POVERTY, INEQUALITY AND NATURAL RESOURCE DEGRADATION:

AN INVESTIGATION INTO THE SMALL-SCALE FISHERY SECTOR OF SOUTH KERALA.

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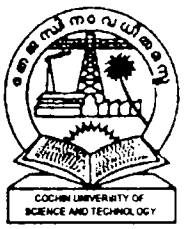

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Certified that the thesis entitled 'Poverty, Inequality and Natural Resource Degradation: An Investigation into the Small-Scale Fishery Sector of South Kerala' is a record of bonafide research work done by Shri R. Mahesh, in fulfilment of the Degree of Doctor of Philosophy in the Department of Applied Economics, Faculty of Social Sciences, the Cochin University of Science and Technology under my supervision. It is further certified that the thesis is not previously used for any Degree, Diploma and Associate Fellowship or for awarding other similar title or recognition.

D. Rajasenan
Supervising Guide

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CHAPTER - I
INTRODUCTION

The present study is an attempt to understand the link between natural resource degradation and poverty among people dependent on these resources. This is done by examining the impact of depletion of marine resources on the livelihood and socio-economic condition of the small-scale marine fishing community in South Kerala.

1.1 BACKGROUND OF THE STUDY

1.1.1 Dependence of poor on natural resources

Degradation of natural resources such as land, forest, marine and fresh water, bio-diversity, etc. threatens the livelihoods of people, especially the rural poor. The poor people depend mainly on these freely available natural resources for their livelihood and survival strategies. They fish from ponds, rivers and the sea, gather fuel wood from woodlands, forests and roadside trees, collect fodder, graze their animals and hunt in the forests. They also collect non-timber products like gums, resins, wild fruits and berries, etc. from forests. These resources provide them a range of goods for household use in various capacities as consumer durables, production inputs, and capital assets. They also perform an important safety net function and safeguard against exogenous stresses and shocks. Even when the poor have access to other resources, these natural resources provide a cushion to them during periods when income from other sources declines or becomes unavailable; and natural resources are sometimes the only asset to which the poor people have access (Shyamsundar, 2002). It is these groups that are the most impacted due to the declining natural resource environment, especially in the absence of any successful process of regeneration. According to the World Development Report 2000/2001, referring to Amartya Sen, "poor people live without fundamental freedoms of action and choice that the better-off take for granted. They often lack adequate food and shelter, education and health, deprivations that keep them from leading the kind of life that everyone values. They also face extreme vulnerability to ill-health, economic dislocation, and natural disasters. And they are often exposed to ill treatment by institutions of the State

and society and are powerless to influence key decisions affecting their lives" (World Bank, 2001). In this present study an attempt is made to understand the way in which natural resource degradation affects poor people with special reference to small-scale marine fisheries of Kerala. Before discussing the link between natural resources and poverty, it is necessary to discuss the concepts of natural resources and poverty.

1.1.2 Concept of natural resources

Classical economists used land as a generic term to describe natural resources. Broadly defined natural resources include all the 'original' elements that comprise the earth's natural endowments of the life support systems: air, water, earth's crust, radiation from the sun, etc. The natural resources may be broadly classified into 'renewable resources' and 'non-renewable resources'. Renewable resources are natural resources capable of regenerating themselves within a relatively short period provided the environment in which they are nurtured is not unduly disturbed, e.g. fish, forests, soil, etc. The renewable resources are further classified into biological and flow resources. (Examples of flow resources are solar radiation, wind, tides and water stream.) Non-renewable resources are resources that exist in fixed supply or are renewable only on a geological timescale, where regenerative capacity can be assumed to be zero, for all practical purposes. These may be classified into recyclable (e.g. metallic minerals) and non-recyclable (e.g. fossil fuels). The term 'environment' generally means a natural resource base that provides sources (material, energy, resources, etc.) and performs as a sink functions (such as absorbing pollution). The term also includes resources that people have relied on and no longer do so, either because the resources are depleted or because they have been replaced by some other resource or technology (Bucknall et al., 2000).

In economic analysis, the difference between a natural resource and an environmental resource lies primarily on the focus of analysis. In natural resource economics, the emphasis is on the inter-temporal allocation of extractive non-renewable resources and the harvest of renewable resources. In other words, natural resource economics is mainly concerned with rates of

exhaustible resource depletion and the determination of optimal harvest rates for renewable resources. Environmental economics, on the other hand, focuses on pollution; and the primary focus is as how to use or manage the natural environment as a valuable resource for disposal of waste.

