

Population, Poverty and the Problem of Natural Resource Management

Dr Utpal Kumar De

North Eastern Hill University

The objective of the paper is to explore the interlinkage among the population growth, poverty and environmental resource use with special reference to North-East India.

Plethora of studies has been conducted and we find conflicting results from those studies. On the one hand, some of the studies concluded that there is an adverse impact of huge population growth on the management of natural resources and environmental conditions. On the other hand, some other studies concluded that population growth is not a problem rather it helps better management of natural resources and improvement of environmental quality.

The North-East India is one of the richest natural resource and biodiversity zone in the world and forest is the host of primary natural resources of the region. The region also recorded rapid population growth and higher incidence of poverty since independence, compared to other regions of the country. Hence the study is undertaken.

Data on population growth, incidence of poverty and changes in forest resources in terms of quantity as well as quality have been collected from the Census, Planning Commission and Ministry of Environment and Forests, Government of India.

After giving some critical review of some earlier studies, some flow charts are given to explain the population, poverty and environmental nexus and it is briefly explained. Also the explanation is given from the observation on the same all over the world. Then we explained the relation between population growth and changes in forest resources at all India level with the available data. Thereafter we have considered the changes in occupational pattern in North-East India and explained how the pressure on natural resources especially land and forest have been increased over time through tabular analysis. Finally, we calculated the correlation between changes in population and incidence of poverty and the changes in forest resources across the North-Eastern states. Also we compared the over time changes in population, poverty and changes in forest resources in the region. We have tested the results by statistical techniques. Then we analysed the results and tried to see whether any EKC type relationship exists or not.

The direct correlation between population growth and degradation of forest cover is not significant (0.05 only) across the North-Eastern states in India. But there is no doubt that population creates pressures indirectly on the resources as is reflected from the variation in per capita availability of resources, income, poverty and degradation. That is clear from the correlation between population growth during 1991-2001 and degradation in dense forest during 1989-99 in North East India, which is -0.51.

From the results we also observe that there is a significantly inverse correlation between the incidence of poverty and the degradation of forest. Also we observe similar kind of inverse relationship between the changes in poverty and the degradation of forest. The results indicate that the degradation of forest (either due to shifting cultivation or other reasons) increases with the decline in poverty in North East India.

Similarly we observe that the correlation between changes in forest cover and per capita income is positive but not so strong. It indicates that as per capita income rises, degradation of forest cover also rises. Even if we take the annual compound rate of degradation of forest during 1989 to 1999 a similar result is observed.

The results may appear to be inconsistent along with inverted U hypothesis (EKC). The fact is that all the North Eastern states have per capita income well below the national average.

Moreover it is associated with high inequality, which is clear from the incidence of poverty. Hence many of the families still face the survival problem and hence they earn mostly from the forest. Poorer possibly uplifted them at the expense of easily accessible forest resource.

The positive correlation between per capita income and degradation of forest is due to fact that these states are still in the rising phase of Environmental Kuznets Curve (EKC). Per capita income of all these states is well below the national average (over Rs 10000) per capita income. They are yet to reach the peak per capita income and the technology after which their dependence on forest will be declining and they will have the alternative opportunities. But the positive relationship between per capita income and degradation of forest is not significant, which may be because of the government policies and initiatives through joint forest management, community forestry, social forestry programmes etc that help protecting and regenerating many forest areas during last two decades. Andrew Foster has shown that economic development in India was associated with the rise in demand for natural resource (forest resource) that led to an increase in its supply during 1971 to 1999 (Smith, 2003). Among those states Mizoram and Tripura occupies top two positions in terms of educational achievement (e.g., higher literacy rate and enrolment ratio) and we observe improvement in forest resource or relatively less degradation there.

Though population growth is not found to be directly related to the degradation of resources in many cases, it indeed put pressure on the natural resources at least at the local and regional level. In addition to the pattern of livelihood, incidence of poverty and institutional arrangement, population growth can also add to the problem of degradation.

The effect is more if technology does not grow at the desired pace and sufficient alternatives of natural resources develop and unless people are able to produce continuously increasing amount from the identical resources. Thus it is not only the size of population but also the effective human resource development that matters much for resource utilisation and environmental degradation.

Moreover the market distortions, inequality in income, educational advancement etc. and regional disparities may play their important roles in inter-regional differences in degradation of resources.

Thus whatever Simon predicted from the examples of a few countries and over all world progress may not be applicable to the regions that are yet to achieve the level of development from which, environmental degradation and resource depletion starts improving. Moreover it would not be wise to allow degradation to continue till market establishes the balance (as there is uncertainty how long it would take to do so) and that may jeopardise our life. Hence Ehrlich rightly pointed out that while estimating the carrying capacity of a region one should take into account the resource condition of that region. One can add to it is the possibility of technological innovation that improves the productive capability of the available resources.

