

## **THE SOCIAL AND ECONOMIC IMPACT OF SOIL DEGRADATION IN INDIA: A SURVEY OF LITERATURE**

Anshika Sharma

The University of Delhi.

### **1. INTRODUCTION**

Soil degradation is defined as “the rate of adverse changes in soil qualities resulting in a decline in productive capacity of land due to a process induced mainly by human intervention.”<sup>1</sup> Soil is of great importance to mankind. It provides food, fodder, and generates employment. Soil supports many ecosystems, biodiversity and ground water. Hence soil degradation can have many undesirable consequences. In order to ensure growth and economic development it is essential to make sure that advances in agriculture and industry do not degrade the soil on which they depend.

According to Sehgal and Abrol, in India, about 187.8 million hectare acres of soil out of 328.73 million hectare acres has been degraded. This works to about 57% of the country’s total area.<sup>2</sup>

The extent of soil degradation has been measured by many agencies such as National Commission on Agriculture, Ministry of Agriculture-Soil and Water Conservation Division, Department of Environment, National Remote Sensing Agency, National Bureau of Soil Survey and LUP.

### **2. CAUSES OF SOIL DEGRADATION**

Malpractices in agriculture and other human activities such as clearing of land, deforestation, industrial development, improper waste management, mining and overgrazing are major drivers of soil degradation. Growing population and demands for housing, food and over use of natural resources have changed the land use and led to deterioration of soil quality. There are natural causes of soil degradation like earthquakes, floods, tsunami etc. Indirect factors such as land shortage, excessive population, poverty of people dependent on soil also contribute to soil degradation.

---

<sup>1</sup> UNEP, “Global Environment Outlook-200,” United Nations Environment Programme. EarthScan, London 1999.

<sup>2</sup> J. Sehgal and Abrol, “Soil degradation in India: Status and Impact.” (New Delhi: Oxford IBH, 1994), 80

## **2.1 Industrialization and Urban Growth**

An increase in industries and development of urban areas is leading to infringement upon the land in the forest, pasture lands, grasslands and common lands. As urbanization gains more momentum, there is need for infrastructure such as houses, water, transport, commerce et cetera.<sup>3</sup> The land so needed is obtained from clearing forests, marginal land etc. This is a leading cause of loss of biodiversity and soil degradation. Industrial effluents, municipal and domestic wastes are not disposed properly thereby leading to a decline in the soil quality. Estimates of this type of degradation are not available, but the problem is extensive.

## **2.2 Mining**

Mining, especially open cast mining alters the physical, chemical and biological characteristics of soil. It leads to a drop in the water table and also pollutes the soil. Mining leads to a decline of the flora and the fauna of that area. Mining generates large quantities of wastes and slime and large areas of land are degraded. According to Sahu and Dash mining leads to a loss of topsoil which is rich in nutrients. The average income of the households living in the vicinity of the mining area has declined. Cash crops cannot be grown as the soil fertility is affected. There is a change in the employment pattern due to mining. There is no data available of soil degradation due to mining. Approximately 0.8 million hectare acres of land is under mining in India. So, this entire area is considered as degraded.<sup>4</sup>

## **2.3 Overgrazing and Deforestation**

Forest cover is being depleted at the rate of 0.34 mha per annum and afforestation being carried out is approximately one mha per annum.<sup>5</sup> This implies a steady decrease in the forest area of India. This is a cause for soil degradation mainly through water erosion. Forests are being cleared mainly for agriculture, timber, timber related industries, firewood and fodder. Soil degradation is also caused by overgrazing of cattle India has 467 million cattle which graze on 11 mha of land. It works out to 42 cattle grazing on 1 hectare of land where is the sustainable level is

---

<sup>3</sup> Barman, Sangar, Manda, Batatcharjee and R. Nandita, "Land Degradation: Its Control Management and Environmental Benefits of Management in Reference to Agriculture and Aquaculture." *Environment Ecology* 31 (2013):1095-1103.