What does environment degradation mean? The term 'degradation' can be interpreted in different ways. As a working definition the term 'environmental degradation' can be used to imply (i) depletion (the damage to a natural resource system, which affects present or future human needs negatively) and (ii) pollution (leading to a damage to human health or decline in the capacity of the environment to sustain natural systems). Environmental degradation is a sub-set of environmental change.

The main causes for natural resource degradation are (i) market failure, (ii) policy failure, (iii) institutional failure, and (iv) population growth. Market failure happens when clear or values for natural resources do not exist or when markets function poorly or distorted relative prices result in miss-allocation of resources, excess resource exploitation and subsequent degradation by private and public users. Policy failure manifests itself when inappropriate government policies, or absence of required policy result in market distortions for natural resource use, aggravated market failures, and natural resource degradation by private and public users. Institutional failure takes place when a country lacks the necessary government structures, environmental legislation and regulations, or when a decline in traditional land-use management processes result in natural resource degradation. Population growth intensifies pressure on the land base in excess of its carrying capacity. Population growth is commonly cited as a major contributor to environmental degradation on the ground that it leads to increased consumption and higher demand for natural resources.

1.1.3 Poverty and natural resource degradation

The link between poverty and natural resource degradation has been the subject of many studies, most of them relating to rural livelihoods. Poor people depend for their livelihood, on various activities which include farm and non-farm activities, petty trade, wage labour, etc. Majority of them, especially those

in rural areas, tend to depend on natural systems, directly or indirectly, for income generation, subsistence and shelter. Therefore, a declining resource base affects their well-being and in turn some times forces them to degrade the environment resource base even further. It is widely hypothesised that there is a spiral or circular relationship between poverty and environmental degradation. In other words, the hypothesis suggests that environmental degradation leads to poverty which in turn leads to further degradation. Some authors argue that poor people extract more natural resources and cause greater environmental degradation than others due to excessive reliance on the natural resource base and the placing of high discount rates on future returns. On the other hand, there are several studies which point out that since poor people depend more heavily on a limited natural resource base, they attach greater value to its conservation and so have developed sustainable management strategies (Reddy, 1999). Poverty is sometimes associated with environmental degradation; but there does not necessarily exists a direct causal relationship between the two. The poverty trap thesis implies that the poor lack the ability to forgo present subsistence in favour of savings for future consumption or environmental quality. This handicap coupled with their high degree of resource dependence, leads to preoccupation with short-term results, thus generating environmental degradation (During, 1989). However, there is little empirical evidence to conclude with certainty the causative link. Some cases support the theory; others disprove it.

The present study is an attempt to examine the impact of natural resource depletion on the livelihood of the poor in the small-scale fishing community in the case of the coastal fishery sector of Kerala. There exists little empirical evidence on the nature and extent of poverty in these communities and on the relative importance of different causes of poverty.

1.1.4 Resource degradation in open access fishery

The depletion of marine fishery is a phenomenon experienced the world over and many people are concerned about this phenomenon. Several causal factors underlie it. Economic considerations and the existence of an open access fishery, may presumably provide a possible causal link.