However it does not mean that there is no relevance of Julian Simon today. It is true that whenever human being confronted with some problems or crises (either due to population pressure or any other reason) they successfully overcome those through technological invention and their implementation. And that perhaps will continue to do so to solve the resource or other problem. At the same time, it is true that unless people were aware (for whatever reason) population would be much more than six billion, what is today and the problem would have been aggravated. It may also be the setback of many regions in terms of resource management and growth unless the benefits of technological development reach to all uniformly.

Introduction

What is the real problem behind the successful management of natural resources? Is it higher population growth or incidence of poverty or wrong institutional arrangement or something else? Even if the relation exists, does it differ from one region to another or from local level to global level? People have been struggling to know for long period of time and to formulate models linking one with another through their physical, technological, social and economic linkages that may lay down the basis for providing a meaningful solution to the observed problems and avoid any disturbance that may lead to economic collapse.

After going through numerous literatures on the topic one may find it very difficult and confusing to conclude whether population really matters for environmental and resource management or not. Plethora of arguments and counter-arguments has been given since the development of literature on population and human resource, poverty, food security, environment and resource management as well as economic development and well-being.

From the studies available, we get the conflicting arguments on how population growth affects and is affected by the environmental changes. Historically human action has often been blamed for its adverse effect on environment and resource condition. Way back to Malthus (1798) who was concerned about the growth of population to outrun the available food supply. The negative impact on the nature due to increasing pressure caused by the population growth and natural logic of diminishing marginal productivity of resources was inherent in his *An Essay on the Principles of Population*. The pessimistic views have been found in the writing of Ehrlich (1968), Meadows et al (1972) etc., who were of the opinion that the world would be falling short of critical natural resources after some time if population continues to grow. They argued that if the existing patterns of population growth and resource use continued, it would lead to environmental breakdown and economic collapse. Therefore a balance between the population growth and resource is well warranted for the sustainable growth of the economies.

On the other hand, we find in Julian Simon (1981, 1996), Simon and Myers (1994), who was of the opinion that population growth is not a danger, but a benefit. The world is not running at the risk of shortage of resources. Population growth in many cases helps economic development and better management of resources through their effort and improving knowledge, innovation. Thus human being continuously learns how to overcome the bottlenecks imposed by the nature. Gale Johnson (2000) also tried to prove through evidences that in spite of huge population growth in the last century the level of well-being has increased manifold. Also there is the weak sustainability argument of Hartwick (1977).

Their arguments derive supports from the fact that at the beginning of Christian era i.e., 1 A.D. world population was around 2.5 crore and growing at around 0.04 per cent per year. Now the world's population passed 6 billion and growing at an annual rate of around 1.5 per cent (Titenberg, 2003). Still now, Malthusian catastrophe that was expected to happen much before and the world to return to a subsistence level have yet not been materialized. The progress was supposed to halt because of over dependence on agriculture (that was subject to diminishing returns) and economic growth was supposed to be outstripped by the growth in population. In 1761 Robert Wallace also argued that the progress would eventually undo itself by overstocking the world with people (<http://www.sthopd.net>). The interesting point to note is that at the time Malthus wrote, most societies were constrained by the agricultural limits and the world population was what India's population today. Still now we did not observe any such catastrophe, rather we are living on an average in a better world today with better food security, fewer famines, lower mortality rates, enhanced life expectancy, better amenities and access to resources and most of those have been possible due to the advancement of education and technology in different fields. Whatever famines and food insecurity we observe today are mostly localized and occur largely due to war, political unrest, market distortions, loss of entitlement and sometimes due to crop failure (that sometimes may be because of unplanned or unsustainable use of land resources).

At the same time we observe rising pollution level at many parts of the world, global warming, acid rain, ozone layer depletion, declining forest resources, rising mortality due to lack of access to safe drinking water, falling long term land productivity, loss of biodiversity etc. Those may be not only due to the growth of population but also for the application of advanced technology (but not environment friendly) to meet the increasing need of the growing population.

“The rapid growth of knowledge has resulted both from the growth of world’s population and the increase in the percentage of that population that is now able to devote time and energy to the creation of knowledge” (Johnson, 2000, p. 13).

At a global level it may be partly true but not at the regional level. If that be so, more scientific inventions would have occurred in Asia and more so in China and India (where more than one third of world’s population live and have experienced higher population growth for many years) and not in Western Europe. It may however be related to the percentage of people engaged in academic and innovative activities, which is definitely higher in European countries. If the acquired knowledge is not distributed uniformly the gain as happened may not lead to harmonious development that has always happened due to political and social disturbances as well as individual/selfish oriented motives.

Here it is to be noted that rising population, when total population is well below the carrying capacity may raise the labour supply, contribute more to the production, better management of resources and thus well being. In other words, if we accept the notion of carrying capacity and the level of population is well below that capacity, growth in population normally tends to better utilization of resources from their sub-optimal level with given technology and other parameters. If it crosses that limit, it would lead to rise in pressure on and thus depletion of resources. Definitely, technological development enhances the scope for use of any resource, its productivity and the capability to tolerate and bear more people (i.e., enhance carrying capacity) over time but there is uncertainty whether the same can grow at the required pace all the time and uniformly. It also varies with the variation in consumption basket that changes along with the changes in standard of living and adjusted by the people with technological invention and innovation. However the concept of carrying capacity is of very little relevance to those who have been optimistic (Simon, Johnson, Solow, Hartwick etc.) and think each and every constraint would be overcome if everybody is free and the markets are allowed to play their role, ensuring that is a remote possibility.

