth, or
- (ii) The net revenue from resource extraction increases primarily due to increase in resource price (for marketable output) and improvement in technologies.

Eventually with the breakdown of social norm, the resource stock will get depleted or even be threatened with extinction which may in most cases result in higher levels of extraction effort.

2.4.1 Dimensions of Property Rights

It is common in economics to view property to be a bundle of rights and all such rights can be exchanged in a market unhindered. In contrast in legal view there are two traditions in property rights, namely *in rem* and *in personam*. The *former* tradition is far older than the *in personam* tradition and conceives property as a right to a thing that cannot be divided and a right that one holds in its entirety (Merrill & Smith^{xli}, 2001 *c.f.* Yonai^{xlii}, 2007: p.162). On the other hand *in personam* tradition considersⁱ property the way the economist does, i.e. as a bundle of rights. It appears that Coase in his seminal paper “The Problem of Social Cost” had adopted the *in personam* approach. His approach is made clear from his stand that property rights must be well defined to achieve efficient outcome. Had Coase hypothesis been founded on *in rem* approach, the actual possession of the asset would be itself able to define the property rights (Yonai, 2007: p. 165). Most of the social norm literature both in economics and law fails to address the existence of this dichotomy in their work (e.g. Ullmann-Margalit, 1977; Ellickson, 1986). Generally, norms are said to exist because they lower transaction cost. At the first place, how does a norm come to exist? Does it arise because people conceive property rights differently from the *de jure* law? This angle of social norm vis-a-vis property rights appears to be missing even in the works of Basu^{xliii} (2000) and Posner^{xliv} (2000). Again as mentioned earlier in the chapter, the cost which is incurred to establish entitlement is also a function of *in rem* and *in personam* notion of rights (Yonai, 2007) because with the decline in “norms of restrain” cost of protection of property rights increases.

It is thus common in developing and transitional economies to face the problem of a *de jure* and *de facto* dichotomy in the enforcement of property rights (De Soto^{xlv}, 2000). It's a

dichotomy which appears as a result of wrong adoption of the *in rem* or *in personam* notion of rights. This also explains why people act in a manner as if the Coase dual causation notion does not exist (Yonai, 2007).

2.5 Property rights and natural resource exploitation

In all human society the role of natural resource is immense and therefore its management and distribution of these resources are important issues. This is an issue that cannot be kept aside unresolved, as demand for resources has been increasing and shows no sign of slowing down and therefore requires immediate attention. Property system, which is a system of rules governing access to and control over resources, also solves the problem of allocation (Waldron^{xlvi}, 1988). Property rights are an important factor to understand the problem in natural resource management (Alston and Mueller^{xlvii}, 2003). When the natural resource is not scarce i.e. it is relatively abundant or plenty in supply, then right of use is generally irrelevant (Deacon and Mueller^{xlviii}, 2004). It is only when the demand begins to increase relative to supply that property rights evolve and also begin to matter (Demetz, 1967). The nature of property rights that evolves plays an important role in determining the manner in which the resource is used and managed.

Increase in demand is likely to be observed in more extraction of the natural resources. This gives rise to externality as the decision of an individual resource use that generally affects the consumption decision of others especially when market for such natural resources are either imperfect or absent. Market failure will be discussed in further details later but it will suffice for the time being to mention that such failures are associated with externalities, asymmetric information, etc. Externality may be defined as a divergence between social and private valuation of an economic transaction. Individual's decision is based on private costs and benefits and does not internalise the externality, as a result, the outcome of a private decision may result in sub-optimal allocation of resources, i.e., Pareto inefficient outcome.

The above inefficient outcome can lead to two different paths. First, there may be a general demand for changes in the existing property right structure which may be adhered to by the state. Second, the state itself may entrust with the management of the natural resource as in the case of India. However, there is a third alternative as proposed by Coase (1967) that regardless of the initial distribution of property rights and in absence of transaction costs the natural resource would always be efficient. Externality is therefore associated with a positive transaction costs (Bromley^{xlix}, 1991).

The demand for changes in the existing property rights structure is not automatically guaranteed. This is because property rights are changed or created by political process, and the group that controls such process will agree to such changes only when they are relevant to them (Deaconⁱ, 2003). Property right that emerges where controlling group is the entire voting population shall be different from where the control is in the hands of small elite group and would be even more different when the group represents alien minority (eg. colonial rulers).

Whatever is the form of externality, i.e. unidirectional externality (one decision-makers decision affecting the welfare level of others) or reciprocal externality (each decision-makers decision affecting the welfare level of others), economic efficiency can be improved if all agree to cooperate. Property rights that may enable to achieve higher economic efficiency may fail to emerge due to informational asymmetry amongst the resource user (Deacon, R. and B. Mueller, 2004: p. 7). Informational asymmetry increases the transaction cost that acts as a hindrance to the emergence of any co-operative solution to the problem and it is less likely that externality shall be internalised. Property institutions serve the purpose of reducing uncertainty and thereby lower transaction cost in economic exchange (Northⁱⁱ, 1990).

Two extreme propositions, the first being Hardin's famous "tragedy of the commons", points out that in absence of property rights, resources are likely to be over-exploited; the second, collective decision making as an alternative would enhance their welfare by mutually agreeing on some resource allocation principle. But it is quite unlikely that a collective decision can be made so easily, since it itself involves transaction costs which is proportional to size and heterogeneity of the group. Establishing appropriate property rights institutions not only enables to lower transaction costs and acts as a catalyst for collective action but also helps to lower dissipation of resource rent. Thus, identifying the appropriate property rights regime has been an important topic of research for past three decades.

The nature of property rights regime vary across a continuum from pure public to pure private. However three distinct regimes has been found to be of prime interest amongst institutional economists, namely, private property, public property and common property. Added to these three regimes is a situation when no property rights exist commonly known as open-access resources (Seabrightⁱⁱⁱ, 1993). Each of these regimes differs from each other in their ability to exclude non-right holders. The two main characteristics of common pool resources that make it difficult to manage are; (i) it is difficult and costly to exclude potential users of the common, and (ii) each unit harvested by a user means a loss of welfare for others

(Ostrom^{liii} *et.al.* 1994). Difficulty to exclude users implies that the users continue to enjoy the benefit from the resource pool without any corresponding contribution, a situation identified as free-riding in natural resource management literature. Again when the boundary of the common pool resource is not well demarcated, it shall be difficult or too costly to monitor its use and any unit of resource thus extracted would mean loss of welfare for the users. The latter is well-known as jointness problem in natural resource literature. A formal introduction to property rights is now required before we proceed further in our discussion on this issue.

2.6 Property Rights Regimes

Property rights regimes perform the function of assigning rules of use of the resource in a sustainable manner, as well as legitimise some kind of enforcement procedures for its proper protection and to resolve disputes. We first consider a resource with no property rights (*res nullius*) more commonly known as open access regime.