<sup>4</sup> H.B. Sahu and S. Dash, "Land Degradation Due to Mining in India it's Mitigation Measures." Second International Conference on Environmental Science and Technology 2011: Singapore.

<sup>5</sup> MoEF, "National Forestry Action Programme." Ministry of Environment and Forest Government of India: New Delhi 1 (1999): 79.

five.<sup>6</sup> This creates an undue pressure on the soil. Due to overgrazing the soil erosion was 5 to 41 times greater in different areas than the normal. In 1997, fuel wood consumption was nearly 260 million m<sup>3</sup> and the sustainable level is 52.6million m<sup>3</sup>.<sup>7</sup> This is indicative of felling of trees and destroying the forest.

## **2.4 Shortage of Land and Population Growth**

India suffers from shortage of land. The country has 2.5% of the world's area and houses 16% of the world's population and 20% of the livestock. With the population increasing the land per capita declines. In order to sustain a large and increasing population along with poverty lead to poor land management techniques and are an indirect cause of soil degradation.

## **2.5 Natural Calamities**

Natural calamities are also a direct cause of soil degradation like earthquakes, volcanic eruptions, tsunamis, floods, droughts, avalanches, landslides etc. This leads to a loss of the topsoil and also the deforms the terrain along with loss of nutrients and organic matter present in the soil.

## **2.6 Agriculture**

Agriculture is the backbone of Indian economy. It is a large contributor to the GDP. The agricultural produce in India has increased from 50 metric tonnes to more than 250 metric tonnes in the last 50 years. Agricultural practices without any conservation methods also contribute to soil degradation by reducing the fertility of the soil leading to low production. Low yield is a threat to food security. Sustainable agricultural practices need to be followed so that environment is not impacted in a detrimental way. Soil is a fundamental resource that must be conserved at all cost.

### **2.6.1 Excessive Cultivation, Use of Heavy Machinery and Irrigation**

To meet the needs of a growing population there is excessive cultivation of land. This along with the use of heavy machineries like harvesters and threshers change the physical properties of soil and cause an adverse effect on the biological properties and the composition of soil.<sup>8</sup>

---

<sup>6</sup> K.B. Sahay, "Problems of Livestock Population." *Tribune*, 2000. <http://www.tribuneindia.com/2000/20000411/edit.html>

<sup>7</sup> MoEF. [http://www.envfor.nic.in/soer/2001/ind\\_land.pdf](http://www.envfor.nic.in/soer/2001/ind_land.pdf)

<sup>8</sup> Hobbs, P. Sayre, K. and R. Gupta, "The Role of Conservation Agriculture in Sustainable Agriculture." *Philosophical Transactions of the Royal Society B*. 363 (2008): 543-555.

There is a fall in the organic matter present in the soil which limits the life of the soil. Excessive tilling needs more irrigation. The public investment in irrigation has increased. The irrigated land has increased from 19% 38% in 40 years.<sup>9</sup> An important source of water for irrigation is the limited ground water. So, excessive cultivation depletes the groundwater and thus leading to the lowering of the water table. Irrigation through canal leads to waterlogging and salinization of soil. Sometimes the land becomes a barren due to the formation of saline sodic soil.

### **2.6.2 Fertiliser and Pesticide Usage**

Intensive cultivation coupled with usage of inorganic fertilisers and pesticides, especially during the Green Revolution, has led to the contamination of the soil. In 40 years India has increased its crop production from million tonnes to 193.million tonnes. This has been due to inputs such as fertilisers, high yielding variety of seeds, pesticides and irrigation facilities. Study has revealed that only 23% of the fertilizer is consumed by the crops, the rest 77% is leached out leading to nitrate pollution of ground water. Fertiliser subsidy is a major cause of soil degradation. The government has been unsuccessful in cutting down the subsidies on fertilisers because of the lobbying by farmer's groups. A study has shown that 1% reduction in fertilizer subsidy will reduce soil degradation by nearly 3%. Estimates have been made by Central Soil and Water Conservation Research and Training Institute about loss of nutrients from the soil. It was found that every year 20million tonnes of nutrients are removed due to cultivation and 74 million tonnes due to erosion.<sup>10</sup> This leads to soil fertility depletion. Use of pesticides has led to the contamination of the soil and the underground water with toxic substances and heavy metals. This has an unfavourable effect on the environment. Use of inorganic fertilisers and pesticides is a major cause of land degradation.