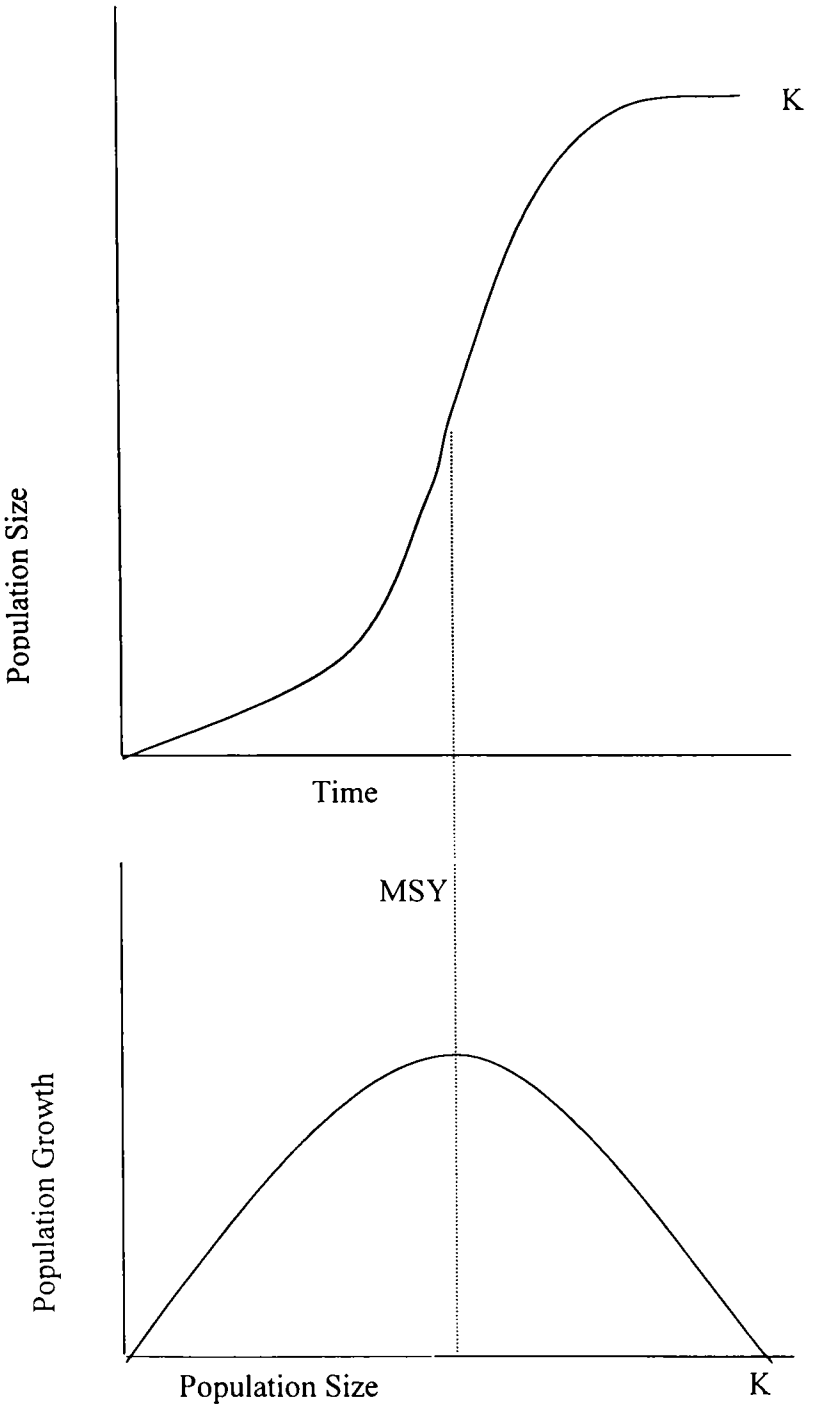
The economic theory of fish resource exploitation has been built up on the basis of relatively simple biological and economic models[1]. One of the biological models is known as the Schaeffer growth model developed by Schaefer (1954). The model postulates that the growth of a stock of fish depends on the size of the standing fish stock. At a small size, the growth rate is small, but it increases as the stock becomes larger until a point is reached beyond which growth declines with further increase in stock. This implies an inverted U-shaped curve as shown in the lower panel of the Figure 1.1.

The curve in the upper panel of figure 1.1 is the logistic curve, which shows the size of the population at different points of time. The implication is that in a stable and unmanaged ecosystem, over time, the biomass of the fish population tends to rise towards the definite maximum size of K, which is the carrying capacity that can be supported in a particular area. It also shows that because of the self-regenerative capacity, within certain limits, it is possible to harvest the resources while maintaining the size of the underlying population. As shown in the upper panel of the Figure 1.1 the maximum productivity corresponds to the inflection point on the population growth curve.

Fishing effort is introduced into this model in the form of human intervention causing fishing mortality in addition to natural mortality. It follows that there exists an inverse relationship between fishing effort and the size of standing stock. When this relationship is looked in conjunction with the relationship between natural growth and stock, we obtain an inverted relationship between effort and growth. Since sustainable catch exactly equals the growth at the corresponding level of effort, the sustainable catch-effort relationship is identical to the growth-effort relationship. In the initial stages of exploitation of fishery, expansion of effort brings about more or less proportional increase in catch; but as effort expands the rate of increase of catch declines, until a point referred to as the maximum sustainable yield (MSY) is reached, beyond which additional effort reduces sustainable catch.