2.6.1 Open Access

Open access refers to a situation when property rights is either absent or not well-defined. This makes exclusion of users very difficult subjecting the resource to over-exploitation and even possible extinction. This regime is tolerable as long as demand for resource is too low to economically justify any effort in its management (McKean^{liv}, 2000). We may ignore this problem in the short run but it would be difficult to continue ignoring the problem in the long run when exogenous factors like technology and population growth increases demand for the resource (Swaney^{lv}, 2003). If we continue to ignore the problem it would lead us to a situation where the resource may be degraded to a point beyond repair, what Hardin (1968) terms as “tragedy of the commons”. To avoid such tragedies, the prescription has generally been in assigning property rights to economic resources for sustainable use.

2.6.2 State Property Regime (*res publicae*)

An asset is a state property when the entitlement to the resource rest entirely with the state, the sole authority to regulate resource use. The state protects its resource from intruders either by “fencing”, primarily done by demarcating areas covering natural resources like forest as national parks, reserves, sanctuary etc., or through legislative measures meant to prohibit entry into the property exclusively designated for the state (Acheson^{lvi}, 2000). Access to state property by individuals is not a right but concessions to be enjoyed at the sole discretion of the state. However, many state property rights have in practice turned into open access regime due to poor enforcement and inefficient monitoring system (Bromley^{lvii}, 2003).

This form of ownership in natural resources has been justified on the ground that it gives precedence to general welfare as against individual benefits. There is however nothing in state ownership to suggest that it can ensure better management of the natural resources, or at least prevent failure in resource management similar to such failure under a private ownership regime operating in a decentralised market system. Government failure in resource management is associated with the divergence in *de jure* rights holders to that of *de facto* users of resources (Berkes^{lviii}, 1989). Mere enactment of law is not adequate to protect state property when the chance of being detected at the ground level is low. Enforcing property rights is at times costly especially when a large population live in close proximity of the resource. Forced entry into state property may be considered to be a sign of conflict between state objectives (read economic goal) vis-a-vis community priority (read conservation goal).

2.6.3. Private Property Regime (*res privatae*)

Private property has been considered as an indispensable factor for economic development in neo-classical economics. This is because under such property rights regime individual's labour is strongly connected with benefits and thus avoids free riding. A private property regime assigns individuals or individual entity, the right to exclude non-right holders and also to regulate the use of resources. Holder of private property rights as compared to the above regime is more effective not only in enforcing their rights, but also in pressurising the government to protect their interest (Bromley, 2003). This regime considers the market price of a resource to be a reflection of its scarcity value and take decisions accordingly to attain an optimal outcome (Grafton^{lix}, 2000). This regime is said to encourage innovation as entitlement to the resource is well defined. Private property has the advantage of excluding those without rights from the CPRs at a cost that is less than the benefit from privatisation. However, when the cost is high, then the relative advantage of the private property declines (Anderson and Hill^{lx}, 1975 *c.f.* Grafton, 2000). Privatisation of a resource may make the new property owners well-off but does not ensure that the society's welfare has improved (Weitzman^{lxi}, 1974). The other major drawbacks of the private property regime are: (i) private valuation may differ from social valuation of the resource generally known as the problem of externality, (ii) private rate of discount may diverge from social rate of discount as a consequence the resource may be harvested comparatively too slowly or too fast as desired from the social requirement, and also (iii) the final distribution of wealth and income under the new regime may lead to increased inequality in the society.

2.6.4. Common Property Regime (*res communes*)

It does not require an elaborate formal analysis of natural resources to realise the importance of CPRs in the lives of the rural poor in the form of agricultural land, threshing grounds, grazing fields, tanks and ponds, woodlands and forests, rivers and streams, coastal fisheries, mangroves, and coral reefs. As has been pointed out by Dasgupta (2005), apart from agricultural land, natural capital has been absent from the formal models of mainstream development economists to arrive at any policy proposals. However, over the past few decades an extensive literature has emerged on the economics of natural resources, which have observed that, excepting for agricultural land, the local natural-resource base is often communally owned.

In property rights literature, “common property” is considered to be the precursor of private property. Under this regime, the property right is held by users who are members of a well-defined group and they can exclude non-members from using the resource as well as take decisions as to how to use the resource amongst them. Generally, common property rights are vested with groups having long term interactions among its members. Long term interaction of the group with the resource naturally helps in enhancing the knowledge base of the community vis-a-vis the resource over the years. Browder (1995) has contested this claim and claims that such knowledge is not unique to traditional dwellers only, but can also be seen among new colonizers.

Common property resources (*res communes*) as developed in the English common law, the German land law, and Roman law, refer to a distribution of property rights in a resource system where the users are well-defined and they enjoy a well-defined stream of benefits. There are two relevant points to be considered, one, the access to such resources is restricted to those who do fall under the category of users, and two, users necessarily do not enjoy equal rights always.

Even when traditional dwellers have successfully excluded non-members from using the resource, yet there are number of factors that may lead to the breakdown of the time-tested mechanism. This happens when the group becomes unmanageably large, social capital has not been adequately developed, monitoring and policing of the CPR becomes costlier, and when one does not bear the consequence of their decisions (Acheson, 2000). This system of managing natural resource is the oldest type of property regime, but it does not mean that this regime have always been successful. Success in natural resource management implies that the

resource has not been depleted, that some investment to increase the resource base has taken place and that the members of the group make decision coherently (Bromley, 2003). Fear has been raised that without adequate safeguards from the state, common property may degenerate into an open access regime (Fuchs^{lxii}, 2003).

Besides, critics of common property regimes, have found it to be inefficient on many counts. Firstly, there is a loss of rent as everyone enters into an unfair competition to get a larger share of the produce (Knight^{lxiii}, 1924; Gordon, 1954; Scott, 1955; Schaefer, 1957; Cheung, 1970; C. Clark, 1976, 1980; Dasgupta and Heal, 1979; *cf.* Ostrom^{lxiv}, 2000). Secondly there is the high transaction cost involved in formulating a consensus policy framework that will help to reduce any overuse of resources (Demsetz, 1967; Coase, 1960, *cf. ibid*). Thirdly, inefficiency arises as individual lack the incentive to increase their productivity, as there is no direct relationship between individual effort and share of gains (North, 1990; Yang, 1987; *cf. ibid*). Another point of criticism against common property regimes is the “rationality” argument. Even when there is an agreement on some rule for resource use by the user groups, a rational individual may find it to his own benefit to break-away and over-exploit the resource, with the assessment that if he does not capture the benefits, others will do so. As an alternative, privatisation of commons has been suggested to avoid the “tragedy of the commons”.

Common property regime shares some features of public property since a member does not enjoy any special privilege vis-a-vis others in the group, and like a private property the ownership of the resource is clearly-defined and exclusively owned by the group that makes exclusion of the non-owners rather easy (Lubna^{lxv}, 2002: p. 6).

