Dimension of Human Resource and the Management of Natural Resources

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Background

Is the development of human resources a solution to all the problems faced by the human being in different spheres including the determination of production and consumption baskets, working modes and technology, scarcity and management of resources whether renewable or non-renewable and continuation of social and economic progress? The problem mainly lies with the aspects of material and human well-being. Till now, human being has been struggling to find a permanent solution to the problem of scarcity of resources needed for the material and social welfare, which is developed due to the growing human population and their rising aspirations for affluence.

According to the conventional notion, structure and level of production of goods and services per capita or per capita gross domestic product of a country determines the level of development of that country. Following Mercantilist view also a country can enhance its wealth through trade or exchange of its produced goods and services with that of another country. But in all cases production of goods and services is the ultimate factor that depends primarily on different types of capital including material means of production, which comes from man-made capital or natural capital. Both man-made and natural capitals are heavily dependent on the basic natural resources available in

the surrounding. Hence natural resources are of vital importance for the progress and welfare of human being.

Over the years, human being have been exploiting the natural resources for the continuous progress and meeting needs for the maintenance and improvement of standard of living. The requirements of resources have been increasing due to the rising aspirations of the people to acquire more and more wealth, which has been compounded by the growing population. Therefore we find severe depletion or degradation and hence in many cases, the reduction in availability of natural resources. Malthus in 1798 already predicted that a growing population exerts pressure on agricultural land, forcing the cultivation of land of poorer and poorer quality. This lowers the marginal productivity of labour, income and thus put more pressure on environment and natural resources causing environmental degradation and finally reduces the population growth. The ultimate result is an equilibrium population with low income and poor environmental quality. The modern view of it is that the natural resources impose a limit to economic growth, with population pressures reducing the marginal product of labour as scarce natural resources are exploited more intensively (Cropper and Griffiths, 1994).

Now even in case of renewable natural resources (fishery, forestry) we observe degradation across various countries in the world. However there is a debate whether these are really the fallout of population growth or policy failure. Also whether the qualitative and quantitative changes in natural resources have reduced the actual availability and scope for production and welfare of the people or not. If so, what are the real reasons behind the degradation of such resources?

Though the development of technology and human resources can increase the utility of natural resources and in many ways reduce the dependence on natural resources, there is a limit beyond which the substitution of natural resource is not possible or feasible. Thus there is a rising concern about the possibility of reduction in supply of basic natural resources for the continuation of production and development process, which has been rising world over after the observation of large scale degradation of land and forest resources, mounting scarcity of water etc. along with the rising pollution manifested in acid rain, global warming etc.

Meadow *et al.* (1972) and other economists of the club of Rome thus predicted about the halt of economic progress due to the constrained critical natural resources. The neoclassical argument however is that, the market if allowed to play its role freely then the price mechanism will solve the problem of scarcity. The scarce resources will be continuously substituted by newly developed, relatively cheaper resources and growth process will continue (Solow, 1974, 1986; Hartwick, 1977, 1978).

Julian Simon (1981, 1996), Simon and Myres (1994), Johnson (2000) however went one step forward and argued that the progress of human qualities or human resources have been successful in many ways to reduce the dependence on natural resources and develop substitutes of scarce natural resources and hence it improves the scope of production activities and welfare through improved and diversified technology. By using a simulation technique, Simon has shown that the existing natural resources can support about 17 million years with progressive development and hence there is no cause of worry about the exhaustibility of resources. Therefore, in their opinion the production and distribution of goods and services depend not only on the availability of natural resources but also on the quality of human being or human capital. Thus the development of human resources can solve many of the problems faced by the people whether it is scarcity or management of natural resources or technological constraint. Even the population growth that has been presumed to be the prime cause of resource degradation in many countries can be tackled and its requirement can be met by the development of the human resources itself. They have cited the example that many densely populated countries (Taiwan, Singapore, Netherlands, Hong Kong etc.) with less natural resource availability, maintained better standards of living and achieved faster rates of growth without degrading the natural resources and surrounding environment much. Moreover, we are now living in a world with highest number of population in human history. Still now Malthusian Catastrophe is not observed. Rather we are living in a better world with lesser number of famines, better standard of living, less food insecurity, enhanced life expectancy, reduced mortality etc. Whatever problem exists has been due to the faulty policies and a correctly chosen socio-economic policy can solve many of the problems faced by us.