Some people often cite the examples of some countries like, Netherlands, Taiwan, Hongkong etc. where the population density have been very high yet developing at faster rates compared to many other countries with lower density of population and thus population may not be a constraint. Also we observe the North-Eastern part of India that suffers from declining forest resources with comparatively higher population growth and sustained poverty (though population density is still well below the national average and poverty level declined over time). That may also be due to lack of alternative opportunity and growing population depends more on natural resources and their traditional agricultural practices.

This paper thus tries to *explore the interlinkage among the population growth, poverty and environmental resource degradation with special reference to North-East India.*

Population, Human Resource and Environment

Whether we accept or reject the argument of adverse impact of population expansion on environmental and resource condition, there is a general belief that more population means more demand for food, shelter, clothing, amenities etc. and hence more drain on natural resources at any existing level or pattern of livelihood (that is also determined by the consumption behaviour of the people) and given technology. A change in pattern of livelihood and technology on the other hand with given density of population may change the consumption and demand for natural resources and thus modify the environmental parameters.

However size of population is not all that matters rather the pattern of consumption that is again determined by the entitlement. A country with even less population can consume and degrade

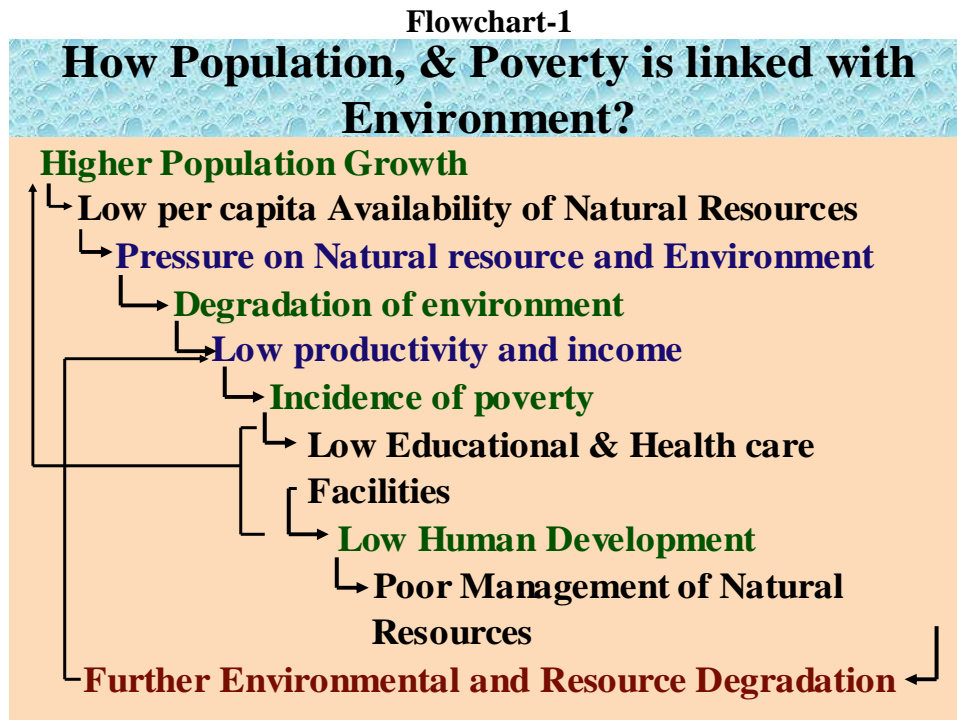
more resource than a country with higher population. For example, an average American consumes more fossil fuel (as per capita number of car is many more than in India) than an average Indian. Hence total resource used and pollution generated in a country with less population may be more than a highly populated country. Similarly, rising consumption and industrial progress in one region besides degrading its own resource may lead to the depletion of natural resources in other region. Also, the pollution generated in one country may affect the other countries or all over the world. E.g., during colonial rule, the rulers abruptly used the natural and other resources of their colonies for meeting their industrial progress. The green house gasses and chlorofluorocarbon emitted from the industries of one country affect people all over the world. Thus the conclusion derived from the explanation of local or regional level population-environment interrelation may not be applicable to global changes in environmental attributes and vice versa. Moreover there are inter and intra-regional relationships. The inter and intra-regional changes are contingent upon the factors like consumption pattern, trade linkages, level of income and incidence of poverty, educational achievement, technological changes etc and their interactions. In fact, the human activities changes according to their socio-economic conditions (incidence of poverty level of development, education etc) and hence the consequent changes in environmental parameters due to human activities depend upon the incidence of poverty, level of economic development, educational achievement etc or over all human resource development in stead of only population size, which in turn affect the population and their activities. A variation of all these factors thus causes to regional differences in degradation and may lead to the locational shift of local level degradations.