The resource held under this regime is collectively owned but used by individuals under some rule. This means that the success of CPR depends on the adherence of rules for sharing the benefit. But in the first place, there must be a consensus among the members of the group in formulating the rules of use and collective effort in managing the resource. Collective action by the group has been subject to scepticism particularly by those scholars who consider that it is a difficult proposition to follow by a rational decision-maker guided by self-interest.

2.6 Discourses in Property Rights: A Brief Overview

A survey of property rights reveals that it is founded on four broad literatures, namely, the anthropological literature, contractarian literature, legal literature and the fourth by property-rights economists (Scott^{lxvi}, 1983).

The anthropological literature has developed as an enquiry in to the nature of rights wherein a particular society's "property system" is embodied. Their works have shown that the social significance of property is much broader than the liberal tradition recognizes, and that the political, economic and social functions of property are in continuous flux. Traditionally, the liberal approach emphasis has been on private ownership, initially to ensure political freedom and later to achieve economic efficiency (Ryan^{lxvii}, 1984). This has led to penetration of exclusive private ownership of property in more and more spheres of human life (Siegrist, 2003, 2006; cf. Hann^{lxviii}, 2007). However, enjoyment of benefits from a resource is not ensured by mere ownership only, rather it is more directly related with "access" to such resources (Rifkin, 2001). Access to resources can be limited by 'thinning out' (*Verdünnung*) of property rights through various regulatory impositions that can be thrust upon owners by the state and other regulatory bodies (Ryan, 1984 cf. Engel^{lxix}, 2002).

The early anthropological scholars on property were primarily preoccupied to trace the development of human societies ultimately into a highly decentralised private ownership system which is characteristic of modern capitalism (Morgan^{lxx}, 1877; Engels^{lxxi}, 1844). Private ownership of property was so deeply embedded in the nineteenth century judicial literature, that acceptance of any other form of ownership threatened to shake the very foundation of accepted social order. As a consequence, the European colonial administrators were struggling to reconcile native systems of land tenure with their western classification. In India, the indecisiveness of the British ruler to recognise communal rights of rural communities and instead considering the *zamindar* to be identical to the English landlord, can be attributed to failure of western category in recognising alternative forms of property. Usurpation of unoccupied land and wastelands hitherto held in common by rural community was witnessed in the colonies in general and India in particular.

The contractarian literature owes its origin in Locke's philosophy of the state. Prior to John Locke's *Two Treatises of Government* published in 1690, property had been viewed, as exclusively something created by government. Locke maintained that it was instead the source of government. He firmly rejected Filmer's (1680) idea that individual property could be granted only by the state. On the contrary, he argued that, not only private property's existence preceded any government, but it was also upheld by natural law and the doctrine of natural rights. Locke claimed that the role of the government was not to create property rights but only to recognize and preserve the existence of the natural rights. Locke's interpretation of natural rights ranged from the broad and philosophical, to the narrow and materialistic.

- While the former includes the rights to one's own life and liberty, the latter relates to rights to produce not only useful consumption goods but also any concomitant producer-good with one's labour. According to Locke, every individual possessing "labour of his body", which in combination with an object (or event), X, is a necessary and sufficient condition of, or constitutes (*ceteris paribus*) the justification of, ownership of X (Coval^{lxvii} *et al*, 1986). Locke's theory of property can at best be considered as a theory of the extension of ownership, but fails to provide a theory of justification of ownership. However, Nozick (1974) went a step further and commented that there is not enough justification for extension of ownership through "mixing" in Locke's theory. The contractarians has therefore been criticised for their failure in explaining how such original property rights have advanced overtime (Scott, 1983).

2.7.1 Ethical Foundation of Property Rights

The above discussion on property rights has a long ethical tradition which finds expression as early as in the writings of Greek scholars and Roman law and later in Aquinas and Locke. Aristotle puts forward a number of advantages of 'private' property *vis-a-vis* 'common' property in *Politics*. First, private property is considered to be more productive. "What is common to the greatest number gets the least amount of care. Men pay most attention to what is their own; they care less for what is common; or at any rate they care for it only to the extent to which each is individually concerned. Even when there is no other cause for inattention, men are more prone to neglect their duty when they think that another is attending to it." (Aristotle^{lxviii}, *cf.* Hoppe, 2004). Secondly, it helps to avert differences and advance harmony, unlike common property where owners shall often have disagreement over the manner in which such property shall be managed.

In Roman tradition, property evolved from undisputed control, the right of usage and freedom of contract. As such, Roman law considered the right of private property as near absolute. As the Greek and Roman were slave-holding societies, it follows that Aristotle considered slavery to be a natural institution (Hoppe, 2004). Such early civilisations had despised labour, commerce and profit. On the contrary, Western society after the fall of Constantinople has essentially moved towards a society of free people and upheld the virtues of labour and work. Lockian justification of property rights is based on the notion that men had a proprietary right over themselves and therefore had the right to reap the benefit of one's labour. According to Aquinas and Locke, property rights first came into existence by labour, developing and cultivating previously unexploited and fallow lands.

2.8. Market based Natural Resource Management and Property Rights

Even before the arrival of the elegant economic theory, economists took note of externality which leads to divergence of social and private valuation and results in market failure. This naturally distorts the optimal outcome which Pigou^{lxxiv} (1920) suggests could be corrected through appropriate fiscal policy (taxes and subsidies). Lindhal^{lxxv} (1958) prescribes establishment of appropriate markets for externality. Arrow^{lxxvi} (1971) observes that externality is a notion more close to the domain of public goods, since market rate of interest is in variance with the socially desirable discount rate. Coase (1960) interprets externality from the legal perspective; so externality refers to some penalisation to someone who has not been a party to the negotiations leading to transactions (Dasgupta, 2007). Such penalisation due to institutional failure is not limited to the current generation only but also penalises future generations who even cannot negotiate through markets, simply because intergenerational market does not exist. The presence of externality leads to over-exploitation of the resource and eventually leads to degradation of the resource.

The re-emergence of interest in alternative form of property rights in economic discourse can be traced in a series of papers published by Buchanan^{lxxvii} (1959), Coase^{lxxviii} (1960) and Buchanan & Stubblebine^{lxxix} (1962). Their work focused on alteration of property rights brought about by any governmentally imposed solution, as suggested by Pigou. The Pigouvian solution refers to a tax equivalent to the marginal social damage is identified with 'externality' situation. The essence of Buchanan-Coase concern was that an implicit property rights change takes place when it becomes economical for those affected by externalities to internalise benefits and costs (Dragun^{lxxx}, 1987).

The objective of property rights in more primitive form of exchange was to ensure efficient allocation of user-rights, whereas, its role under the present market structure is to ensure efficient transfer of property values (Sankrityayana and Mukherjee,^{lxxxi} 2004). As a result of this the present market system cannot play the desired role of allocating use-rights to those who needs it most. The mainstream economists continued to justify economic exchange based on private ownership simply because it can ensure a welfare maximising outcome measured in terms of Pareto criteria. However, when markets are seen as abettor of wealth enhancing institutions, then expectations of speculative gains would result in holding of resources and other practices that may result in an outcome far off from the socially desired level. The resulting distribution shall be skewed unfavourably, which seriously raise doubt about the effectiveness of allocation of private property to all economic resources.