Human capital is however shaped by the level of education, health care facilities, which again determines the level of income and population growth and hence the supply of labour in terms of quality and quantity as well. Therefore the production capacity is determined not only by the availability of natural resources (land, water, mineral, forest etc.) but also on the quality of human being. The requirements also determined by the size and structure of population as well as, their consumption and livelihood pattern.

Whether development of human resource can solve the natural resource problem or not is clear from the progress of Japan, a country where 'in spite of natural resource scarcity' per capita production and export is the highest in the world. Also the damage of natural resource like that of forest is negligible. Many of the countries in the world having very high human development index experienced very low degradation or improvement of forest resource, an example showing better management when human resource is very rich.

In this paper we tried to highlight the basic linkages between the aspects of human resource development and the management of natural resources, especially the forest resources. Effort is here to find out whether the variation in human resources could affect the management and degradation of natural resource or environment by using the data on degradation of forest across the countries and within India. If the relation exists, we will try to see whether an EKC type relationship exists between population growth/human resource and deforestation or not and also try to find out the alternative policy options.

Interaction Among the Components of Human Resources and their Interlinkages with the Environment

Level of human development depends on the level of income, nutritional intake, and technology, facilities of education, health care and natural resources respectively. At micro level, the cluster of factors like nutrition, health, formal education and training all are embodied in an individual and these factors provide the individual some advantage over the others without them in the society. At the same time the health and education of an individual have an important effect on that individual's capability

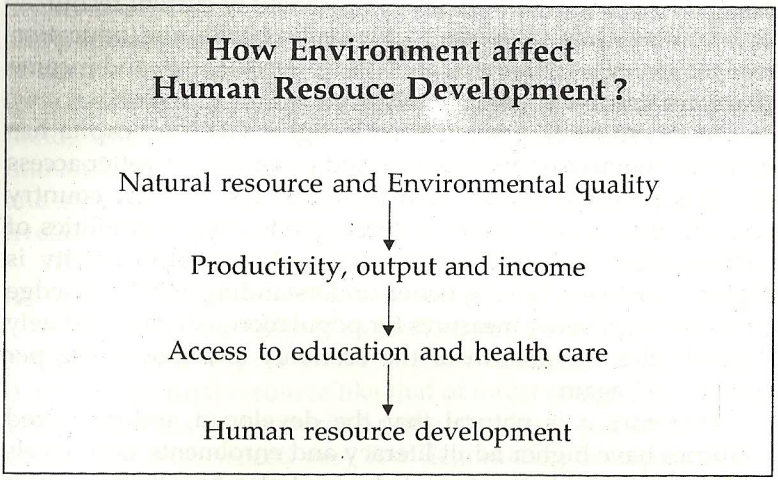
to produce. A healthier, better-educated person is capable of producing more. Therefore the commitment of current resources or income to improving an individual's health and education leads to increase in that person's future productivity and income (Bardhan and Udry, 1999; p. 123).

At macro level, a country with higher GDP per capita has better entitlement or affordability and possibility of better access to education and health care facilities. As the rich country can afford to acquire more of these goods, their capabilities of technological innovation, efficiency and thus productivity is higher. Moreover, having better understanding and knowledge they can adopt better measures for population control. Ultimately it accelerates the growth of the economy and thus rising per capita GDP again.