The aforesaid discussion reflects the dependence of human being on the nature and that changes in environmental parameters are the integral parts of developmental activities undertaken by the human being. Human activities in many cases lead to changes in the environmental parameters at local, regional and global level. At micro level, increasing population leads to more pressure on the resources and hence environmental conditions. The effect varies with the variation in level of income, incidence of poverty, education and overall human development. Regions with high human development are seen to observe less resource degradation. Where as the regions with low human developments are observed to experience high natural resource degradation. Data available on degradation of forest and human resource development at cross country level shows that degradation of forest is very low in the countries that acquired very high human development (Human Development Report, 2000). Only in Bahamas average annual deforestation during 1990-95 was 2.6%. In Japan, Finland, Korea, Brunei Darussalam, Argentina & Chile it was merely 0.1, 0.1, 0.2, 0.6, 0.3 & 0.4 per cent. In other cases there was either no degradation or improvement in forest area. On the other hand, degradation of forest is comparatively higher in most of the countries that achieved medium or low level of human development (Human Development Report, 2000). It was 7.5, 8.1, 2.6, 3.5, 2.6, 2.5, 2.9, 2.4, 2.2, 3.1 & 5.8 % in Jamaica, Lebanon, Paraguay, Philippines, Thailand, Jordan, Pakistan, Malaysia, Panama, Costa Rica & Comoros.

Models

Although there is a growing recognition of the important linkages between population and the environment our understanding of exactly how these linkages operate is still rather limited. We may intuitively understand that human population and their activities cause environmental change and that change in turn affects the quality and condition of human lives; but the specific details of these interactions are still largely speculative. Population environment interactions have been studied from different perspectives by different groups. The neoclassical group holds that environmental and resource degradation is not the result of population pressure rather economic inefficiencies and market distortions. If market is allowed to play freely as mentioned earlier, resource problem will automatically be solved. On the other hand, the natural scientists follow the tradition of Malthus and argued that population is the main source of environmental degradation. Hence population control is essential for protecting environment. The political theorists however state that poverty and inequality of distribution of resources are responsible for degradation and

hence the solution lies in the removal of poverty and inequality. A number of causes and explanations have been given in this paper for the regional resource degradation. The flowchart-1 describes how a number of factors interact in a circular way and lead to degradation of resources in a region.



The flow chart-1 shows the downward spiral linkage of population growth, poverty, human capital or broadly speaking quality of life and environmental quality/natural resource. The vicious circle of environment will continue whether there is population growth, poverty, low educational and health care achievement or poor and degraded environment in the beginning. Thus there will be continuous mounting of pressure on natural resources and decline in availability unless the linkage is broken through population check and proper environment care, sustainable resource management and striking against poverty simultaneously.

Poverty and Environment or Natural Resource Use

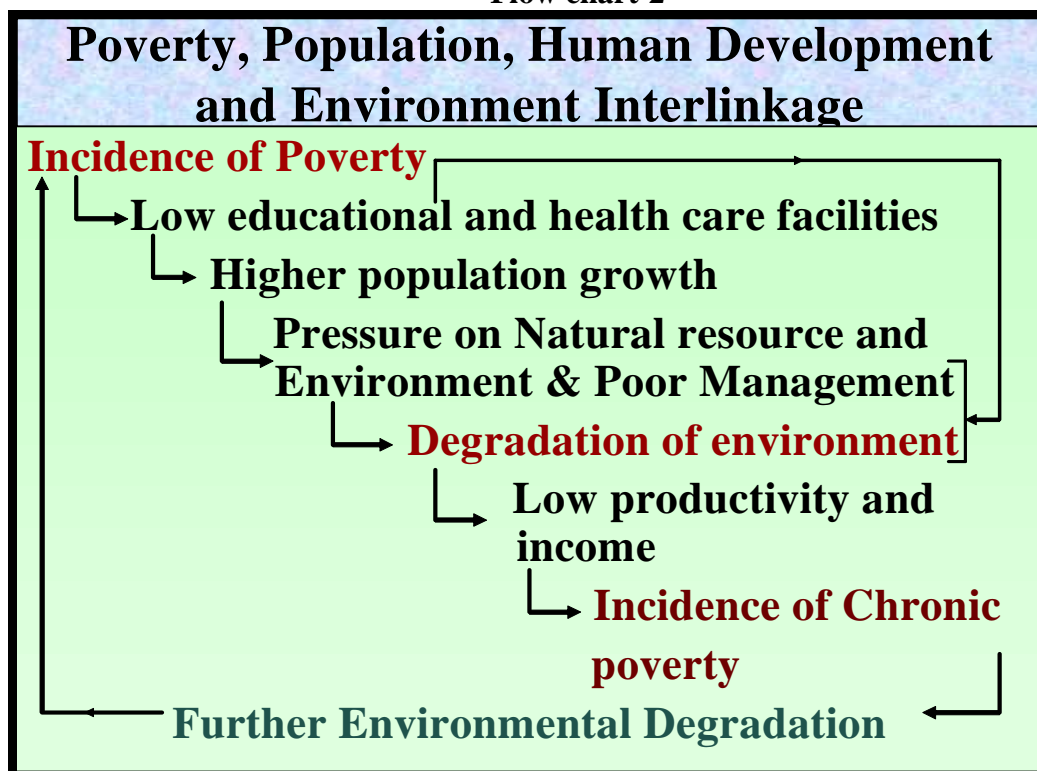
The poor people mostly belong to the remote areas and their living conditions are directly affected by the availability of critical natural resources in their surrounding. In most cases they earn their livelihood directly from the environment (e.g., from common forest they collect fuel wood, timber, leaves and herbs for building cottage, extract food articles and some other things to sell and earn something. Also they use grazing field for raising livestock, harvest common fisheries, water bodies for drinking water and so many) (Jodha, 1986). Moreover, due to limited access to education, health care and awareness, tendency of population growth is relatively higher among them, which put more pressure on environment and accelerate the process of environmental degradation and thereby the productive capacity of those natural resources. This in turn affects their livelihood through declining impact on their income and materials collected from nature. Thus poverty alleviation has been identified as one of the important remedies of environmental degradation (World Bank, 1987 and 1988).