There has been a considerable change in the position of property rights in economics during the transition from classical to neoclassical approach. During the past two centuries both economics and political philosophy (ethics) has moved far away from their common origin in natural order and instead pursued apparently, immaterial intellectual endeavours. The classic theory of property based on private ownership, commandeering and contract reached its height of influence in the eighteenth century but since then had slipped into oblivion (Hoppe^{lxxxii}, 2004).

Unlike ethics which is a normative science, economics has evolved as a value free “positive” science. For economics it was natural to justify means to attain a desired end, whereas ethics continued to enquire what end is one justified to choose. This separation resulted in gradual disappearance of property in both disciplines. Economists considered property to be too normative whereas for political philosophers it was an uninteresting economic issue. The re-emergence of property rights in economics is the direct result of the Rothbardian movement.

While Rothbard was busy in reinstating and reviving the past glory of private property in economics and reintegrating economics with ethics, there was a spurt in academic research on private property from economists and legal theorists of the University of Chicago such as Ronald Coase (1960), Harold Demsetz (1967), and Richard Posner (1973). Rothbard’s primary concern was private property and ethics whereas the Chicago school gave precedence to economic consideration over property and ethics. In Coase theorem, for instance, where irrespective of initial assignment of property rights under a costless transaction system shall ensure an optimum outcome as long as property rights are well-defined. From the classic viewpoint on property rights; it matters to identify who has inflicted damage and who is the victim? The important point is that market cannot be relied upon to resolve the problem especially when severe inequality in resource allocation exists already.

Secondly, the Chicago school prescription that property rights are assigned in a manner such that wealth or the value of the production is maximised is also flawed. Both the positive and the normative claim of Chicago law and economics must be rejected^{lxxxiii}. The level of production, more specifically the value of the social production depends on the resource allocated to producing enterprises. This allocation is not given *a priori*, rather it depends on the previous acts of appropriation and production. In other words it means that in our pursuit of maximum production we may aggravate the already existing problem of misallocation of resources.

Hence, market based on private property cannot be relied upon to deliver especially where large part of the economy remains demonetised. This is true for the forest dwelling community where a part of the forest output (non-timber forest product) does not have an immediate market value though they have high use value for them. Will then creation of limited private property in the form of community property rights in those commodities help in solving the problem of “tragedy of the commons”? The next section therefore explores the role of property rights in natural resource management.

2.8.1 Community Property Rights and Natural Resource Management

The primary goal of managing natural resources is to maximize the long-term economic rent. For many years scholars believed that a resource held under a common property resource (CPR) regime is inherently inefficient since individuals do not get proper incentives to act in a socially efficient way and therefore such management regimes generates little or no rent (Adhikary, 2001). It was thought that when individuals share ownership of resources with others, they are prone to over-use (Gordon 1954; Demsetz 1967; Hardin 1968). Two major solutions have been proposed; state control and management (Ophuls^{lxxxiv}, 1973) or privatisation of the commons (Demsetz, 1967).

The nature of human-natural resource interaction is defined by institutions of property, and much of environment related problems arising from human interventions are result of incomplete and ill-defined property institutions (Hanna and Munasinghe^{lxxxv}, 1995). Institutions may be defined as a set of rules/norms that help each individual in a society to interact and work harmoniously with others, thereby reducing conflicts and enabling members to achieve a desired result. The way these natural resources are used by people depends to a great extent on the nature of property rights governing these resources (Tietenberg^{lxxxvi}, 1994). Therefore, distribution of property rights is central to any nation’s natural resource policy. The conditions of access to and control over natural resources have a direct bearing on natural resource managements. A well-defined structure of property rights induces efficiency in the use of resources.

A well defined structure of property rights has four distinguishing characteristics, i.e., rights are universal, exclusive, transferable and enforceable^{lxxxvii} (Posner, 1973). Most of the natural resource problems can be traced in the difficulty of framing enforceable command and control institutions, which can administer the resource management system [RMS] to the overall benefit of the community. While in standard practice the world over, enforceability

depends on the existence of legal sanction; two variants of legal enforcement can usually be discerned.

The first of these is *common law* (alternatively, *customary law*) such as *panchayats*^{lxxviii}, legal sanction of which draws weightily upon tradition and past precedents. Common law systems are not uncommon to the Himalaya; they are used extensively, for instance, to administer *jhum* (swidden) lands in the North East, or civil (*soyam*) forests in the Western Himalaya. However, for common law systems to work efficiently, there must be established precedents and identity in circumstances which creates obvious difficulties when population grows, land availability changes and scarcity increases. Other difficulties in administering common law as mentioned earlier relates to the high transaction costs of having to handle each decision individually and limited information and expertise, especially if the nature of conflicts is new.

An alternative legal system, well reflected for example in Indian Forest Law, is *statutory law*, by which all rights and prohibitions are duly recorded and generally administered under Courts of Law. Such a system, while having the advantage of lowered as well as uniform transaction costs, has the disadvantage of being inflexible unless periodically amended. A more serious failing of the system arises when the number of access right holders multiplies beyond control. For instance, when both population and consequent resource dependence increase, the burden of enforcement in a statutory law system lies with a neutral authority rather than with the users themselves. In effect, most often a *free rider* situation ensues where the effective penalties are minimised in several cases because of lack of detection.

However, the primary difficulty with both legal systems - customary or statutory - is the lack of an adequate incentive structure that ensures optimal resource management. This difficulty is centred around the problem of property rights, in the sense that precedence of access rights to common resources and the nature of allowable *versus* disallowable uses is not well defined and too complex and interlinked to be written as a formal contract (Seabright, 1993). It is interesting to note that the existence of property rights is also essential to the working of markets. If property rights are well defined, enforceable and transferable, and markets exist where these can be traded among users under competitive conditions with reasonable efficiency (Field, 1996), the outcome of market trading in access rights can lead to a socially desirable result which balances resource supply with all potential needs of the community.

Efficiency in market-incentive based RMS systems rests on the well-known Coase Theorem of environmental economics (Farrell, 1987). Briefly stated, the theorem applied to CPR contexts argues that when a set of holders of access rights are empowered to extract a penalty against resource overuse by another set of rights holders, the extent of resource depletion will ultimately be limited to the point where the penalties that the latter are willing to pay exactly compensate the former for resource needs that have remained unfulfilled. What is important for the theorem to work is that the access rights are well defined and the penalties enforceable, so that the socially optimal level of resource use can be determined by trading behaviour between the two sets of users. Reinterpretation of the theorem (Ostrom, 1990), particularly in community-based natural resource management systems again postulates that voluntary negotiation between CPR-users can substitute for market transactions in achieving a 'fully efficient outcome', when (a) initial rights of access are well defined; (b) negotiations between users are costless; and (c) there are no income effects. State intervention is no longer necessary to achievement of a Pareto-efficient resource allocation through negotiation, since the negotiations remain costless. Since, moreover, the allocation is *optimal*, independently of the initial assignment of access rights no tragedy of the commons need occur to an unregulated common property resource, since negotiations between users would inevitably avoid an inefficient outcome.