Therefore it is natural that the developed, industrialized countries have higher adult literacy and enrolments at all levels and thus acquire better knowledge and also have better health care facilities and hence higher life expectancy at birth. On the other hand, the low-income countries in general have low adult literacy (in most cases first generation is literate), though the enrolment ratio has been rising at the primary level (due to special public policies and efforts of different governments) dropout is increasing at higher order and access to health care is also poor and thus life expectancy at birth is less. Hence human resource development is poor.

Like income and human capital circular linkage, there exists a circular relationship between the natural resource and environmental quality and human resource development — specifically with its components. The flow chart reveals that if availability of natural resources and environmental quality is poor, productivity and hence output, income will be less. It provides people with less scope to access standard education and enjoy the facilities of health care, sanitation etc. and hence poor human resource development, which ultimately leads to poor management and thus expedite the degradation of environmental quality and natural resources. Also for higher incidence of poverty, lower access to health care, lack of awareness (due to illiteracy), the tendency of population growth is higher among them that further accelerates the process of degradation (De, 2004).

Flow Chart



Population, Human Resource and Environment

Population environment interaction is not a new debate. It has been continued since the time of Malthus and now widely discussed at different national and international forum for the rising concern about food and economic security, problems related to different aspects of human development and sustainable resource management. Simply speaking, rising population means more demand for food, shelter, clothing, amenities etc. and hence more drain on natural resources at any given technology with existing level or pattern of livelihood (that is also determined by the consumption behaviour of the people). 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 of the people. A country with even less population can consume and degrade more resources 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 or any developing country. 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 industrial progress in their own countries. The green house gases and chlorofluorocarban emitted from the industries of one country affect people all over the world. Thus the conclusion derived from the observations 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 change 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 instead of only population size, which in turn affect population and their activites. 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 development 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 on 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 region with low human developments are observed to experience high natural resource degradation.

Human Resources and Degradation of Forest at the International Level

Data available from the mongabay.com show that largest net loss of forests (4.3 million hectares per year) during 2000–2005 was observed in South America and that is mostly due to development of cattle ranches and soybean plantations. Africa especially Nigeria and Sudan suffered the second largest net loss of 4.0 million hectares annually during that period and that is mainly due to subsistence activities. The regions with the highest tropical deforestation rate were Central America that lost about 1.3 per cent or 285,000 hectares of its forests annually. In Asia countries like Bangladesh, Bhutan, Brunei, Cambodia, East Timor, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam lost about 1 per cent of its forests each year. Illegal logging, clearing of forest for agriculture, fuelwood collection by the rural poor, forest fires often purposely set by the people are considered to be the leading cause of deforestation. The rate of primary forests degradation has been the highest in Nigeria (55.7 per cent) and followed by Vietnam (54.5%), Cambodia (29.4%), Sri Lanka (15.2%), Malawi (14.9%), Indonesia (12.9%), North Korea (9.3%), Nepal (9.1%), Panama (6.7%) and Guatemala (6.4%). In absolute sense, highest deforestation of 3,466 thousand hectares annually has been observed in Brazil and followed by Indonesia (1447.8), Russian Federation (532.2), Mexico (395), Papua New Guinea (250), Peru (224.6), USA (215.2), Bolivia (135.2), Sudan (117.807) and Nigeria (82) thousand hectares respectively.

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, 0.3 and 0.4 per cent. In other cases there was either no degradation or slight 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 and 5.8 per cent in Jamaica, Lebanon, Paraguay, Philippines, Thailand, Jordan, Pakistan, Malaysia, Panama, Costa Rica and Comoros.