However one exception is there that the poorer are not always responsible for environmental degradation. In many cases due to their better accessibility and encouraging government policy of the developed world (e.g., subsidies for fossil fuels or large scale commercial fishing fleets), they cause much more damage to the environment than the poorer. They do the damage primarily due to their unsustainable luxurious consumption of natural resources and their profit motive and also they

are responsible for the creation of large-scale industrial waste and pollution (without taking proper measure for treatment), the burden of which has been mostly shouldered by the vulnerable poorer. On the other hand, many of the poorer do not have proper accessibility to those resources (may be due to lack of property right or capabilities) and even in some cases they are found to invest and judiciously manage (due to their indigenous knowledge) those resources. Whatever damage they do is mainly for their survival. Their income, opportunities and health are highly affected by the depletion or degradation of natural resources that is clear from the following facts (DFID & UNDP, 2002).

The impact of population and incidence of poverty on natural resources also depends on the institutional arrangement and nature of resources. If the resources are common property resource, with same population growth and identical poverty, it will be more prone to degradation and vice versa (Hardin, 1968; Buchanan and Yoon, 2000; Parisi, Schultz and Depoorter, 2000). Below Flow chart-2 shows the both way linkages between poverty, population and environmental degradation.

Flow chart-2



Temporal Changes in Forest Resource in the World, India and Per Capita Availability in India

During the decade of 1980s and 1990s due to the expansion of agriculture, logging, development and other human activities the deforestation of annually more than 120000 Sq Km. of forest area in the World have been observed (FAO, 2000). These trends in forest cover are undoubtedly related to the population growth though there is no simple way to describe such linkage. These in most cases are treated as the direct and indirect effect of population expansion but the relation is not found to be uniform in all the regions. Though we find a strong relationship in Central America, East and West Africa and South Asia; a much less clear association is observed in Amazonia i.e., South America and Central Africa (Rudel et al, 2000; Pfaff, 1999). Even in highly developed country like U. S. A., Russia and also China forest cover has been recovering for some time after extensive earlier deforestation (FAO, 2000). In these countries population growth has been reduced to a significant extent and population began to shift from agriculture to non-agricultural activities and also tried to shift their requirement to non-agro-based product and sometimes import these products (whenever needed) from other regions where the effect is felt.

Thus the North-Eastern part of USA that was deforested almost entirely during the middle of 19th Century is now largely regenerated. Here both population and per-capita income increase are no longer associated with local forest degradation but with that of other places as explained earlier.

The recorded forest area in India was about 68 million hectares in 1950-51 and that increased to 75 million hectares in the early 1980s and further increased to 76.5 million hectares in 1997. But the authenticity of the historical data on the forest area has been doubtful (Ministry of Environment and Forest, 1997).