It needs to be noted that for the property rights system to operate, CPRs have to be made a private property institution. This must not be confused however with *individual* property rights, since the private right may well belong to a community group rather than to its individual members. The Coase Theorem moreover works irrespective of which group is assigned the initial property right since the results of bargaining lead the community to the same outcome. In substance, therefore, the approach is conceptually suited to managing fuel and fodder access rights without legal intervention in rural communities, provided such rights are unhindered, enforceable and tradeable, and recognised as such by government.

State mediation and other intrusions in CPR systems ultimately bring market integration in their wake, a glaring consequence of which is the alienation that users feel from resources which are no longer attached to traditional community settings. The alienation disrupts the frequency of interactions among rights holders, impairing their incentive "to adopt cooperative behaviour" (Cordell and McKean, 1986 *c.f.* Baland and Platteau, 1996: p. 185). Another adverse impact of market integration arises from the demonstration effect it has on individual user preferences. The shift to individualistic consumption patterns and modes of

living often compels users to sell productive assets in their drive to acquire hard cash. Even the poor may resort to sale decisions, which precipitate drastic changes in 'ecological and socioeconomic environments' (Baland and Platteau, 1996: p. 281)³⁰.

However, besides the impact of state mediation and market integration, the most crucial factor responsible for altering traditional CPR systems is population growth. The consequences of an unabated rise in population and a constant resource base affect most severely the collective property rights-holders, causing a decline in their individual resource shares and gradual erosion of social power. Ultimately, this threatens the viability of the traditional RMS system and only through provision of alternative income and employment opportunities can the negative impact on CPR allocation and management rules be contained.

Despite the apparent rigor of incentive-based RMS systems, instances of management failure occur frequently in income-poor regions and countries, primarily because the incentive structures that exist are not in tune with resource priorities and needs. The mismatches are often most evident in the rupture of fuel, fodder and landuse systems leading to widespread rural poverty. The problem is delineated over several successive stages, each denoting further internal collapse within the RMS system, until the poor are driven to migrate and seek shelter in other places and occupations (Newcombe, 1989). Usually triggered again by rapid population growth, the chain of occurrence commences when the local commons on which village communities depend for fuelwood and fodder are taxed beyond their replenishment thresholds by increasing resource draws. As forest cover and usufruct yields decline, other substitute biomass resources available locally, such as cowdung, straw and crop residues are diverted from manuring and fodder uses into meeting energy demands, causing a continuous decline in crop yields. Not until forest usufructs become *priced* rather than *collected* commodities, does the collection of these generate notional savings for the rural families. Till then, collection pressure continues to fall on forest lands rather than common lands. The crisis however deepens uncontrollably when the biomass CPRs are transformed into priced resources, escalating their depletion rates with the materialisation of fodder and fuel markets. The stripping of vegetative cover from common lands accelerates erosion and further reduces agricultural production, until even the bare subsistence needs of farm families cannot be met without selling off landed assets and property. Faced with no further options after all assets have been lost, the pauperised farm family migrates into other occupations and eventually to urban areas to swell the ranks of the assetless urban poor.

What would be the appropriate property right arrangements to manage natural resources like forests has been a source of major debate in the resource economic literature? The research on property rights has been mainly concerned with who should hold the rights to a resource, or what property rights arrangements will best manage the resource in the short and long run? As a consequence, mainstream economists seemed to have concentrated on two contrasting forms of property rights as far as natural resource management is concerned, namely, private property and open-access property. The result of this debate was the emergence of the dominant view that ownership of such resources by the government would help resolve the problems, where it is impractical to establish private property (Gibson^{lxxxix}, 2002). Alternative models of property rights, in which the community acts as conservation's caretaker of forests, were usually regarded as archaic and illogical. As a consequence the access is restricted to people who have historical rights over those resources; which, for most intents and purposes are rural poor communities in the locality.

2.8.2 Property rights in Forests – A Digression

It would not be inappropriate here to discuss property rights in forest since the central focus of our study is forest as a CPR. There is no adequate information on the evolution of property rights in forest history. Before man settled as cultivators, the nomadic society did not recognise land as property. Even when they settled on it, it was only the cultivable lands and farms that constituted landed private property, the rest were either nobody's property or collectively owned under some community arrangements. The former evolved in natural resource literature as open access resources, which could be accessed without any hindrance. The latter came to be known as the common property resources. Such community ownership of natural resources debar a non-member from entering or accessing the resource, while the produce of the resource was shared according to some principle established by customary rules.

Traditionally, people enjoyed the right to hunt in forests. However, this was restricted when forests came to be reserved for game hunting by the royalty. It appears that exclusive private property rights in forests came into existence only in the later Roman period when forests were kept aside for hunting purposes (Fernow^{xc}, 1911). State forests find mention in German "Grenzmarken" or frontier forests, which were reserved to form a barrier and defence against enemy invasion. Such frontier forests were also used by Greeks, Romans and Indian rulers to designate the limits of agriculture settlement. While timber cutting was prohibited in reserved forests by a state proclamation, cutting of timbers in holy groves was forbidden as it was

considered nobody's property and kept aside for religious use (*res sacra*) (*ibid*: 15). With the spread of Christianity the emperor assumed ownership of all lands and forests that were set aside for religious use. For almost one thousand years in Europe (i.e., between the fall of Rome to the fall of Constantinople), the dominant view was that ownership of all produce of earth is vested with the Church and the Emperor as representatives of God on earth for common good. It was thus argued that sanctity of private ownership comes from the state and hence a privilege bestowed by the state to individuals.

This view came to be seriously challenged and it was argued that the achievement of common good (public welfare) was not antagonistic to private ownership of resources. In Great Britain the advocates of *laissez faire* were against all government interference for the public welfare. State ownership of forest was thus objected and State Forestry in Great Britain could not make a beginning before 1920 much later than it was introduced in its colonies.

2.9 Dilemma in Common Property Resource Management

Justification of property rights rests on those basic values which are being furthered by that institution itself. While the libertarians concern for rights to natural resource is grounded in the domain of distributive justice especially in the context of moral property rights (Steiner^{xcii}, 2009). The neoclassical position on property rights is often claimed to be based on their interpretation of Locke's position on property rights (Henry^{xciii}, 1999). Their argument is based on individual rational behaviour, maximizing self-interest, and equilibrium outcome (Hahn^{xciiii}, 1984), which is independent of any underlying set of social relations and institutions. Such abstraction was considered necessary to understand individual economic behaviour in isolation, devoid of all social interactions (Knight^{xciv}, 1960). Individual pursuit of self-interest would not only ensure efficiency in resource use but also maximise society's welfare through acquisition of nonattenuated property rights. But this was not the position of Lock vis-a-vis property rights. He considered that all interactions in a society were guided by natural law in which certain moral values are to be enforced. Thus property rights had to conform to a larger morality, and property holders have a social obligation that transcends "Paretian Optimality" in resource use as envisaged by market.

