Land Degradation and the Extent of Soil Degradation in Haryana

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ABSTRACT: *This paper reveals a general state of soil quality in Haryana using averages computed from soil samples collected by CSSRI, Karnal. The data and results indicate that the pH value of the agri-soil in Haryana is slightly on alkaline side and therefore it has the capacity to absorb more phosphate and potash whose availability is low. The abysmally low organic carbon may be the cause of high salinity and deficiency of all other micro (Zn, Fe) and macro (P_2O_5, K) nutrients. The nature of this data distribution also suggests that within the given ranges a monotonic increase (decrease) in OC (EC) shall lead to higher crop yields and vice-versa in Haryana. The recognized reasons of decrease in soil quality are fertilizer use in imbalanced or inappropriate path amid cultivating, salted soils due to low level ground water and soil sanlinization. Because of increased soil disintegration, soil richness decay, polluted ground water, environmental change or diminished biodiversity, agribusiness need to confront loads of negative impacts, for example, lessening in farmers income, farmers suicides and increase in agricultural obligation in the form of subsidies.*

Key Words: *Salinization, Soil Quality*

1. Introduction

The present pace of agricultural development in India is confronting different difficulties to proceed. The two noteworthy issues with respect to farming that should be comprehended are the manageable utilization of characteristic assets and improvement of yield levels. To accomplish sustainability, if there should be an occurrence of yield enhancement, we need to manage declining agricultural soil quality. India's agribusiness unequivocally requires the independence and sustenance security for the increasing population. In the late sixties, the nation attained a huge consistent development with the seed-fertilizer upheaval. Indian agribusiness faces a considerable measure of difficulties, for example, declining yield, low soil quality, unseemly climate conditions or out of date agricultural practices. As indicated by a report of Swaminathan Committee (2006) on farmers, the per unit yield of Indian farming is much lower than other real product yield of delivering nations.

Table 1: Yield Productivity of Selected Crops of India & Other Countries. (Kg/ha)

Country / Crops	Paddy	Wheat	Maize	Groundnut	Sugarcane
India	2929	2583	1667	913	68012
China	6321	3969	4880	2799	85294
Japan	6414	N.A.	N.A.	2336	N.A.
USA	6622	2872	8393	3038	80787
Indonesia	4261	N.A.	2646	1523	N.A.
Canada	N.A.	2591	7974	N.A.	N.A
Vietnam	3845	2711	4313	1336	65689

Source: Table 3, Fifth NCF Report based on Agriculture at a Glance (2002), Ministry of Agriculture.

It appears in the table, in contrast with other nations where Indian agribusiness exists. There is a solid requirement to use such approaches which will help to boost the development of Indian agriculture. As indicated by this Committee, out of the gross sown area of 192 million ha, rain-fed farming adds to 60 per cent of gross cultivated area and 45 per cent of the aggregate farm produce. The extent of land degradation in India given by different agencies has been shown in the Table 2.

Table 2: The Estimates of Degraded Land in India

Name of Agency	Degraded Lands (mha)
National Commission on Agriculture. Govt. of India. (1976)	175
Department of Environment, Government of India, (Vohra 1980)	95

Society for Promotion of Wasteland Development, (1984)	93.7
National Remote Sensing Agency, Hyderabad, (1985)	53.3
National Wasteland Development Board, Ministry of Environment and Forest, New Delhi, (1985)	123
Soil and Water Conservation Division, Ministry of Agriculture, (1991)	173.6
National Bureau of Soil Survey and Land Use Planning, (1994)	166
Abrol & Sehgal (1994), GLASOD Mapping	187.7

Source: Statistical Abstract of Haryana (1997-98), Government of Haryana, (1999).

Earlier, soil saltiness was essentially associated with high ground water tables, which conveys salts to the root zone of soil. Be that as it may, increased wrong usage of ground water has caused depletion of underground water tables and prompted the soil degradation by the utilization of low quality ground water. In a few sub zones of Upper East India, underground water is extracted, water table falls, and salts are found in root zone because the high amount of bad quality underground water is pumped out. All things considered, agriculturists need to confront heaps of issues because of low characteristic-salted water and furthermore the soil salinization. They need to manage salted water that is unsafe for crop yield. To take care of this issue, farmers irrigate with trench water and ground water for cultivating as often as possible. They need to do it to alleviate the unfavorable impact of soil saltiness on crop yield. Low quality of ground water, low soil quality and wrong appropriation of water system has prompted abatement in incomes of cultivating network. The social and financial misfortunes because of ecological degradation through the issues of water logging and soil corruption are considerable dangers to the supportability of farm production in Haryana state. Unseemly water system prompts soil degradation or additionally adds salts to the root zone. Despite the fact that accessibility of underground water of bad quality and soil degradation are the fundamental drivers in diminishing the crop yields. It should be noted that agriculture soil quality deterioration is one dimension of the land degradation. The district wise area of degraded land according to the source cause is given in the Table 3 as below:

