AN ANALYSIS OF THE IMPACT OF LAND DEGRADATION ON AGRICULTURE IN INDIA

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Abstract

Agriculture is one of the main occupations in developing countries. More than 58% of population depends on agriculture directly or indirectly in India. Agriculture production is based on fertile soil. Soil fertility and productivity are directly influenced by a balance of chemical and organic fertilizers. But disproportionate and imbalanced use of chemical and organic fertilizers and other natural hazards affect the soil fertility. According to National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) 146.8 Mha of land has degraded in the year 2004 in India, which had a direct impact on sustainable agriculture. Government of India has taken important measures to improve soil fertility by providing awareness and announcing several programmes about soil fertility and sustainable agriculture to farmers. In this context, it has provided Soil Health Card to farmers. Soil Health Mission is an important initiative by Government of Karnataka. These programmes aim to provide awareness to the farmers towards improving soil fertility and sustainable agriculture. In spite of all these initiatives, the data reveals declining soil fertility and depletion of nutrients. This study aims at analysing the trends in the usage of chemical fertilizers, soil degradation in India and Karnataka. The analysis observed that Madhya Pradesh and Chhattisgarh states have highest degraded area (26.2 Mha) followed by Uttar Pradesh and Uttarakhand. Karnataka's soil is largely Zink deficient. The paper discusses about the impact of agricultural policy and suggests required measures to reduce soil degradation for sustainable agriculture.

Keywords; Agriculture, Land, Degradation, India, Karnataka

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INTRODUCTION

Agriculture is the main occupation in many developing countries. More than 58 percent of population depends on agriculture directly or indirectly in India. Agriculture production is based on fertile soil. Soil fertility and Productivity is directly impacted by a balance of chemical and organic fertilizer. But disproportionate and imbalanced use of chemical and organic fertilizer and other natural hazards affect soil fertility. According to NBSS&LUP 146.8 Mha of land has degraded in the year 2004 in India, directly affecting sustainable agriculture. Land is an important resource for food production. Until recently, policy makers and policy analysts have not perceived land degradation as a threat to global food security. It has been widely assumed that at the global level, land is in abundance, and is less important than other factors in determining agricultural productivity (De Vries et al. 2002)

Soil is the uppermost layer of the earth and one of the most important natural resources. It plays a crucial role in agriculture production, because there is no substitute for the soil for cultivation. Based on depth, clay content and other soil parameters there are six types of soils in India. They are red soil, black soil, alluvial soil, laterite soil, desert soil, hills and terrain soils. Red soil covers the largest area (105.5 M ha) and black soils cover 73.5 M ha. While alluvial soil 58.4 M ha, laterite soils 11.7 M ha, desert soils 30 M ha and hills and terrain soil covers 26.6 M ha.

The term soil fertility has many definitions and is understood in many ways (Patzel et al. 2000). In its narrow sense, soil fertility refers to the soil capacity to supply nutrients to the plant in sufficient amount at the right time. The three major nutrients are Nitrogen (N), Phosphorous (P) and Potassium (K). Soil fertility is understood as a combination of chemical, physical and biological factors that affect the land capacity to supply nutrients to the plant. As defined by the Soil Science Society of America (SSSA, 1997) soil fertility is "the quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants or crops". This definition seems more appropriate as the different practices used by farmers not only change the nutrient status of the soil but also its structure and its biological status (e.g. the preservation of crop residues enhance the soil structure as well as its nutrient content). Excess quantity and imbalance in the usage of chemical fertilizers, unscientific farming and natural calamities influence the soil fertility negatively.

Soil fertility is the soil's ability to produce and reproduce. It is the aggregate status of a soil consequent on its physical, chemical and biological well-being (Reddy, 2013). Soil fertility decline encompasses nutrient depletion or nutrient decline (i.e. removal of nutrients greater than addition of nutrients), nutrient mining (i.e. only removal of nutrient, no addition of nutrients), acidification (i.e. decline in soil PH), the decrease of soil organic matter content and the rise in toxic element like Aluminium (Hartemink, 2006). Thus, practices related to soil fertility encompass practices for the replenishment of the soil fertility practices to sustain soil fertility and the ones to enhance soil fertility (Jeannin, 2013).

According to the Compendium on Soil Health, Ministry of Agriculture and Cooperation (2012) “Intensive agriculture, while increasing food production, has caused second generation problems in respect to the nutrient imbalance including greater mining of soil nutrients to the extent of 10 million tonnes every year, depleting soil fertility, deficiencies of secondary and micronutrients, decline of water table and its quality of water, decreasing organic carbon content and overall deterioration in soil health”.