[1] During the fifties, the fundament of modern fisheries research was laid by the biologists Schaefer and Beverton and Holt, and by the economists Gordon and Scott (See Schaefer, 1954; Beverton and Holt, 1957; Gordon, 1954; Scott, 1955). Gordon's seminal paper still provides the essentials for understanding the problems with fisheries. The model he developed, based on the logistic growth model extensively used by Schaefer, is commonly referred to as the Gordon-Schaefer model.

Figure 1.1 Logistic Curve and Schaefer Curve Illustrating the Formulation of MSY



Fishing takes place because fishing is profitable to fishermen. In considering the effect of fishing on a stock of fish, it is necessary to examine the economics of fishing from two points of view: first the economics of the whole fishery, i.e. the economics of the industry and secondly the financial consideration of the individual fishermen, i.e. the economics of the firm.

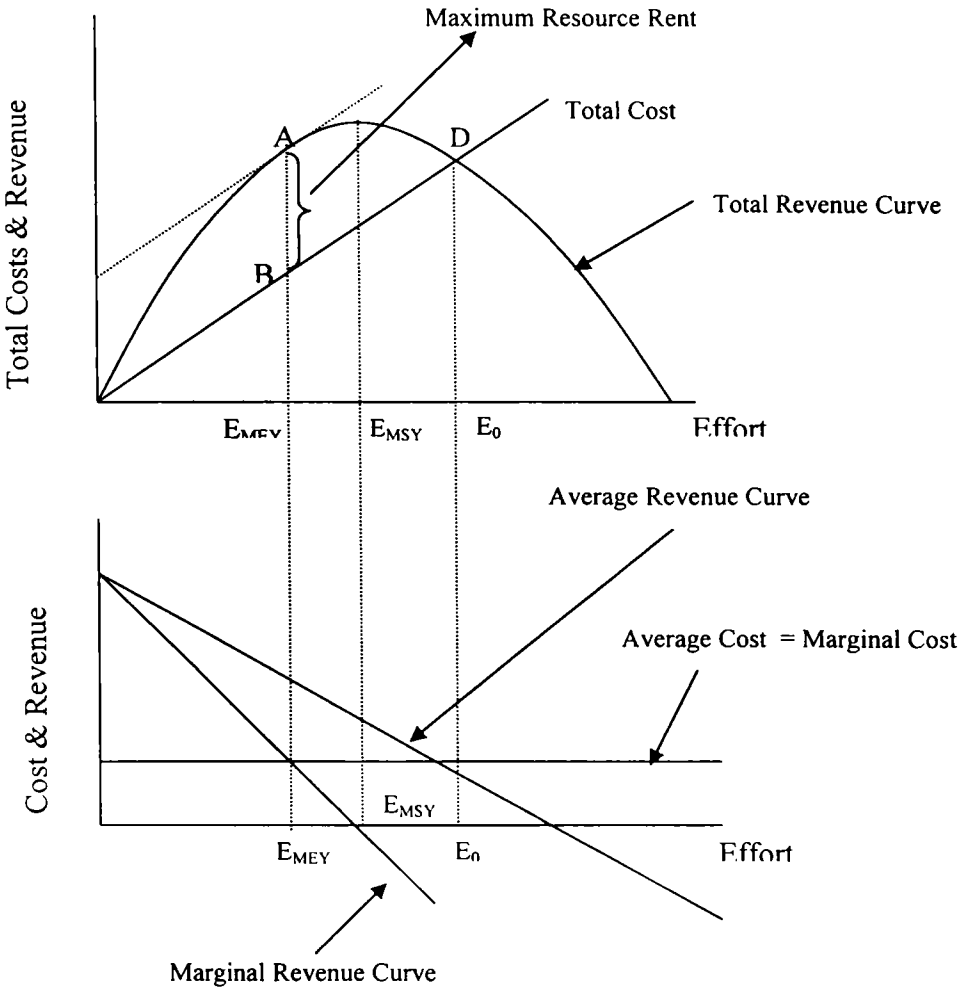
Figure 1.2 is a standard figure for explaining the economics of fishery exploitation as developed by Gordon (1954). As in most economic models, it is assumed that price of fish remains constant, the cost per unit of fish caught remains constant for all quantities caught, there exists a single species fishery and finally fishers operate in perfect competitive conditions.