If we regress the rate of deforestation during 1995–2005 across top 32 Human Developed countries on their population growth, GDP growth, ratio of consumption of traditional fuel to total energy consumption we find that deforestation level rises significantly with the growth of population. GDP growth has significant negative impact on the rate of deforestation and the countries with higher proportion of fuel collected from the forest to total fuel consumption recorded significantly higher rate of deforestation. The estimated linear equations are:

1. $DF = -0.194 + 0.625\ Pop^{*} - 0.1934\ GDP^{*}$ .... $R^2 = .26$
   (3.08) (−1.6)
2. $DF = -0.29 + 0.416\ Pop^{*} - 0.178\ GDP^{*} + 0.045\ TRDL/Total\ Energy^{*}$ ... $R^2 = .46$
   (2.223) (−1.67) (3.268)

Regressing on different components of Human Development index we get

3. $DF = 4.797 - 5.23\ EDU^{*}$ .... $R^2 = .12$
   (−1.9)
4. $DF = 5.49 - 6.33\ GDP^{*}$ .... $R^2 = .25$
   (−2.74)
5. $DF = 2.799 - 3.34\ Life\ Exp.$ .... $R^2 = .15$
   (−.68)

Considering education and GDP index as explanatory variables we get

6. $DF = 6.45 - 1.86\ EDU - 5.44\ GDP^{*}$ ... $R^2 = .21$
   (−.58) (−1.95)

Adding population as explanatory variable we find

7. $DF = 1.44 + 3.22\ EDU - 5.69\ GDP^{*} + 0.527\ Pop^{*}$ ... $R^2 = .31$
   (.81) (−2.14) (1.97)

Taking all the human development indicators as explanatory variables we observe

8. $DF = -1.60 + 6.446\ Life\ Exp. + 2.98\ EDU - 8.26\ GDP^{*} + 0.45\ Pop^{*}$ .... $R^2 = .34$
   (1.02) (.75) (−2.26) (1.7)

Here DF = deforestation, EDU = education index, GDP = gross domestic product index, Life Exp. = life expectancy index, Pop. = Population growth and TRDL/Total energy = proportion of traditional fuel to total energy used. Figures in the bracket represent t value and * indicates that the coefficient is significant at 5 per cent level of significance.

We observe education and GDP index have significantly negative impact on the rate of deforestation, where as life

expectancy has negative but insignificant impact on the same. Population growth has always significantly positive impact on the level of deforestation indicating that even though those countries have been able to improve their human qualities significantly, much of the pressure that has been taken off the forest resources due to GDP growth and transformation to environment friendly technology along with rising political demand, has been nullified by the population growth. Though variation in population growth across the countries is positively associated with the degradation of forest, on an average the degradation in high human developed countries is much lower than the countries having medium or low human development, especially where per capita GDP is at relatively lower level and population growth is very high. The positive but insignificant sign of coefficients of education and life expectancy in equations 7 and 8 are due to the presence of multicollinearity among those explanatory variables, which has been shown in the correlation Table-1.

Correlation Table-1

	Life Exp.	EDU	GDP	Population
Life Exp.	1	0.27	0.69	–.0157
EDU		1	0.544	–.70
GDP			1	–.353

The fact is that high educational index is associated with the high GDP and health index and negatively associated with the population growth.

In case of 43 countries with medium or low human development we find

9. DF = 3.33 + 0.763 Pop – 0.127 GDP .... R^2 = .09
(–1.7) (–.069)
10. DF = 4.056 + .736 Pop. – 1.117 GDP – .0059 TRDL/Total Energy; ... R^2 = .13
(–1.69) (–.416) (–.51)
11. DF = –1.83 + 4.283 Life Exp. – 0.52 EDU – 3.063 GDP – 0.398 Pop .. R^2 = .23
(2.36) (–.323) (–1.2) (–.907)
12. DF = 0.75 + .0835 EDU + 1.164 GDP .... R^2 = .12
(.048) (.509)

Here also we observe that population growth has positive impact on the degradation but not significant. This is because of rising awareness among the people with the expansion of education and political demand in various countries, aforestation

campaign in the countries like India. Also GDP index has no significant impact, though in many cases GDP growth is associated with rising degradation (as seen in equation 12) as economic activities in many cases are forest based and many of the poorer are dependent on forest for their sustenance (De, 2004). Even with high education and life expectancy index, GDP per capita and its growth is lower in the country like Jamaica and hence dependence on forest is high and hence degradation. On the other hand, with lower human development and higher population density due to successful campaign India could restrict degradation and even improve forest resources during last few years. Therefore the regression results in case of low or medium human developed countries, does not reflect the exact impact of different factors on deforestation. The changes in coefficients in different equations here are also due to the presence of multicollinearity among the explanatory variables as shown in the correlation Table 2. But in all cases (high or medium human developed countries), education and GDP are negatively correlated with the population growth as expected.