Chauhan and Mittu (2015) observed soil fertility as a function of the biological, physical and chemical characteristics of soil. Therefore, it is suggested that an organic fertility program should consider all of these interrelated factors to optimize and sustain crop production. Decrease in soil fertility has negative consequences on agricultural production. As observed by Lal (2015) soil degradation characterized as decline in quality and decrease in ecosystem goods and services, is a major constraint in achieving the required increase in agricultural production.

As per the estimates of Indian Council of Agricultural Research (ICAR, 2010), out of total geographical area of 328.73 million hectares, about 120.40 million hectares is affected by various kind of land degradation resulting in annual soil loss of about 5.3 billion tonnes through erosion. This includes water and wind erosion (94.87 M ha), water logging 0.91 (M ha), soil alkalinity (3.71 M ha), soil acidity (17.3 M ha), soil salinity and mining and industrial waste (0.26 M ha).

REVIEW OF LITERATURE

Lal (2015) analyzed the importance of soil fertility in agriculture in the study ‘Restoring soil quality to mitigate soil degradation’. The main aim of this study is to identify the strategies for improving soil quality to mitigate risks of soil degradation. The study identified creating a positive soil or ecosystem budget, improving availability of macro and micro nutrients, increasing soil biodiversity especially the microbial process, enhancing rhizospheric process as important strategies to restore soil fertility and reducing environmental damage. A similar study by **Sannappa and Manjunath (2013)** shows that PH and EC of soils ranges from 5.25 (Sirsi), 7.83 (Madikeri) and 0.03 (Sirsi) and 0.28m.mhos/cm (Shimogga). Organic carbon and available nitrogen content are significantly more in H.D.Kote and Sakaleshpura regions. Madikeri region's soil contains high phosphorus content. Both Madikeri and Sakaleshpura region recorded highest potassium content. The work of **Singh and Tiwari (2012)** is based on both primary and secondary data. Primary data was collected from scientists and farmer's interaction. The study selected 200 soil sample surveys and then the findings were interpreted by comparing with earlier results. The soil samples collected were mainly from fields growing rice- wheat, rice-vegetables-pea, rice -vegetables, pea-sugarcane-ratoon - wheat cropping. This study highlights imbalanced use of fertilizers in rice-wheat cropping, depletion of organic matter, ground water and humus attributed to more use of pesticides and pathogens as the reasons for soil fertility depletion. The study suggests training programmes, deep ploughing, green manuring, organic farming, crop residue management, crop diversification, balance use of fertilizer etc. as measures for maintaining soil fertility. Another study by **Majumdar (2015)** shows that there is a positive and significant relationship between the bio fertilizer use and agricultural output. The use of bio fertilizer in the place of chemical fertilizer is a good way for the sustainable agriculture.

OBJECTIVES

The main aim of the study is to analyse the trends in the soil degradation in India in general and Karnataka in particular.

METHODOLOGY

The study is based on secondary data sources. The data was collected from various reports published by the Government of India and Karnataka such as Environment reports, Soil Health Mission Report etc. Necessary details extracted from these reports are shown in Table 1.

Table 1: Land degradation in India estimated by different organizations

S/N	**Organizations**	**Assessment Year**	**Degraded Area (Mha)**
1	National Commission on Agriculture	1976	148.1
2	Ministry of Agriculture-Soil and Water Conservation Division	1978	175.0
3	Department of Environment	1980	95.0

4	National Wasteland Development Board	1985	123.0
5	Society for Promotion of Wastelands Development	1984	129.6
6	National Remote Sensing Agency	1985	53.3
7	Ministry of Agriculture	1985	173.6
8	Ministry of Agriculture	1994	107.4
9	NBSS&LUP	1994	187.7
10	NBSS&LUP (revised)	2004	146.8

Source: Ranjan Bhattacharyya et al. (2015)

ANALYSIS AND DISCUSSION

According to 2004 revised statistics of National Bureau of Soil Survey & Land Use Planning (NBSS&LUP), out of total geographical area of 328.7 Mha in India 146.8 Mha (44.60%) was degraded by various sources. This shows a decline in the degradation from 187.7 Mha reported in the year 1994. Even after giving allowance for the differences in methodologies, the estimates show a considerable amount of degraded land in India.