Record shows that the overall forest cover has been declined from about 40 per cent of country's geographical area a century ago (Guha, 1983) to nearly 22 per cent in 1951 and further to around 19 per cent in 1997 (Ministry of Environment and Forest, 1997), which is well below the standard 33 per cent stipulated by the National Forest Policy, 1988. The forest cover declined from 71.8 million hectares in 1951 to 63.9 million hectares in 1991 and further to around 63.3 million hectares in 1997 that indicates a continuous decline of forest cover till now. Though the rate of decline has been decelerated over time due to campaign, legislation (Supreme Court's ban on felling of trees) and special afforestation programmes through JFM, community forestry, social forestry, tree growers' cooperative etc. for the revival of some degraded forest area; in qualitative terms (crown density) there has been continuous decline of forest resources. FAO (2000) assessment shows that the aggressive policy of the Government has offset some losses in forest cover and in spite of significant population growth during 1990s India could regenerate 381000 Hectares through tree plantation programmes. Despite governmental efforts through the aforesaid means this is not a significant improvement of forest resources (recorded area has increased slightly and in a scattered manner). Though the rate is declining, population is still growing at an annual around 2 per cent compound rate. Moreover, population growth, urbanisation etc. have been causing rise in demand for timber, fuel wood, grazing etc. Hence the per capita availability of forest resources is bound to decline. Of course there has been a gradual decline in per capita forest resource mainly timber, and a shift of demand towards relatively cheaper substitutes; still one cannot ignore the importance of forest for arresting soil erosion, maintaining biodiversity, productivity and environmental balance (temperature etc.) that proved to be very costly to mitigate. Foster and Rosenzweig (2003) also argued that the little improvement was due to relatively closed economy and that would be reversed if the economy is open.

In addition to poverty and faulty institutional mechanism (De, 2003), several other reasons are there for this degradation and population may be a part of it as mentioned earlier. Encroachment led the list in the diversion of forest area for non-forestry purposes between 1950 and 1980 to the order of 4.5 million hectares i.e., at an annual rate of 0.15 million hectares. Thereafter marginal decline in forest area have been recorded by an annual rate of 0.016 million hectares (*Economic Survey*, 1998-99). Illegal grazing by around 100 million livestock in the tracts of forestland also results in forest degradation in India (World Resource Institute, 1994).

Due to population growth and simultaneous decline in forest resource per capita forest resource availability declined over time that further deepens the pressure on forest resources despite the development of alternatives to forest resources and related technologies. During 1950s per capita forest area was around 1.2 hectares that declined alarmingly to 0.0666 hectares during 1997-98 and still now it is around 0.07 hectares, which is well below the world standard.

Population Growth and Stress on Natural Resource in North East India

The economies of all the states of North East India are primarily agricultural. Though there has been decline in dependence on primary activities, still now majority of the people are engaged in primary sector. This is clear from table-1 that shows the changes in sector-wise distribution of main workers during 1971 to 1991. The reduction in dependence on agriculture has been very slow across all the North Eastern states. However, the supply of primary input of agriculture i.e., land is fixed due to nature. But population continued to grow at rapid rates in all these states. Thus per capita availability of usable land has been decreasing as is shown in table-2. As majority of people

are still engaged in agriculture and its allied activities, pressure on land has been increasing. Also, fallow period of shifting cultivation has been falling drastically (from 17 - 20 years in 1970s to 2 - 3 years). Further the methods adopted to increase the productivity of land in many cases leads to decline in long run productivity of soil. Moreover conversion of forestland has been taking place to make up the shortage of cultivable land and to meet the need of increased population. So degradation of forest has been taking place to meet the increasing need of the people. The method of shifting cultivation that is widely practised in North East India is also partly responsible for the degradation of forest (Reddy et al., 2001).

Table-1
Changes in the Sector-wise Distribution of Main Workers from 1971 to 1991

State\Year	% of Main Workers in Primary Sector		% of Main Workers in Secondary Sector		% of Main Workers in Tertiary Sector	
	1971	1991	1971	1991	1971	1991
Arunachal	80.44	67.44	0.45	8.66	19.11	23.96
Assam	77.04	73.99	4.20	5.56	17.86	20.45
Manipur	71.30	70.00	12.24	9.66	16.46	20.34
Meghalaya	81.84	74.81	3.30	3.74	14.86	21.46
Mizoram	84.17	65.99	1.76	5.07	14.07	28.94
Nagaland	79.46	75.26	2.38	3.48	18.16	21.26
Tripura	76.58	64.08	4.25	6.41	19.17	29.51
N-E India	77.45	72.61	4.93	5.78	17.62	21.61
All India	72.56	67.50	10.69	12.00	16.75	20.50

Source: (1) Basic Statistics of North Eastern Region, 2002

(2) NEDFi, Report, 2002

Table-2
Per-Capita Availability of Land in North East India (Hectare)

State\Year	1971	1981	1991	2001
Arunachal	12.07	8.86	6.36	5.04
Assam	0.54	0.39	0.35	0.29
Manipur	2.06	1.56	1.20	0.93
Meghalaya	2.22	1.68	1.26	0.97
Mizoram	6.52	4.26	3.03	2.35
Nagaland	3.20	1.79	1.28	0.79
Tripura	0.67	0.51	0.38	0.33
N-E India	1.16	0.84	0.71	0.58
All India	0.55	0.45	0.36	0.30

Source: (1) Basic Statistics of North Eastern Region, 2002

(2) NEDFi, Report, 2002.