Under these assumptions, the total revenue (TR) curve has the same shape as the sustainable yield curve given in Figure 1.1. Assuming a constant average cost per unit of fishing effort, the total cost (TC) is graphed as a straight line as given in Figure 1.2. Putting revenue and cost together, we obtain a complete bio-economic model, in which the net economic yield or resource rent is obtained as the difference between total revenue and total cost. The maximum resource rent is obtained at E_{MEY} level of effort where the marginal revenue of effort equals the marginal cost of effort. This level of effort however, is not tenable in an unregulated open access fishery, and gravitates towards a much higher level of effort at E_0 where all resource rent is dissipated.

Under an open access regime, access to the fishery is unregulated and is free and open to any person who has the capability and the desire to harvest. Its exploitation will then result in over-fishing and the resource rents will dissipate over a period of time[2]. The free access equilibrium is then reached at E_0 where total cost is equal to total revenue, that is at point D in Figure 1.2.

[2] Resource rent, defined as the surplus value over and above the opportunity cost for all the factors of production, arises from the ownership of, or access to, a valuable resource in limited supply.

Figure 1.2 Resource Rent in Open Access Equilibrium



Fisheries in the open access system is a classical example of a common pool resource (CPR) that can be exploited by anyone and is sensitive to over-exploitation. One of the methods of classification of resources followed in resource management is that of the properties of 'exclusion' and 'subtractability'. Exclusion refers to the degree to which access to the resource could be restricted. Subtractability deals with whether or not one person's appropriation of a resource reduces the availability of that resource for others

(Randall, 1983; Hussen, 2000). These two properties lead to the generation of a two-by-two typology of resource as given in Table 1.1.[3]

Table 1.1 Resource classification by subtractability and exclusion

Excludability	*Subtractability*	
	Low	*High*
Difficult	Public goods	Common pool resource
Easy	Toll goods	Private goods

As will be seen, the types of resources to which access cannot easily be denied are 'public good' and 'common pool resources' (CPR). The boundary between public goods and CPR is not, however, clearly fixed. This is due to the property of subtractability cross-cutting the four types of goods. Public goods are considered low in subtractability, while by definition CPR is high in subtractability. Marine fishing which supports a few fishers using traditional fishing methods, has almost no subtractability. The commons is then a public good. However, when the commons is appropriated by a large number of fishers and that also using modern fishing technology, it becomes unequivocally a CPR. The difficulty of exclusion (referred to as the free rider problem) combined with high subtractability can lead to the CPR dilemma referred to as Hardin's (1968) 'The Tragedy of Commons' if no effective mechanisms exist to regulate access to the resource and its use[4]. Gordon's (1954) basic argument is that in an open access fishery, resource rents will dissipate over a period of time.

In short, open access regimes result from the absence of well-defined property rights. Access to the resource is unregulated and is free and open to everyone (Feeny et al., 1996). Rent is completely dissipated at open access equilibrium.

[3] There are other classifications of resources that have different problems and appropriate solutions.

[4] When Gordon (1954), Scott (1955) and Crutchfield (1956) found that the core problem in fishery was open access and that many stocks were in serious decline, their recommendation was to restrict access.

1.2 STATEMENT OF THE PROBLEM

Kerala State with a coastline of 590 kms has plenty of marine resources with a predominance of oil sardines, mackerel, anchovies and prawns. The potential of marine fishery resources of the State within a depth of 200 m range is estimated at 7.51 lakh tonnes. (See Table 1.2)

Table 1.2 Marine resource potential of Kerala

Depth zone	*Area (Sq. kms)*	*Potential Resources (tonnes)*		
		Pelagic	*Demersal*	*Total*
0 – 50 m	15993	342000	229000	571000
50 – 200 m	23146	124000	56000	180000
0 – 200 m	39139	466000	285000	751000