### **2.6.3 Improper Crop Rotation**

Improper crop rotation contributes to the erosion of soil, especially by wind, of the cultivated land. Cultivation in the marginal land areas which have less organic matter because of poor cropping patterns has led to land degradation.

### **2.6.4 Burning of Crop Residue**

---

<sup>9</sup> Bhattacharyya, Ghosh, Mishra and Mandal, "Soil Degradation in India Challenges and Potential Solutions." Sustainability (April 2015) Doi:10.3390/su7043528

<sup>10</sup> R.N. Prasad and P.P. Biswas, "Soil Resources of India" *50 Years of a Natural Resource Management* Indian Council for Agricultural Research (2000) New Delhi.

The Ministry of New and Renewable Energy states that 500Mt of crop residue are produced every year out of which one fourth is burnt.<sup>11</sup> The largest quantity of crop residue is produced in Uttar Pradesh followed by Punjab and Maharashtra. The crop residue generation is dominated by cereals(352Mt).<sup>12</sup> Out of the cereals rice has a share of 34% and wheat of 22%.

### **2.6.5 Cultivation Practices**

Shifting cultivation or Jhum cultivation is followed in 13 states of India, especially in the north-eastern states. It is an agricultural practice in which a piece of land is cleared of its natural vegetation by cutting and burning it. The land is cultivated temporarily. It is then left fallow. With increasing population and its pressure on land, shorter fallow periods are followed. This is not sufficient to restore the fertility of the soil thus leading to a decline in the productive capacity. This agricultural practice not only degrades the environment but also leads to soil erosion as forests are cleared to make way for slash and burn cultivation.

### **2.6.6 Green Revolution**

In the 1960s, the era of Green Revolution, there was an increase in agricultural production due to more area being brought under cultivation by clearing forests and common land. This resulted in noticeable soil erosion. Use of high yielding variety of seeds, chemical fertilisers and pesticides did increase the production but had far-reaching effects on the quality of the soil. The technologies used in the green revolution is capital intensive and labour saving hence the real wages remained constant or even declined in a few states.

## **3. SOCIAL AND ECONOMIC IMPACT OF SOIL DEGRADATION**

The social, economic and ecological consequences of soil degradation are wide ranging. Three fourths of the poor who are food insecure are dependent on natural resources for survival. Many different measures have been used to find the economic effects of degradation of soil such as amount of food consumed from farm production, number of food insecure people, level of malnutrition, level of rural household income and consumption, migration rate etc.

### **3.1 Estimation Model**

---

<sup>11</sup> MNRE, *Annual Report of the Ministry of New and Renewable Energy*. Government of India (2009): New Delhi, India.

<sup>12</sup> NAAS, "Management of Crop Residue in the Context of Conservation Agriculture" Policy paper National Academy of Agricultural Sciences. 58 (2012): 12.

Econometric models have been used to estimate soil loss in which the yield function is the input response and the soil quality the multiplier function. Potential yield value lost as a result of fall in the soil quality can be determined.<sup>13</sup>

Estimation model was formed to find extent of economic losses due to soil degradation. The model uses the degraded land data estimated by National Remote Sensing Services. This district wise land data is multiplied with total value of output per hectare and the harvest price of the crops.<sup>14</sup> This gives the monetary loss in production due to soil degradation. A sensitivity analysis was also carried out and economic losses were calculated for two alternative scenes-10% lower extent of the degradation and 10% higher extent of the degradation. This was done to take the effects of increase in soil degradation over time or decrease due to reclamation procedures. The study used data from National Bureau of Soil Survey, Land Use Planning and estimates of Abrol and Sehgal. Productivity value at current and constant prices was calculated. The economic losses were estimated to Rs. 285.51 billion at current prices. The maximum economic loss was in Andhra Pradesh and the least in Punjab. Most of the studies about valuation due to soil degradation have ignored the soil types found in various regions of India.<sup>15</sup>