Apart from agriculture and forest base activity many people earn their livelihood from mining and its related activities. Petroleum, natural gas, coal and limestone are the major minerals of the region. In case of coal and limestone dominated Meghalaya, it was shown that if the current trend of extraction continues the coal would last 40 – 50 years (Rout, De and Das, 2005) and limestone 120-130 years (De and Kharlukhi, 2005). Oil stock of Assam has already been depleted to a great extent and chance of finding new reserves that can be exploited economically have been declining over time. Moreover, most of the limestone and coal produced are exported either to other region of India and extensively to Bangladesh to meet their industrial needs as there are very limited industrial base in the region. Here though most of the minerals (except oil, gas and uranium) are

privately owned the theory of anticommons fails to explain the reasons behind such over-exploitation.

Table-3
Changes in Population and Forest Cover in the last Decade

	Population in Lakh		% Growth of Population	Percentage Change in Dense Forest	Annual Compound Growth Rate of Forest Cover (Percentage)
State\Year	1991	2001	1991-2001	1989-1999	1989-1999
Arunachal	8.65	10.91	35.15	-0.22	- 8.57
Assam	224.14	266.38	23.36	7.33	0.75
Manipur	18.37	23.89	32.46	2.49	- 0.90
Meghalaya	17.75	23.06	32.04	-15.26	- 3.48
Mizoram	6.90	8.91	48.55	-10.70	0.08
Nagaland	12.10	19.89	50.05	-32.84	- 1.33
Tripura	27.57	31.91	31.92	-33.26	- 2.18

Sources: Census of India, 1991, 2001; Provisional Population Totals.

Government of India, Ministry of Environment and Forests, *Forest Survey of India*, New Delhi

Forest is one of the major natural resources of North-East India (which is partly owned by the government and partly by community and individuals) on which a sizeable population especially the poorer depends for their livelihood. Also it is one of the major 18 hotspots in the world. Table-3 shows that there is a general decline in forest cover in all the North-Eastern states except Assam and Mizoram. Degradation in area under forest is the highest in Arunachal and lowest in Manipur. Tripura and Nagaland recorded significantly higher degradation of dense forest. In Assam population growth is comparatively low and there is improvement of forest cover, which may be because of successful afforestation programme and educational improvements. Though population growth is higher in Mizoram, still forest cover increased though insignificantly. If we compare the population growth with the degradation of all the North-Eastern states it can be safely asserted that per capita availability of forest resources has declined. Comparing with the other states of India, the degradation was found to be on the higher rate in the north-eastern states, which may be due to the practice of traditional *jhum* (*shifting*) cultivation (Reddy et al, 2001). Rao (1994) has also identified population growth as another cause of degradation in this region as population has been increasing at significantly higher rates as compared to the forest cover and hence the per capita forest cover decreased and the pressure on forest is mounting. It is compounded with the higher incidence of poverty, which has been higher than the national average and only below the state of Bihar and Orissa.

Poverty, Per-Capita Income and Change in Forest Cover in North East India

Though there has been decline in incidence of poverty across all North Eastern states it is still higher than the national average. The rate of decline also varies across the states. The highest rate of decline was observed in the successful state Mizoram (from 36 per cent in 1983 to only 19.47 per cent in 1999-2000) i.e., by 45.92 per cent where literacy and other human development indices are also higher. It was lowest in Assam where percentage of poverty declines from 40.47 in 1983 to 36.09 in 1999-2000 i.e., by only 10.82 per cent. Table-4 shows the rate of changes in incidence of poverty in North Eastern states during 1983 to 2000.

The theory of Environmental Kuznets Curve (EKC) says that the degradation of environment first rises with the rise in per capita income and reaches a maximum and thereafter it declines with further rise in per capita income due to positive income elasticity of demand for environmental quality (Shafik and Bandyopadhyay, 1992; Seldon and Song, 1994; Grossman and Krueger, 1995). Therefore a similar kind of relationship is expected to exit due to the same reason

between quality of environment/ natural resource and per capita NSDP. Also spread of education makes people more conscious about the management of natural resources and enhances their productivity. On the other hand, management of resources is essential for maintaining the productivity and earning of the people.

Table-4
Changes in poverty in North East India (Percentage)

State\Year	Incidence in Percentage			Changes in Percentage		
	1983	1993-4	1999-00	1983 to 1993-4	1993-4 to 1999-00	1983 to 1999-00
Arunachal	40.38	39.35	33.47	-2.55	-14.94	-17.11
Assam	40.47	40.86	36.09	0.96	-11.67	-10.82
Manipur	37.02	33.78	28.54	-8.75	-15.51	-22.91
Meghalaya	38.81	37.92	33.87	-2.29	-10.68	-12.73
Mizoram	36.00	25.66	19.47	-28.72	-24.12	-45.92
Nagaland	39.25	37.92	32.67	-3.39	-13.84	-16.76
Tripura	40.03	39.01	34.44	-2.55	-11.71	-13.96

Source: Planning Commission, Government of India.

Even though owned by the community or the government forests in North East India are mostly open access common forest and that is why in many cases even the legislation fails to protect unless and otherwise protected through the participatory management or by the community. Now we shall try to look into the relationship between degradation of forest and Per Capita Income as well as incidence of poverty.