Table 3: District Wise Area of Degraded Soil Classes in Haryana (000' Hectares)

#	Districts/ Classes*	1	2	3	4	6	7	8	12	13	14	18	19	Total	Degraded Lands	%	Rank
1	Ambala	3	0	2	0	0	0	0	0	1	0	0	0	157	6	3.82	14
2	Bhiwani	0	0	0	0	0	0	0	0	2	0	0	1	478	3	0.63	19
3	Faridabad	30	0	0	0	0	2	0	0	5	0	1	0	215	38	17.67	7
4	Fathabad	3	0	0	0	0	5	1	0	0	0	0	0	253	9	3.56	15
5	Gurugram	77	0	0	0	0	4	1	0	0	0	2	0	275	84	30.55	3
6	Hisar	2	0	0	0	0	10	0	0	0	0	0	1	399	13	3.26	17
7	Jhajjar	0	0	0	0	0	1	0	0	1	0	3	1	183	6	3.28	16
8	Jind	0	0	0	0	0	12	0	0	13	0	0	0	270	25	9.26	12
9	Kaithal	0	0	0	0	0	1	0	0	20	0	0	0	232	21	9.05	13
10	Karnal	0	0	0	0	0	1	0	0	28	0	0	0	251	29	11.55	9
11	Kurukshtra	0	0	0	0	0	0	0	0	16	0	1	0	153	17	11.11	10
12	Mehandergarh	0	0	0	0	0	0	0	0	0	0	0	0	185	42	22.7	4
13	Panchkula	42	0	0	0	0	0	0	0	0	0	0	0	89	59	66.29	1
14	Panipat	59	0	0	0	0	1	0	0	49	0	0	0	128	50	39.06	2
15	Rewari	0	0	0	0	0	0	0	0	0	0	2	0	158	22	13.92	8
16	Rohtak	20	0	0	0	0	1	0	0	2	0	0	0	174	4	2.3	18
17	Sirsa	0	0	0	0	0	4	0	0	6	1	1	0	428	47	10.98	11
18	Sonipat	36	0	0	0	0	1	0	0	39	0	1	0	213	41	19.25	6
19	Yamunanager	31	0	0	0	0	1	0	0	1	0	1	1	180	35	19.44	5
20	Total	303	0	2	0	0	44	2	0	183	1	12	4	4421	551	12.46	

Source: NBSS & LUP, Indian Council of Agriculture Research

Notes: Classes*: 1 Exclusively water erosion (>10 tonnes/ha/yr); 2 Water erosion under open forest; 3 Exclusively acid soils; 4 Acid soils under water erosion; 6 Exclusively wind erosion; 7 Exclusively saline soils; 8 Eroded saline soils; 12 Water logged saline soils; 13 Exclusively sodic soils; 14 Eroded sodic soils; 18 Mining/Industrial waste; 19 Waterlogged area (Permanent) Others**: Normal agricultural lands, water-

bodies, rivers, lakes and habitats etc. (based on the limited reconnaissance survey)

2. Methodology

The primary data has been collected from the farmers taking farm as the unit of analysis using a schedule of questions (Data Collection Form). All data was collected in person by the researcher herself while visiting the villages with direct interview method. The Data Collection Farm (Given at the end of this Chapter) was designed in such a way that all necessary information required for estimation of cost/production function of total rabi & kharif output of a farm could be extracted. To include the information on soil quality, only those farmers have been included in the study that has been issued Soil Health Cards (SHC) by Agriculture Department, Haryana. When the study was started, only 1.5 lakh farmers were issued SHC but now the state government has issued a SHC to every farmer who has sought it from a nearby extension service centre. The information about farming practices, experience and education was also collected to judge the inter-relationship with farming decisions.

The primary data from 303 farm units for 10 villages and 3 districts of Kurukshetra, Jind and Hissar of Haryana has been collected. The names of villages are Buana, Kinana, Hariyapur, Jainpur Jattan, Rattan Dera, Dhirpur, Sanwala, Kanipla, Brachpur, and Bugna.

Soil Quality Indices

For the analysis of district wise cross sectional secondary data five Soil Quality Indices have been developed namely, - PHINDEX, ECINDEX, OCINDEX, P2O5INDEX sand KINDEX representing the acidity-alkalinity, electrical conductivity, organic carbon, phosphate and potassium of the soil. All the indices are simple weighted averages of the values of the variables with their respective number of soil-samples. First, the indices have been computed at block level and then from these block level values the average indices values for district level have been computed.