Source: Dept. of Fisheries, GOK, 2002

The fishing activity in the marine sector, however, is largely concentrated in the inshore areas within a depth range of 0-50 m. Against the optimum sustainable yield of 5.7 lakh tonnes, the fish landing from this inshore area is now around 6.0 lakh tonnes thus leading to a resource depletion crisis Govt. of Kerala (GOK, 2004). In Kerala, the marine fishery sector is *de jure* under state ownership, but *de facto* it is unregulated and is open access in nature. Against this background, the development programmes undertaken by the government in the sector, which included modernisation of country crafts, popularisation of new generation crafts, and subsidised distribution of suitable complements of fishing gear, have led to an enormous increase in fishing pressure. Increase in fish prices due to increased demand both in the domestic and the export markets, has also promoted large-scale investments in craft, engine and gear leading to over-capitalisation. High price and high demand for prawns in foreign market are responsible for the anarchic growth of the number of mechanized boats in Kerala (Rajasenan, 1987). The fishery resource forecast based on 'auto regressive moving average' (ARMA) shows stagnation with reference to most of species in Kerala (Rajasenan, 1987). The enormous increase in the number of fishing crafts especially in the number of motorised country crafts and the use of ring seine, a prohibited fishing gear, are considered to be the main causes of resource depletion. Indications are that large potential resource rents are lost in fisheries because of over-fishing.

Marine fishing is a traditional activity of certain communities in the coastal area of the State. It is estimated that in Kerala about 8.4 lakh fisherfolk depend on marine resources for their livelihood[5]. Modernization ideologies in the early sixties aimed at increasing the extractive capacity of the fisheries sector and access to investment funds, led to a dualism in the form of coexistence of large-scale mechanized fisheries side-by-side with small-scale artisanal fisheries. In the years that followed the rapid expansion of the mechanized sector cut into the harvest of artisanal fishermen. The artisanal fishers responded to the new developments by going in for motorising their country crafts. The expansion of motorisation was very fast; and in order to cope with intensive competition new types of gears like ring seines were also introduced. Of the initial stages while these changes enabled the fishermen to fish more efficiently and to expand their activity space, the continuation of the process led to stagnation in fish production. Further, with about 50 percent of the fish output cornered by the large-scale sector and another 40 percent by operators of large seines in the motorised sector, traditional fishermen especially those in the non-motorised sector found themselves marginalized (Yohannan *et al*, 1999). As more and more fishermen motorised their crafts, fishing pressure increased on the limited fishery resources, which led to resource depletion. Individual catches and income began to level off and non-motorised operations lost ground. At the same time, increasing cost of operating motorised crafts reversed their initial advantage over the non-motorised crafts. The income distribution has thus become highly skewed since the mechanized trawlers and those using large seines account for only a small percentage of active fishermen.

It is believed that with modernization of fishing technology, economic and social stratification and inequality in the fishing communities have increased. The costs of resource degradation are disproportionately borne by the poor who are the primary users of the commons and environmental resources. For many fisherfolk in the small-scale sector, daily earnings from fisheries are low, fluctuating and often uncertain, affecting their livelihood security. For them

[5] The sector provides direct employment to 1.8 lakh active fishermen during 2001-02 (GOK, 2004). The population figures are estimates provided by the Directorate of Fisheries, Government of Kerala.

outward movement to non-fishing activities is difficult because of lack of knowledge of opportunities and lack of skills. To understand their plight, poverty has to be seen not only as income-poverty, but also in its wider sense to encompass low levels of achievement in education, health, sanitation and socio-political status. Some anecdotal evidence exists to show that fishing communities have above-average poverty rates, but few hard data and analyses are available on the nature and extent of poverty in these communities, and on the relative importance of different causes of poverty and on the most effective actions to alleviate poverty (FAO, 2001). The real benefits of fisheries development policies followed by Government and the general trends of economic growth do not seem to have reached the people in the lower strata of the fishing community. In order to evolve policy initiatives for sustainable improvement in the living conditions of the fisherfolk, it is essential to have a clear understanding of the nature and extent of poverty in all its different dimensions and also to find out its causes and consequences.

1.3 REVIEW OF LITERATURE

In this section we present an overview of poverty-environment linkages, poor peoples' dependence on common property resources and concepts of poverty and inequality, and its measurement based on the available theoretical literature as well as empirical studies carried out in different parts of the world.

1.3.1 Environment and natural resources

Natural resource and environmental degradation, and the resulting economic and social impacts are often viewed as a problem unique to developing countries. Deforestation, soil erosion, siltation of rivers and urban pollution are serious barriers to sustainable development in most of the low income countries of the world. However, degradation of natural resources and the environment is common to some degree throughout the world, across different economic and political systems and touching both the rich and the poor countries.