Soil degradation has become a serious problem in both rain fed and irrigated areas of India. India is losing a huge amount of money from degraded lands. This cost is documented by declining crop productivity, land use intensity, changing cropping patterns, high input use and declining profit. (Ranjan Bhattacharyya et al. 2015). The issue of land degradation needs attention as soil degradation has an influence on the livelihoods of millions of marginal and small farmers in the form of increasing the cost of cultivation as more and more external inputs are needed to maintain the same levels of output.

State-Wise Land Degradation in India

Soil degradation is not uniform across the country. Some states have more degraded land compared to others. As reported by Bhattacharya (2015), Madhya Pradesh and Chattisghar has more degraded land. The table below shows the extent of degraded land in different states.

Table 2 The Extent of Degraded Land in Different States

S/N	**State**	**Degraded Area (In Mha)**
1	Andhra Pradesh and Telengana	15.0
2	Goa	0.2
3	Karnataka	7.6

4	Kerala	2.6
5	Tamil Nadu	5.3
6	Manipur	1.9
7	Mizorum	1.9
8	Meghalaya	1.2
9	Assam	2.2
10	Arunachal Pradesh	4.6
11	Nagaland	1,0
12	Sikkim	0.2
13	Tripura	0.6
14	Himachal Pradesh	4.2
15	Jammu and Kashmir	7.0
16	Uttar Pradesh and Uttarakhand	15.3
17	Delhi	0.1
18	Haryana	1.5
19	Punjab	1.3
20	Bihar + Jharkhand	6.3
21	West Bengal	2.8
22	Union Territories	0.2
23	Gujarat	8.1
24	Rajasthan	11.4
25	Madhya Pradesh and Chhattisgarh	26.2
26	Maharashtra	13.1
27	Orissa	6.1
28	Grand Total (Mha)	146.8

Source: Ranjan Bhattacharyya et al. (2015)

The above data shows that out of the total geographical area 328.7 Mha, 146.8 Mha was degraded area by various sources. Madhya Pradesh and Chhattisgarh states have highest degraded area (26.2 Mha), Uttar Pradesh and Uttarakhand states are in the second place in degraded area and its share is 15.3 Mha, Andhra Pradesh and Telengana are in the third place in degraded area (15.0 Mha) whereas Karnataka state has 7.6 Mha of degraded area. In the absence of total cultivated area in different states the share of degraded land in the total area in respective states is not known.

Soil fertility status

Fertility status of soil in different states as reported in fertilizer statistics (2013-14) provides an overview of fertility status in different states of India. The status is estimated based on the quantity of NPK used. Usage of more than 450 kg of Nitrogen, 50 kg of Phosphorus and 280 kg of Potash is considered as high usage.

Table 3: Soil fertility status in India in terms of N P K

S/N	States	Nitrogen	Phosphorus	Potash
1	Assam	Medium	Medium	Medium
2	Arunchal Pradesh	High	Low	High
3	Manipura	Low	Low	Medium
4	Meghalaya	High	Low	Medium
5	Mizoram	High	Low	Medium
6	Nagaland	High	Medium	Low
7	Odisha	Low	Low	Medium
8	Tripura	Medium	Medium	Medium
9	West Bengal	Medium	Medium	Medium
10	Gujarat	Medium	Low	High
11	Goa	High	Medium	Medium
12	Madhya Pradesh	Medium	Medium	High
13	Maharashtra	Low	Low	High
14	Haryana	Low	Low	Medium
15	Himachal Pradesh	High	Medium	Low
16	Jammu and Kashmir	Medium	Low	Low
17	Punjab	Medium	Medium	High
18	Uttar Pradesh	Low	Low	Medium
19	Andhra Pradesh	Low	Low	High
20	Andaman and Nicobar Islands	Low	Low	Low
21	Karnataka	Medium	Medium	High
22	Kerala	Low	Medium	Medium
23	Puducherry	Low	Low	Medium
24	Tamil Nadu	Low	Medium	High
	India	**Low**	**Medium**	**High**

Source: Fertilizer Statistics 2013-14, Department 0f Fertilizers Ministry of Chemicals and Fertilizers, Government of India

The Table 3 shows the information about soil fertility status in terms of major nutrients in India. At an all India level the availability of nitrogen is observed to be low. On the other hand the phosphorus content in the soil is observed to be at medium level (25-50 Kg/ha). However, the availability of potash content in the soil is observed to be high (more than 28 kg/ha). This data clearly shows the imbalance in the availability of major nutrients in the soil. In Karnataka state the availability of nitrogen and phosphorus content is of medium level but potash content is of high level. This also shows the imbalance in the availability of nutrients in the soil.