All the secondary data has been collected is organized on 22 districts of Haryana for the year 2015-16 from various websites of Centre and State. District wise data on soil quality of Haryana have been collected from (CSSRI) Central Soil Salinity Research Institute Karnal. It is based on 1,55,128 soil-samples collected from 95 blocks of 22 districts on five soil-quality variables namely,- pH, EC, OC, P2O5 and K.

3. The Extent of Land Degradation in Haryana

The recognized reasons of decrease in soil quality are fertilizer use in imbalanced or inappropriate path amid cultivating, salted soils due to low level ground water and soil salinization. Because of increased soil disintegration, soil richness decay, polluted ground water, environmental change or diminished biodiversity, agribusiness need to confront loads of negative impacts, for example, lessening in farmers income, farmers suicides and increase in agricultural obligation in the form of subsidies. As per another report named Vision 2030 by Indian Institute of Soil Science, Bhopal, the traditionalist assessments demonstrated that the demand for food grains would increase from 192 million tons in 2000 to 355 million tons in 2030. In opposition to increasing livelihood demands, the factor profitability and rate of response of yields to related fertilizers under intensive farming area are declining step by step. The status of supplement use effectiveness as indicated by the report is very low, if there should be an occurrence of **P** (15-20%), **N** (30-50%), **S** (8-12%), and **Zn** (2-5%), **Fe** (1-2%), **Cu** (1-2%) because of decay in composition, physical and natural strength of soils. First systematic soil fertility map of Indian soils was published in 1967 by Ramamurthy and Bajaj (1969). At that time, around 4% soil test shown high level of accessible **P**. The soil richness outline in 2002 (Motsara, 2002) demonstrate that around 20 % of soil tests are high in accessible **P**. GIS based area savvy soil fertility maps of India (Muraliadhauduet.al. 2011) demonstrated that the soil of around 57% regions were low in accessible **N**, 36% medium and 7% were high. Additionally, soils of around 51% locale were low, 40% were medium and 9% were high in accessible **P**. Accessible **K** status demonstrated that the soils of around 9% areas were low, 42% were medium, and 49% were high in accessible **K** status. The high **P** status in a few soils is expected to unscientific use of phosphetic manures by the farmers. This proposes that the significant bit of soils in the nation may have turned out to be wealthy in accessible **P** as the farmers keep on using the phosphetic composts.

Significant piece of the state falls under the most prolific tract of the Indo-Gangetic alluvial plain, where 78% of population is occupied with farming. The principle sustenance crops are pearl millet, rice and maize amid kharif and wheat and chickpea in rabi. Critical business crops are sugarcane, cotton and rapeseed and mustard which add up to corrupted badlands and are spread in around 551 thousand ha (around 11% of TGA). Water disintegration represents 303 thousand ha (around 7% of TGA), trailed by sodicity, influencing 183 thousand ha (around 3.7% of TGA) and saltiness, influencing 46 thousand ha (around 0.9% of TGA). Add up to region influenced by water disintegration in the state is 303 thousand ha out of which Gurgaon

accounts for (77 thousand ha), Panchkula (59 thousand ha), Mahendragarh (42 thousand ha), Sirsa (36 thousand ha), Yamunanagar (31 thousand ha) and Faridabad (30 thousand ha) are the most exceedingly awful influenced locale. Around 2 thousand ha is influenced by soil corrosiveness. Little fixes have issue of wind disintegration moreover. Saline and sodic soils (both disintegrated and uneroded) jump out at the degree of 4.6 % of the TGA of the state. Areas exceedingly influenced by saltiness are Jind (12 thousand ha), Hisar (10 thousand ha) and Fathehabad (6 thousand ha). Sodicity influenced territory happens in Panipat (49 thousand ha), Sonepat (39 thousand ha), Karnal (28 thousand ha) and Kaithal (20 thousand ha). Exceptionally, corrupted locale are Gurgaon (84 thousand ha), Panchkula (59 thousand ha) and Panipat (50 thousand ha).

4. The Extent of Soil Degradation in Haryana

In this paper, we present the district wise soil quality in the form of the five selected indicators namely; - acidity-alkalinity (PH), electrical conductivity (EC), organic carbon (OC), phosphate P_2O_5 (PO) and potassium (K) found in the soil samples. Before presenting the descriptive results, it would be interesting to have a look at the macro and micro-nutrients deficiency of soil in Haryana from the Table 4. Very humbly, it is also mentioned that the present study is considering the estimation of social cost as an effect of macro-nutrients only leaving the scope for further study.