Natural resources, both renewable and non-renewable play a central role in the development of an economy. Renewable resources naturally regenerate themselves within reasonable time. These resources include forests, fish,

wildlife, water, agricultural crops, and even soil. Stocks are not fixed but can be increased or decreased. Renewable resources take many forms. Some, like forests, can be stored in the sense that the harvesting decision can occur at various times over the life of a stand of trees. Economics can help producers understand the optimal age to harvest a forest. Property rights in forestry for managed commercial stands are often efficient. Other renewable resources such as communal forests and fish however, tend to occur under less efficient property rights regimes. While biological growth functions in the case of both forests and fish are basically similar, the economics of their harvesting are slightly different from each other.

A major question relating to natural resources of a region is: how long and under what conditions can natural resources continue to support economic and social development? If natural resources are managed properly, they can contribute to development over an extremely long time period; some would argue for an indefinite time period. One among the major causes for natural resource degradation is the intervention of human activity in natural systems. Most human activities comprise the transformation of resources into products and services that are useful to human beings. Despite the income level and the stage of development, any economic activity would alter the state of the environment in one way or another and has the potential to cause a number of negative impacts in the form of unsustainable depletion of natural resources. Thus, degradation of natural resource bases is having a substantial negative externality impact on developing economies. It is apparent that the intensity of suffering of the poor from the adverse impacts of environmental shocks is much higher than that of rich. Owing to lack of proper assets, the poor are less capable of coping with those impacts.

All over the world, in the course of economic growth and development, the nature, the content and the quality of environment undergo changes. This environment-economy nexus is of great concern to all societies. The manner in which these two are related to each other is also a question posed by development thinkers. Based on a similarity between an inverted U shaped curve developed by Simon Kuznets (Kuznets, 1955) showing how income inequality changed as per capita income in a country increases, Panayotou

(1993, 1995) noted the similarity between the two patterns and it is considered. It was probably Panayotou who first coined the term 'Environment Kuznets Curve' (EKC) as in environmental studies. Panayotou investigated the EKC hypothesis for sulphur dioxide, nitrous oxide, suspended particulate matter and deforestation. All the fitted relationships were found to be consistent with the EKC hypothesis. This relationship was also explored by Stern et al. (1996) who also critically reviewed the literature on the existence of meaningful EKC relationships.

'Environmental Kuznet Curve' shows how environmental quality or pollution change with changes in income in a country. The interpretation of EKC is that an increase in economic activity is accompanied by deterioration in environmental quality, but that beyond a turning point, as income increases the demand for a cleaner environment reduces the level of pollution.

Recently, many studies have made evident the existence of an inverted U-shaped relationship between environmental quality and per capita income level (See Torras and Boyce, 1998; Grossman and Krueger, 1996; Beckerman, 1992). Data analysis seems to demonstrate that in the early stages of the economic growth process (the transition from agricultural to industrial society), environmental quality falls, but then, as income exceeds a threshold level and the economic structure moves from industry to services, it starts to rise. However, it is worth noting that rural environment, urban centres, and industrial location face quite different environmental problems. Rural population is more concerned with the use, control, accessibility, and management of natural resources. The problems in urban centres relate much more to air, water and noise pollution, and waste disposal (sewage and solid waste) (Ahmed, 1995).

Environmental conditions often have a major influence on the livelihoods, health, and security of poor people. It is widely accepted in the literature that natural resources are crucial to the routine functioning of poor households providing them sources such as materials, energy and water as well as performing sink functions such as absorption of pollution. These items could be public or semi-public goods such as open access watersheds or common property grazing lands; or private goods such as air inside a house or

household drinking water. It is often stated that poverty and environmental degradation are intimately connected, so that poverty is seen as both a cause and an effect of natural resource depletion, in a downward spiral. If the environmental resource remains a common pool resource in nature, the tendency to become degraded is all the more strong.

1.3.2 Poverty-environment linkages

In the late 1980s, the World Commission on Environment and Development (WCED, 1987) known as "Brundtland Commission" drew attention to some important links between increasing poverty and environmental degradation. The report pointed out that "many parts of the world are caught in a vicious downward spiral: Poor people are forced to overuse environmental resources to survive from day to day, and the impoverishment of their environment further impoverishes them, making their survival even more difficult and uncertain" (WCED 1987:27). This hypothesis was later called as the "poverty-environment hypothesis" and was presented by the Brundtland Commission in the context of making proposals for "Sustainable Development" (SD).