The mainstream economics thus became an "amoral" science (if it be science at all?) in its pursuit of wealth maximisation. Lionel Robbins^{xcv} (1932) has been criticised for putting economics in the realm of ascetic positivism. His intention was to make economics immune to ethical principles, but it also had an unintended consequence of making it immune to

common sense as well. As a consequence economics have steered off-course towards a value-free discourse in the name of "science" for mere objectification of facts (Putnam,^{xcvi} 2003). Neoclassical economics in search of equilibrium (*optimality*) have put their faith in individual rationality (*self-interest*) free from all social relationships (Hahn, 1984; Knight, 1960; cf Henry^{xcvii}, 1999). They asserted that property holders who base their decisions on "social conscience" would yield sub-optimal results that damage not only their own interests, but also the interests of others (Friedman, 1972).

On the basis of the above argument, two types of property ownership has been generally prescribed as the most efficient regimes to manage natural resources; private property and also reluctantly the state property regimes. Common property regimes was never considered to be a practical proposition since people placed in a situation where everyone could gain from cooperation will be unlikely to do so in the absence of external forces. Therefore, the only alternatives would be private enclosure or nationalisation of resources (Wade^{xcviii}, 2003). The problem of CPR is that any rule of cooperation is likely to fail when individuals are sceptic about their rivals' intention, and thus free-rides, fearing that restraint on his part may not be reciprocated by others. CPR problems has been approached and analysed from different perspectives. Technologists have considered this to be failure or a drawback which arises due to lack of technological knowhow and hence prescribe technical solutions. Economists consider this to be a problem which arises due to the divergence between private and social benefits/costs. Divergence between social and private valuation arises due to presence of externality and economist's solution is therefore internalisation of the externality through correction of the market or creating a market for the resource (Pigou, Lindhal). Institutional look at CPR problem as failure of institutions. They recommend creation of appropriate kind of institutions and restructuring of property rights. Game theoretician finds situations which are similar to various types of game such as Prisoners' Dilemma, Assurance Game, Chicken Game, Tender Trap, etc.

Institutions governed by rules, norms, and formal hierarchies within the group that mould agent's behaviour and expectations (Heltberg^{xcix}, 2002). Institutions play important part in economic functions, helping to resolve situations with missing or asymmetrical information, facilitating and enforcing market and non-market transactions, encouraging cooperation and collective action and also reducing transaction costs (*ibid*: p. 190). Institutional approach has two distinct paths of analysis: (i) first, enquiring CPR problem on the basis of transaction cost

and imperfect information, and (ii) second, analysing the problem in the framework of collective action theory.

The transaction cost approach view institution to produce cost minimising response to transaction costs and imperfect information. The collective approach makes attempt to identify factors that are conducive in promoting collective action. To a certain degree analysts are sceptical about the role of collective action in management of natural resources. Mancur Olson^c (1965) has challenged the general view that group of individuals having common interests generally tend to work together to achieve their desired goal.

Streams of benefits that accrue from CPRs are mixed collective goods. These mixed collective goods cannot be provided relying entirely on voluntary contribution of the members. In practice it requires some sort of force to ensure that members not only contribute but contribute adequately for CPRs to exist. In a large group, each individual is too small an entity and by contributing or not contributing they virtually have no significant impact on the maintenance of CPRs, but they can share the benefits. This is what we generally refer to as 'free-riders' problem. If the group is large, transaction cost will be higher to bring the members together for any collective action. This is why large groups fail more frequently to provide collective goods to its members (Singh^{ci}, 1994).

Under this logic the collective action approach results in non-cooperation especially in management of natural resources at the local level where individual adherence to the rule is largely voluntary and their contribution difficult to monitor. This is analogous to the well known Prisoner's Dilemma situation which is a non-cooperation game where the players cannot communicate freely. The "dilemma" in natural resource management as described above does not imply that at the local level community arrangement for resource management has never met with success. There are plenty of examples of successful community management in various case studies undertaken in the developing countries. Over the years researchers have developed the reservoir of analytical tools to understand the complexities involved in use of natural resources, game theory is one such framework.

2.10 Natural Resource Management and Game Theory

Game theory captures the essence of uncertainty in outcome in a strategic situation where the outcome varies considerably with change in rule of use of the resource. Game theory has generally been applied to many environmental and natural resource management problems simply because they involve strategic decision making, uncertainties in outcome and poorly defined property rights which are amenable to game theory approaches. Recent work on the

non-cooperative game theory focuses mostly on repeated games with asymmetric information. The premises of game theory are quite opposite to those in neoclassical economics such as equilibrium and perfect factor markets (Camerer^{cii}, 1991; Ostrom and Gardner, 1993). Game theory finds application in neoclassical economics to study oligopoly markets in which interdependencies among producers are assumed.

2.10.1 Collective Action and Prisoner’s Dilemma Game

The outcome of the game theoretic models depends on (a) set of institutional rule and (b) on the technical and physical characteristics of the CPR. The classical-game models do not distinguish between a game and its rule, though this axiomatic form has served game theory successfully over the years. But such form fails to explain the CPR problem and hence a separation of the rules and game is required (Gardener *et. al.*^{ciii}, 1987; *cf.* Singh^{civ}, 1994, p. 38). Moreover, an additional distinction between institutional rules and regularities present in the physical characteristics of the CPR is also required to model a game and analyse the outcome properly. Therefore, if we study CPR with same physical characteristics under different institutional rules, then there will be different game models and different outcomes. Similarly, same institutional rules applied to different resource regimes shall produce different game structures and different equilibria.

Therefore, different game theoretic models have been formulated to analyse the CPR problem, for example, Prisoners’ Dilemma (PD) game (Campbell, 1985; *cf.* Singh, 1994); N-Person Commons Dilemma Game (Dawes, 1973, 1975; *cf. ibid*); Assurance Game (AG); Chicken Game etc. Among these, the non-cooperative Prisoner’s Dilemma game is commonly used to study collective action in CPR. Though free communication with each other is restricted, each player is fully aware about the structure of the game tree and payoffs attached with each outcome. Players also have a dominant strategy, implying that each player is better off choosing their dominant strategy.