Correlation Table-2

	Life Exp.	EDU	GDP	Population
Life Exp.	1	0.526	0.718	–.33
EDU		1	0.643	–.32
GDP			1	–.266

The over all result however weakly supports the EKC hypothesis. For the low developed countries, degradation sometimes positively related or insignificantly related to the growth of GDP and it is significantly inversely related to the same in case of highly developed countries.

Temporal Changes in Forest Resources in India and Per Capita Availability

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 in 1997) and special aforestation programmes through JFM, community forestry, social forestry, tree grower, cooperatives etc. for the revival of some degraded forest area; in qualitative terms (crown density), there has been continuous decline of forest resources. Despite governmental efforts through the aforesaid means, there has not been 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, fuelwood, 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.

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, 1998–1999). Illegal grazing by around 100 million livestock in the tracts of forestland also results in forest degradation in India (World Resources 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

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around 1.2 hectares that declined alarmingly to 0.066 hectares during 1977–1978 and still now it is around 0.07 hectares, which is well below the world standard. By running a regression of changes in forest cover during 1989–1997 on the literacy rate, population growth during 1991–2001, density of population, per capita NSDP and growth of per capita NSDP of major 25 states of India we observe:

$$\Delta F = -14.04 + 0.1509\ \text{Lit} + .0634\ \Delta\text{Pop.} + 0.003\ \text{Pop.D} + .0022\ \text{PCNSDP}^{*} - 2.548\ \Delta\text{PCNSDP}$$
$$(.97) \quad (.568) \quad (.69) \quad (2.57) \quad (-1.51) \quad R^2 = .36$$

Excluding literacy rate as explanatory variable we get

$$\Delta F = -7.82 + 0.051\ \Delta\text{Pop.} + 0.0031\ \text{Pop.D} + .0025\ \text{PCNSDP}^{*} - 1.486\ \Delta\text{PCNSDP}$$
$$(.462) \quad (.695) \quad (2.97) \quad (-1.15) \ldots. \quad R^2 = .32$$

Here ΔF = changes in forest cover, Lit = literacy rate, ΔPop = population growth, Pop.D = population density, PCNSDP = per capita net state domestic product and ΔPCNSDP = change of PCNSDP. Figures in parentheses represent t value and * indicates that the coefficient in significant at 5 per cent level of significance.

The result shows that population and literacy rate have insignificant impact on forest cover changes, while variation in per capita NSDP across the states is significantly positively associated with the changes in forest cover. However, the changes in NSDP per capita are negatively associated with the same though it is insignificant. The implication is that though in many cases forest resources improved with educational achievement and successful political campaign through community or joint management, the adverse impact of population growth has largely neutralised it and the growth of income in many areas has been at the cost of forest resources.

Conclusion

In conclusion we can say that though population growth puts more pressure on forest especially in the poorer region (where people earns a substantial portion of their sustenance from the forest) it is not always responsible for the destruction of forest. Rather it is the consumption and livelihood pattern of the people that is also influenced by their level of income, standard of education i.e., overall human development. Moreover, the business activities of the people related to forest resources may lead to more damage to the forest even if they are rich. Therefore, the

growth of the economy itself that helps the transformation of technology and creation of alternative sources of income to remove pressure on forest is essential. Thus the ultimate remedy of such problem lies in the development of economy itself, which must be associated with the reduction in poverty and progress of human resources so that people become more aware and can better manage such resources.

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