The poverty trap thesis specifies a circular or a spiral relationship between poverty and environmental degradation; in other words, it suggests that environmental degradation leads to poverty, which in turn leads to further degradation. It is widely viewed that poverty is the main cause of environmental deterioration, because the poor are not in a position to use natural resources sustainably (Duraiappah, 1996; Prakash, 1997).

"Environmental deterioration hurts the poor more than the rich" (Dasgupta, 1996; Kadekodi, 2001). In primary rural areas where people live in a local biomass-based economy it is plausible that environmental degradation or lack of natural productivity in the environment leads to poverty due to the lack of surplus, the thinness of markets, the absence of institutional developments, etc. However, the second aspect of the poverty trap namely that poverty leads to degradation has not been adequately demonstrated (Prakash, 1997). It is argued that environmental degradation is a negative externality whose causal roots, as well as solutions lie in institutional and policy issues rather than in poverty itself. There has been much controversy surrounding poverty-

environmental degradation nexus. However, a rising trend is in evidence in economic literature which disputes the conventional theory and argues that simple generalizations of this multidimensional problem are erroneous and that a more complex set of variables are in play (Leach and Mearns, 1995).

The actual effects of and responses to poverty-environment interactions for particular groups of poor people depend on three things. First is the availability of environment resources. Second, are the factors that determine the ability of different groups of people to gain access to and make effective use of environmental resources. Third, are the changes in environmental entitlements over time. Environment entitlements are one among several kinds of livelihood sources for the poor; they are especially important in their livelihoods, largely because of lack of alternative choices.

It is usually stated that environment is an income-elastic commodity. In the later stages of development, environmental quality improves because people become more environmentally conscious and can afford to build up political pressure for the enforcement of environmental regulations and for increasing budgetary expenses for the protection of the environment (Panayotou, 1995; Grossman and Krueger, 1995). The assumption is therefore that individual demand for environmental quality rises with income.

With the goal of better understanding of the relationship between poverty and common-pool stocks of natural assets, Gupta et al. (2005) investigated the extent to which rural households use and depend on common-pool natural resources for their daily livelihood. Using survey data collected from 550 households in 60 Indian villages, they estimated the contribution that natural resources make to rural household incomes. Like other previous studies, their also established that resource use increases monotonically with income. In their sample, poor households use fewer resources than do rich households. Unlike previous studies, however, it does not find that resource dependence necessarily decreases with income: poor households are not necessarily more dependent on natural resources than are the rich. Instead, they found evidence that dependence follows a U-shaped relationship with income: dependence declines at first but then increases with increase in income, especially in areas

where forests are abundant and grasslands are well stocked. This result suggests that households in rural areas do not turn to the environment only in times of desperation. Richer households, which tend to have broader sets of options to choose from to earn a livelihood, turn to the environment as a profitable source of income.

The study conducted in 29 villages of the Shindi ward in southern Zimbabwe shows that environmental resources account for roughly 35 percent of the average total household income and that the poorer the household, the greater is the share of income from environmental resources. However, even though the poor are more resource dependent, they generally use less of these resources than the better off. The poorest households use three to four times lower in quantity terms than the richest (Cavendish, 1999a). Cavendish also attempted to quantify the contribution of environmental resources to household welfare, where most standard household budget surveys omitted this source. His study showed that incorporating environmental income in household accounts resulted in dramatic and significant reduction in poverty by 50 percent or more than conventionally measured. (Cavendish, 1999b)

The study carried out by Cardenas (2001) deals with inequalities in the commons by drawing some lessons from two sources of field evidence from different regions and villages in Colombia. The following four sets of results emerged from the empirical evidence: i) land inequality increased the negative effect of population pressure over the conservation of the village commons; ii) lower exit options outside the use of the experimental commons induced greater cooperation by those with poorer private options and higher dependence on the conservation of the commons; iii) actual assets inequality in a group of experiment participants induced greater wealth distance which reduced the possibility of cooperation via self-governed mechanisms; and iv) familiarity with commons dilemmas and lower levels of private assets were associated with higher levels of cooperation in the experiments. The results provide some parallels and methodological complementarities that could contribute in a rather inconclusive way on the literature, and also a revisit to the relation between poverty, inequality, and conservation of natural resources.