### **3.2 Economic Impact of Soil Degradation.**

The degradation of soil is a major problem in India. Large amount of money is being lost due to soil degradation. National Remote Sensing Agency has estimated that there has been a production loss of Rs. 68 billion in 1988-89. This cost is calculated by diminished crop yield, intensity of land use, more use of inputs and declining profits.<sup>16</sup> A study revealed that there was a loss of 13.4 million tonnes of crop production, that is US \$ 162 billion, due to water based soil erosion.<sup>17</sup> According to Brandon, Hommann and Kishor the loss due to salinization of soil was 6.2 million tonnes as per FAO data, the Indian data states 9.7 million tonnes.<sup>18</sup> In a study conducted by TERI, the cost of land degradation in India was nearly 2.54% of India's GDP in the year 2014 to 2015. The country suffered an economic loss of Rs. 285.51 billion at current

---

<sup>13</sup> K.S. Parikh and U.Gosh, "Natural Resource Accounting for Soil Towards an Empirical Estimate of Costs of Soil Degradation in India." *Indira Gandhi Institute of development research Discussion Paper 48* (1991).

<sup>14</sup> Vashisht, Singh and Mathur, "Economic Implications of Land Degradation and Sustainability and Food Security in India." *Agropedology* 13, no. 2 (2003): 19-27.

<sup>15</sup> Sehgal and Abrol, "*Soil Degradation in India: Status and Impact.*" (Oxford: Oxford and IBH 1994).

<sup>16</sup> V.R. Reddy, "Land Degradation in India: Extent, Cost and Determinants." *Economic and Political Weekly* 38, no. 44 (2003): 4700-4713.

<sup>17</sup> Sharda, Dogra and C. Prakash, "Assessment of Production Loss due to Water Erosion in Rain Fed Areas of India." *Indian Journal of Soil and Water Conservation* 65 (2010): 79-91.

<sup>18</sup> Brandon, Hommann and Kishor, "The Cost of Inaction Valuing the Economy: Wide Cost of Environmental Degradation in India." *UNU Conference on Sustainable Future of Global Systems Tokyo* (October 1995).

prices. This is about 12% of the agricultural output of the country. The direct cost of land degradation is 2% of the GDP and 4% of the agricultural gross domestic production(AGDP).

Soil degradation is a serious constraint to the food problem. A fall in the quality of the soil and its fertility results in lower production and higher costs because more inputs need to be used in order to get desirable output. The agricultural income falls and its multiplier effect takes place.

A decline in the soil fertility is of significance both in the national consumer market and the export market. It leads to a decline in the aggregate supply. This in turn will lead to a decrease in the exports of the agricultural produce and in case of extreme shortfall may have to resort to importing food grain.

Effect of soil degradation on consumption by the rural poor is significant. It is a threat to food security for subsistence producers with few alternative sources of livelihood.<sup>19</sup> Soil degradation has a negative effect on national wealth. Decline in the quality of the soil decreases the long-term productive capacity of the soil. This threatens the resource base and food security of generations.

Soil houses many ecosystems. Degradation of soil harms these ecosystems also. The benefits provided by these ecosystems cannot be valued in monetary terms due to measurement problems.<sup>20</sup> Computed economic losses do not present an accurate picture as there is failure to include these values while calculating potential and actual losses through soil degradation.

It is estimated that 6000 to 12000 million tonnes of soil are eroded in a year. Soil that is eroded by wind is deposited in the water reservoirs thereby reducing their capacity by 1-2%. This results in reduction of electricity production. This in turn affects the industrial production which too declines. All this combined, affects the size of government spending.<sup>21</sup>

### **3.3 Social Impact of Soil Degradation.**

Communities rely on ecosystems for their basic needs. Degradation of the soil and depleting it of its natural nutrients also destroys many ecosystems. Thereby affecting the communities who are dependent on them.