Status of Soil Fertility in Karnataka

Agriculture productivity depends on quality and availability of natural resources like soil and water. So fertile soil is more important to agriculture production. Using the improved varieties of seeds and the usage of the chemical fertilizer increases the agriculture production. But on the other hand use of chemical fertilizers results in mining of soil nutrients leading to depletion of soil fertility and organic matter etc.

Soil Health Mission (SHM) of Karnataka has estimated the nutrient deficiency of soil in different districts of Karnataka during the year 2013-14. As per the estimates, Karnataka has serious deficiency in several important nutrients.

The data relating to the nutrient deficiency of different districts is presented in table 4.

Table 4 : District wise percentage deficiency of nutrients in soils of Karnataka (2013-14)

S/N	District	N	P	K	Acidic	EC	S	Zn	Cu	Mn	Fe	B
1	Chikka magalur	36.11	17.72	23.54	43.57	0.00		67.76	3.14	2.79	12.42	18.10
2	D.Kannada	3.89	13.77	8.18	95.91	0.52		62.16	2.37	27.03	6.90	
3	Mandya	25.93	7.76	9.69	14.32	1.33		99.16	2.23	6.30	0.20	
4	Bagalakote	2.11	83.51	0.00	0.00	1.21						
5	Bidar	19.00	6.71	0.15	4.45	0.00		35.97	0.95	7.40	70.89	
6	Belagaum	28.17	36.13	0.21	13.47	0.21						
7	Gadag+ Haveri	39.67	64.10	0.31	0.11	0.55						
8	Hassan	27.46	4.86	5.75	34.37	0.06						
9	Kolar	83.42	32.70	10.97	1.47	0.21		28.81	0.50	3.04	19.69	
10	Tumkur	94.41	11.06	6.01	13.39	0.27	13.14	76.71	8.86	21.96	69.87	75.19
11	Shimoga	57.66	12.86	12.34	12.86	31.14	24.73	63.20	2.13	5.96	1.01	12.06
12	Dharwad	28.58	56.28	0.77	8.45	0.13	32.58	35.90	0.00	25.64	53.85	19.19
13	Kodagu	10.17	20.05	11.75	84.14	0.00		16.39	4.46	2.49	1.44	
14	Raichur+ Koppal	2.46	1.43	1.26	0.09	0.00						
15	Gulbarga+ Yadgiri	26.54	23.08	0.20	0.08	0.00						
16	Bangalore urban+ Bangalore rural+ Ramanagara	40.70	0.89	20.35	25.91	0.16		54.03	1.35	1.51	22.61	65.67
17	U. Kannada	31.60	40.88	28.18	69.81	0.08		24.52	0.00	4.09	1.09	
18	Davanagere	44.22	23.74	4.86	13.06	0.20		78.71	3.41	0.34	8.70	
19	Ballary	55.87	51.20	0.52	0.37	4.02	0.97	3.10	0.00	0.00	14.99	
20	Mysore+ Chamaraja nagara	62.38	18.98	6.70	8.64	0.26		59.68	0.25	7.50	57.90	
21	Bijapura	64.67	70.30	0.00	0.00	1.59						
	Total	**41.17**	**26.31**	**7.96**	**19.52**	**2.61**	**4.43**	**52.24**	**2.24**	**6.23**	**24.76**	**35.93**

Source: Soil health mission 2014-15, government of Karnataka, Department of agriculture.

The data shows that Karnataka soil is severely deficient in zink. As per the estimates there is more than 50 percent (52.24%) zink deficiency in the soils of Karnataka. Higher deficiency of zink is observed in Mandya (99.16%), Tumkur (76.71%), Shimoga (63.20%) Davanagere (78.71%), Chickkamagalur (67.76%) and Dakshina Kannada (62.16%). The next important nutrient which is found deficient is Nitrogen which is deficient by 41.17%. Among the districts Kolar (83.42%), Tumkur (94.41%), Bijapura (64.67%), Mysore and Chamarajanagara (62.38%) and Shimoga (57.66%) are the highly deficient districts. Deficiency of Potash is observed in Bagalkot (83.51%), Gadag and Haveri (64.10%), Dharwad (56.28%) and Bijapura (70.30%).

Fertile soil is most important in the agricultural production and sustainable agriculture. Natural calamities and unscientific farming has lead to soil degradation which will affect soil fertility. Present study analyses land degradation in India in general and Karnataka in particular. The major findings of the study shows Madhya Pradesh and Chhattisgarh states having highest degraded area (26.2 Mha) followed by Uttar Pradesh and Uttarakhand states and where as Karnataka soil is severely deficient in zink.

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