The pay-off matrix of the PD game is shown below:

Figure 2.1: Two Person Prisoner’s Dilemma Game

		<i>Player B</i>	
		<i>C</i>	<i>B</i>
<i>Player A</i>	<i>C</i>	5,5	-1,10
	<i>D</i>	10,-1	0,0

Source: Baland and Platteau, (1996)

Analogous to confess and not-confess in standard PD games, the PD games as adopted in natural resource management model considers that the two alternative strategies available are to cooperate (C) or to defect (D). PD model of strategic behaviour poses an obvious problem since the outcome in this model is non-co-operation. If we assume that a player commits to co-operate (which is an irrational behaviour at least in this model), the other player will still continue to free-ride. In other words, both players have an incentive to violate such agreement of co-operation. Here the (D,D) strategy is obviously Nash equilibrium but Pareto sub-optimal.

Ostrom (1990), Runge^{cv} (1986) and others have shown that local institutions along with customs and social norms has helped to overcome the difficulties in collective action and ensured efficient use of resources. The limited applicability of the PD game model thus require further improvement of the PD model so as to enable us incorporate appropriate conditions where non-co-operation would no longer be the optimal outcome even under the basic framework of the PD game (Baland & Platteau, 1996: p. 57).

2.11 Are CPRs doomed to fail?

Having considered the three game theoretic models^{cv}(PD,AG and CG) in collective action analysis the common issue in all of them has been free-riding. This has a serious implication for resource management involving local community. Even if an agreement is reached to develop rules for management the problem will not be resolved because no one has an incentive to follow the rule. The natural outcome to this debate is then that the enforcement of the rule requires an external agency, i.e. either private control or state control. However both privatisation and state control has not served as a panacea for resource conservation, as we shall soon find out.

According to Jodha, privatisation of common land under land reform policy was just not conferment of ownership to a parcel of land but also disentanglement from the CPR, which has caused faster deterioration of the native resource (Jodha,^{cvii} 1994). Parcelling out of natural resources to multiple owners may not be cost effective, as the direct cost of transferring ownership and defining it may be too high for the local community to bear (Runge, 1990). Added to this direct cost is the cost imposed on the society due to wrong distribution of the right itself. Privatisation may be in favour of the elite section of the community (Jodha, 1986) and it may marginalise people forcing them to increase the intensity of resource use and hence further deterioration of the resource may result from such privatisation.

The other alternative exogenous arrangement suggested is state control. Ostrom (1990) was of the opinion that the cases for state control is based on the government's ability to acquire full information about the resource, ability to device appropriate policy, ability to implement the policy, ability to monitor and penalise at a zero administration cost. The truth is far away from this, and state ownership has resulted in loss of resources overtime (Arnold and Campbell^{cvi}, 1986).

The state control is practically flawed because the decision-makers are far away from the site of the resource as well as lack knowledge about the local ecology (Dasgupta and Mäler^{cix}, 1994). Their use-decisions are usually based on short time horizon and more often than not such decisions are influenced by interest lobbies having strong political clout. Thus there is little justification for state ownership of resources.

2.11.1 The Case for CPR

The case for CPR is based on the critique of the models of collective action. The Prisoners Dilemma variant of the game analysing the problem is based on the assumptions that, (i) no communication between players and their decision is independent of their rival's choice, and (ii) the game is a one-shot game which means players cannot revert their decision later when they find what other players have chosen. The assumptions are best summarised in Ostrom's (1990) own words: "they are useful for predicting behaviour in large-scale CPRs in which no one communicates, everyone acts independently, no attention is paid to the effects of one's action, and the costs of trying to change the structure of the situation are high" (p. 183). On the other hand if the players know that the game will be repeated then cooperation may be the best strategy, hoping that the other players will also reciprocate positively to such good gesture (Wade^{cx}, 1987).

If we assume that the PD game is repeated, then it creates what is generally known as (PD) super game that enables us to arrive at co-operative equilibrium. Repetition of the game does not necessarily yield higher average payoffs to the players than the corresponding one-shot game (Myerson, 1991 *c.f.* Baland & Plateau, 1996: p.57). Under this new game framework, co-operation between players occur as repetition of the game over an infinite time horizon giving rise to uncertainty about other strategies, that is, information is incomplete.

Fig. 2.2 A repeated PD game

		<i>Period 1</i>				<i>Period 2</i>	
		<i>Player B</i>				<i>Player B</i>	
		<i>C</i>	<i>D</i>			<i>C</i>	<i>D</i>
<i>Player A</i>	<i>C</i>	5,5	-1,10	<i>Player A</i>	<i>C</i>	5,5	-1,10
	<i>D</i>	10,-1	0,0		<i>D</i>	10,-1	0,0

The following need to be considered in detail:

1. The above example given in figure 2.2 shows that when the game has a finite length, non-co-operation is the unique equilibrium outcome. If we consider two period game then each player has two options: either to co-operate or defect in first period as well as in the second period. The move opted by players in second period is conditioned by the outcome of the first period, and this shows that a strategy is a plan of complete action over the whole game.

If in the first period player *A* makes an initial move by co-operating, he will also co-operate in the second period provided player *B* has co-operated in the first period or defect if player *B* has not co-operated in the first period.

“Backward induction argument”, PD game repeated over a finite period T : player realise that co-operation in period $T - 1$ does not ensure co-operation in period T . So they defect in period $T - 1$, by backward induction argument, co-operation in period $T - 2$ will not ensure co-operation in period $T - 1$. So unconditional defection at all periods is the equilibrium strategy of this game

2. But what happens when the time period is infinite. In this case we cannot apply the “backward induction argument” because there is no last period from which to reason the way we did in above paragraph. If the period is infinite co-operation is worth a try because of the ‘tit for tat’ strategy based on the following principles:

- (a) Start by choosing to co-operate;
- (b) Thereafter choose the strategy in period t what the other player choose in period $t - 1$.

		<i>Player B</i>	
		<i>C</i>	<i>D</i>
<i>Player A</i>	<i>C</i>	$b - c, b - c$	$-c, b$
	<i>D</i>	$b, -c$	$0, 0$

Fig. 2 A 2×2 symmetrical PD game.

From figure 2 given above, c may be considered as the loss of utility when a player co-operates while the other(s) free rides; b is the utility gained by a player when the other player co-operates and $b > 0, c > 0$. So when both player co-operate the pay-off for both is $b - c$ and when they defect the pay-off is zero. Here we assume that $b > c$, so the players gain more from joint co-operation than under joint defection. The game is played repeatedly and non-anonymously enabling each player to gather experience of their rivals' behaviour. It is assumed that players ignore whether they are interacting for the last time, this means that game horizon is finite but they do not know about the end of the game. Let π be the probability that, after each round the game would be carried over to the next period. This assumptions offer a valid description of the way human interaction works in many small group settings.

Simplifying let us consider the strategy to be a plan to play the whole extended game. Two possible strategies are- unconditional co-operation and unconditional defection, the former meaning co-operating in every round and the latter meaning defecting in every round irrespective of their rival's behaviour. Unconditional co-operation cannot be an equilibrium strategy, because if A knows that B will always co-operate whatever he (she) does, then A will never have the interest to co-operate with B and B would be an eternal sucker S . As a result the only reply to S is strategy of unconditional defection denoted by N (for nasty). N is an equilibrium strategy because if A knows that B will always free-ride, there is no point in his (her) ever co-operating with B .