Table-5
Poverty, Per-Capita Income and Changes in Forest Cover in North East India

State	Poverty in 1999-2000, Percentage	Per Capita Income 1999-2000 (at 1993-94 prices)	Changes in Forest Cover in 1995-97 (Sq. Km)	Percentage Changes in Poverty Ratio	
				1993-94 to 1999-00	1983 to 1999-00
(1)	(2)	(3)	(4)	(5)	(6)
Arunachal	33.47	9170	-19	-14.94	-17.11
Assam	36.09	5978	-94	-11.67	-10.82
Manipur	28.54	7231	-140	-15.51	-22.91
Meghalaya	33.87	7826	-55	-10.68	-12.73
Mizoram	19.47	8109	199	-24.12	-45.92
Nagaland	32.67	9118*	-70	-13.84	-16.76
Tripura	34.44	6813	4	-11.71	-13.96
$R_{24} = -0.723, R_{45} = -0.77, R_{46} = -0.792, R_{34} = 0.233$					

Note: (1) * For Nagaland the data on per capita income was taken from 1998-99 year as it was not available for 1999-00. (2) R_{ij} represents the correlation between i^{th} and j^{th} column.

Observation and Discussion

The direct correlation between population growth and degradation of forest cover is not significant (0.05 only) across the North-Eastern states in India. But there is no doubt that population creates pressures indirectly on the resources as is reflected from the variation in per capita availability of resources, income, poverty and degradation. That is clear from the correlation between population growth during 1991-2001 and degradation in dense forest during 1989-99 in North East India, which is -0.51.

From the results we also observe that there is a significantly inverse correlation between the incidence of poverty and the degradation of forest. Also we observe similar kind of inverse relationship between the changes in poverty and the degradation of forest. The results indicate that the degradation of forest (either due to shifting cultivation or other reasons) increases with the decline in poverty in North East India.

Similarly we observe that the correlation between changes in forest cover and per capita income is positive but not so strong. It indicates that as per capita income rises, degradation of forest cover also rises. Even if we take the annual compound rate of degradation of forest during 1989 to 1999 a similar result is observed.

The results may appear to be inconsistent along with inverted U hypothesis. The fact is that all the North Eastern states have per capita income well below the national average. Moreover it is associated with high inequality, which is clear from the incidence of poverty. Hence many of the families still face the survival problem and hence they earn mostly from the forest. Poorer possibly uplifted them at the expense of easily accessible forest resource.

The positive correlation between per capita income and degradation of forest is due to fact that these states are still in the rising phase of Environmental Kuznets Curve (EKC). Per capita income of all these states is well below the national average (over Rs 10000) per capita income. They are yet to reach the peak per capita income and the technology after which their dependence on forest will be declining and they will have sufficient alternative opportunities. But the positive relationship between per capita income and degradation of forest is not significant, which may be because of the government policies and initiatives through joint forest management, community forestry, social forestry programmes etc that help protecting and regenerating many forest areas during last two decades. Andrew Foster has shown that economic development in India was associated with the rise in demand for natural resource (forest resource) that led to an increase in its supply during 1971 to 1999 (Smith, 2003). Among those states Mizoram and Tripura occupies top two positions in terms of educational achievement (e.g., higher literacy rate and enrolment ratio) and we observe improvement in forest resource or relatively less degradation there.

Conclusion

Though population growth is not found to be directly related to the degradation of resources in many cases, it indeed put pressure on the natural resources at least at the local and regional level. In addition to the pattern of livelihood, incidence of poverty and institutional arrangement, population growth can also add to the problem of degradation.

The effect is more if technology does not grow at the desired pace and sufficient alternatives of natural resources develop and unless people are able to produce continuously increasing amount from the identical resources. Thus it is not only the size of population but also the effective human resource development that matters much for resource utilisation and environmental degradation.

Moreover the market distortions, inequality in income, educational advancement etc. and regional disparities may play their important roles in inter-regional differences in degradation of resources. Thus none of the factors alone is responsible and we should address all the factors simultaneously. Joint management or participatory management in many cases have been found successful in case of open resources (De, 2003).

Thus whatever Simon predicted from the examples of a few countries and over all world progress may not be applicable to the regions that are yet to achieve the level of development from which, environmental degradation and resource depletion starts improving. Moreover it would not be wise to allow degradation to continue till market establishes the balance (as there is uncertainty how long it would take to do so) and that may jeopardise our life. Also it is very difficult to say whether establishment of perfect market at global level is possible or not. Moreover there is the lag in adjustment.

Thus even though human being whenever confronted with some problems or crises (either due to population pressure or any other reason) they successfully overcome those through

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technological invention and their implementation; it will not be wise to leave it for natural automatic solution. It is true that unless people were aware (for whatever reason) population would be much more than six billion, what is today and the problem would have been aggravated. It may also be the setback of many regions in terms of resource management and growth unless the benefits of technological development reach to all uniformly.

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