---

<sup>19</sup> S. Scherr, "Soil Degradation: A Threat to Developing Country Food Security by 2020." International Food Policy Research Institute: Washington (1991).

<sup>20</sup> Nkonya, von Braun, Mirzabaev, Le, Q.B. Kwon and Kirui. 2013. "Economics of Land Degradation Initiative: Methods and Approach for Global and National Assessment." ZEF Discussion Paper 183.

<sup>21</sup> Nkonya, Ephraim, Mirzabaev, Alisher, von Braun, "Economics of Land Degradation and Improvement of Global Assessment for Sustainable Development."2011.

Earlier there was spare land and resources for the poor farmers to fall back upon. In case their land was degraded that they could take new land into cultivation or depend on the forest for their livelihood. Now there is shortage of land due to an increasing population coupled with soil degradation leaves nothing for the poor fall back on. The only alternative for them is migration to the urban areas.

One of the important effect of soil degradation is reduction in the water holding capacity of the soil. The water table decreases. This leads to an increase in the irrigation costs and also the villagers have to go much farther in order to get water.

Deforestation has forced village folk to walk longer distances to collect fuel wood.

Depleting the soil of its fertility decreases the agricultural production. This implies a decline in the rural household income and consumption. Thus, soil degradation increases the food insecure households and the number of malnourished children.

#### **4. CONCLUSION**

Soil is considered as a non-renewable source hence it's degradation is undesirable. It is estimated that nearly 40% of world's agricultural land is degraded. It is a major concern for Indian agriculture because two thirds of Indian population depend on it for their livelihood. Soil management, in India, has not been systematic. There is no fuel wood, grazing or fodder policy at national level. Expenditure in soil conservation is of utmost importance. There is need for sustainable agricultural practices with micro irrigation, afforestation, waste land reclamation and efficient use of marginal lands. Land fragmentation should be controlled. As the number of cultivators per unit of cultivated area increases by 1% it leads to an increase in soil degradation by 0.9%. There has been initiation of many policies and programmes in the last twenty years to tackle this problem of soil degradation but the results are modest.

Environmental Kuznets theory states that in the initial stages of growth there is more environmental degradation. This degradation declines after a threshold is reached. Agricultural GDP is an indicator of growth and we can say that per capita income has not reached that threshold yet where soil degradation is concerned. To prevent soil degradation is an important environmental management issue.

#### **REFERENCES**

Joshi, Wani, Chopde and Foster. 1996. "Farmers Perception of Land Degradation: A Case Study." *Economic and Political Weekly* 31, no. 26: A89-A92.

- MoEF. 1999. "National Forestry Action Programme." Ministry of Environment and Forests Government of India, New Delhi 1: 79.
- Narayana, V.V.D. and Babu Ram. 1983. "Estimation of soil erosion in India." *Journal of Irrigation and Drainage Engineering* 109, no. 4:419-434.
- Ratna, Reddy V.1999. "Valuation of Renewable Natural Resource: User Perspective." *Economic and Political Weekly* 34, no. 23: 1435-1444.
- Reddy, V.R. 2003. "Land Degradation in India: Extant, Costs and Determinants." *Economic and Political Weekly* 38, no. 44: 4700-4713.
- Sehgal, J. and I.P. Abrol. 1994. "Soil Degradation in India: Status and Impact." Oxford": Oxford and IBH.
- UNDP, FAO and UNEP. 1993. "Land Degradation in South Asia: Its Severity, Causes and Effects upon the People." Rome: FAO, World Soil Research Report 78.
- Vasisht, Singh and Mathur. 2003. "Economic Implications of Land Degradation on Sustainability and Food Security in India." *Agropedology* 13, no. 2: 19-27.