Another equilibrium strategy is precisely the simple tit-for-tat strategy (T), such strategy as we know is based on conditional co-operation or reciprocity. If two T - players meet, then continue to co-operate since both start by co-operating. If however, a T -player meet a N -player, the T - player will co-operate only in the first round; thereafter he will defect. This is because the T - players are not altruist^{cn1}: they will co-operate with people like them but avoid being suckers.

Following Baland and Platteau (1996), we consider that there are three possible counter strategies to T : T itself, N , and a new strategy A , where A consists of defecting in odd-number rounds and co-operating in even-number rounds. It can be shown that one of these three strategies must be a best reply to T . The expected utility derived from playing each of these strategies against T is given as:

$$E(T, T) = (b - c) + \pi(b - c) + \pi^2(b - c) + \dots$$

$$= \frac{b - c}{1 - \pi}$$

$$E(N, T) = b + 0 + 0 + \dots = b$$

$$E(A, T) = b - \pi c + \pi^2 c - \pi^3 c + \pi^4 c + \dots$$

$$= \frac{b - \pi c}{1 - \pi^2}$$

If $\pi > c/b$, we have $E(T, T) > E(N, T)$ and $E(T, T) > E(A, T)$. So when $\pi > c/b$, then T is better than N or A as a reply to strategy T . In other words, tit-for-tat is a better strategy and an equilibrium strategy: if the first player knows that the second player follows the tit-for-tat strategy, the most rational thing for the first player to do is adopt the same strategy.

Let us observe the condition $\pi > c/b$ more closely. If the game is certain to end after first period then $\pi = 0$, so the condition is certain to be violated. This brings us back to the one-shot PD game in which each player defects. If now the game horizon is infinite then $\pi = 1$, then the condition for T to be an equilibrium strategy is automatically satisfied (since by assumption c/b is less than one).

Application of game theory in understanding the CPRs is not without limitations. Repeated games have multitude of equilibria depending on the trigger strategy adopted, but the theory is unable to identify which strategy shall be chosen by the player. For example, when externality costs are not divisible then conflict in resource use will be an exception rather than a rule. This is similar to AG which is a cooperative game. This analysis suggests that if everyone in a group of collective owners is assured that a critical mass of others will obey a common property arrangement, then it is in each person's interest to do likewise. Range (1986) further identifies the following causes that assist in the emergence of a successful cooperation among resource users:

- (i) Generally, if community has low income, depends critically on the natural resource but faces high uncertainty over other resources, collective forms of management are likely to be more cost effective and efficient;
- (ii) More homogeneous the community, the greater will be the possibility of cooperation, since people will share similar economic goals and uncertainties as well as socially accepted norms of cooperation.
- (iii) Even in a heterogeneous community, if a crucial mass of the community unite to cooperate, communal property may emerge.

Common property regime may be the only viable choice when relative poverty is high, resource dependence is high, there exists uncertainty in resource use, and establishment of an alternative management institution involves high transaction cost. Also, free riding may not be a universal phenomenon in CPRs as sceptics would like us to believe. In fact, in the villages of the developing countries, social pressure is enough to keep people from free riding. Informal nature of social interactions results in high levels of interaction between people at rural level, which makes monitoring relatively easier by local communities. Therefore, it is suggested that we move out of the conventional 'either public or private' dichotomy (Lubna, 2002) and embrace common property regime as an alternative institution for successful resource management.

2.11.2 How to ensure that CPR works?

For CPRs to be successful in resolving the challenges associated with governing natural resources by local communities based on collective action, a number of factors have been identified by various scholars (Ostrom, 1990; McKean, 1992; Wade, 2003). They are- size of the group, homogeneity of the group, well-defined boundary of the common property and its users, ability to monitor and successfully exclude non-members, government recognition of the local community to organise. Ostrom (1990) has elaborated seven 'design principles' that characterize robust institutions, present in several cases of common property resources that she studied. Below in Table 3.1 we present the seven design principles of Ostrom.

Table 2.2 Design Principles Illustrated by Long-enduring CPR Institutions

<ol style="list-style-type: none"> 1. Clearly defined boundaries. Individuals or households who have rights to withdraw resource units from CPR must be clearly defined, as must the boundaries of the CPR itself. 2. Congruence between appropriation and provision rules and local conditions. Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material, and/or money. 3. Collective choice arrangements. Most individuals affected by the operational rules can participate in modifying the operational rules. 4. Monitoring. Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to appropriators or are the appropriators. 5. Graduated sanctions. Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offence) by other appropriators, by officials accountable to these appropriators, or both. 6. Conflict-resolution mechanisms. Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators
--

and officials.

7. Minimal recognition of rights to organize. The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.

Source: Ostrom (1990, p.90)

We must not exaggerate the role of CPRs because not all rural communities have such informal arrangements, but at the same time there is neither a general failure. In fact there is significant difference both across time and space in ability of the villagers to manage their collective resources. Several stylized fact has emerged from various case studies undertaken by scholars during the past couple of decades.

Firstly, it is related to the size of the community where reports suggest that smaller groups are likely to be more successful in managing CPRs, which is in conformity with Olson (1965) theory. Second, to ensure compliance of CPR rule, context-specific penalties in the form of fines in cash or kind, moral persuasion, and social boycott is used, in contrast to all-or-nothing trigger strategies as contemplated by game theoreticians (Ostrom, *et al.*, 1994). Third, collective action for resource management is more likely when the potential net gain is larger from cooperation (Wade, 1988). Fourth, imprudent external intervention in the form of nationalisation of forest undermines the role of local institutions governing natural resources (Bromley, 1991). Government intervention has generally led to degradation of the resource. Also, when external authority attempted to introduce new resource management institution without corresponding local legitimacy and credibility, it failed. External intervention by NGOs and other voluntary organisations have positively contributed to CPR management (Chopra and Gulati^{cxii}, 1988). Fifth, the presence of inequality within the group gives rise to distrust, which is both cause for suspicion, effective vigilance and cooperation, as well as cause for suspicion, conflict and break down of cooperation (Platteau^{cxiii}, 1992).

The high dependence on CPRs by the poor (Jodha, 1986; Cavendish, 2000) is largely due to the low opportunity cost of time, especially in forest communities where alternative employment opportunities are limited and migration is not an option due to low value of the social capital. Where yield from the resource is widely dispersed across time and space, CPRs also play the role of insurance where the risk is mitigated by pooling the resource. It is important to note that CPRs will not alleviate poverty, rather high dependence on CPRs are signs of poverty. Promoting CPRs will largely contribute to help mitigate fluctuations in the income of the poor. All these and also the possibility of conserving the natural resource make a strong case for CPRs especially in developing countries like India.

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