Table 4: Macro and Micro-nutrients Deficiency of Soil

Sr. No.	**Macro Nutrient**	Soil Samples (%) showing low nutrient status	**Micro Nutrient**	Soil Samples (%) showing low nutrient status
1	Nitrogen	94	Zink	20
2	Phosphorus	89	Iron	26
3	Potash	6 low 46 Medium 48 High	Manganese	7.2
4	Sulpher	9		

Source: http://agriharyana.nic.in

Table 5(a) and (b) shows the district-wise average values of these indices. It should be noted that this data was collected from 155128 soil samples taken from 95 blocks of 18 districts of Haryana. Each index is a weighted average of middle-values and their respective number of samples. From these two tables, it is revealed that in Haryana, acidity-alkalinity is no big issue as 94.10 per cent soil samples have demonstrated PH in a healthy range (6.5 to 8.6). Soil pH is a measure of the acidity and alkalinity in soils. The pH levels range between 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. The optimal pH range for most plants is between 5.5 to 7; however many plants having adopted to thrive at pH values outside this range. The pH value (PH index) presents a satisfactory or overall normal situation for over all Haryana.

Six districts namely, - Kurukshetra, Sirsa, Fatehbad, Jind, Karnal and Mahendergarh show higher pH than the Haryana average pH (7.6519), although are still in an acceptable range. The higher values of PH in these districts indicate the increased burden of back to back cropping pattern on agricultural land. The generally slightly higher pH in Haryana suggests that the soil should get enough time to regain its fertility or nutrients. The response of plants to either low levels of fertilizer salts (EC<1) or high fertilizer salts (EC>1) will ultimately result in stunted growth and poor health. For most plants an ideal EC range should be 1to 3 mili Siemens per centimeters (mspc). As discussed with scientists in CCS Haryana Agriculture University, Hisar, the EC less than 2 mspc is acceptable for the crops to be raised in Haryana. The electrical conductivity (EC) measuring the soil salinity in this way is found normal in 91.32 per cent samples (i.e. <0.8 mili mhos or mili Siemens per centimeter). The level of salinity, generally increases when we move southward in Haryana. However, it is highest in Jind & Jhajjar and lowest in Panchkula & Karnal.

The agricultural soil seriously falls short of the organic carbon (OC) which is found low (< 0.4 %) in 90.70 per cent samples. The OC is main determinant of the nitrogen carrying capacity of the soil. The OC, found highest in Panchkula (average 0.4029 %) is also very low from the desirable level 2 per cent. It is clear; we need to increase the OC 8-9 times from the present average level in the Haryana Agriculture soil.

The availability of phosphate P_2O_5 (PO) is found low (0-10 Kg/acre) in 77.56 per cent samples and medium (10-20 Kg/Acre) in 18.93 samples with an average 6.56 kg per acre. It should be noted that the availability of phosphates to plant decrease with higher pH and the farmers solve this problem by adding lime to the soil. However, the increased use of phosphate fertilizers can cause a deficiency of zinc (Zn) and iron (Fe) by

the formation of zinc and iron phosphates in the soil. The average availability of phosphate is high only in Jind (15.73 Kg/Acre) and is below required levels in all other districts.

The availability of Potassium in agri-soil of Haryana is found relatively high in 52.96 per cent samples (>135 Kg/acre) representing a skewed unscientific use of the chemical fertilizers. The availability of more than 70 Kg per acre is considered sufficient for production of cereals. In Haryana, in 5.84 per cent soil samples, potash is found low (< 55 Kg/Acre). It is also evident that there are huge variations as reflected from big values of C.V. (Coefficients of Variation) in the availability of phosphate and potassium.

The level of organic carbon (OC) in the Haryana agricultural soil is very low and could worsen in future. The level of OC in soil of Panchkula District is exceptionally higher (0.4029 %) but in all other districts it ranges between 0.2 - 0.29 % with an average of 0.24 per cent. Due to this kind of extent of soil degradation, it could result into a steep decrease in crop yields in coming years. The quantity of Phosphorus is high (15.72) in the Jind districts. The availability of potash in the soil at Fatehbad district is much higher (170.08). On the other hand, there are negligible amount of Potash in the Panchkula and Rewari districts. Overall picture state that the soil quality in Haryana contains variations in concern of PH, EC, OC, Potassium and Potash.

Table 5 (a): Distict Wise Soil Quality Indices in Haryana

	Indices for Soil Quality Indicator				
Districts	pH Value in Log o. of H^+ ions (PH)	Electrical Conductivity (EC) (Mili Siemens)	Organic Carbon % (OC)	Phosphate $P_2 0_5$ Kg/Acre (PO)	Potassium Kg/Acre (K)
Ambala	7.5696	0.4537	0.2407	7.7150	89.2638
Faridabad	7.5652	0.5186	0.2947	5.3103	114.2370
Fatehbad	7.7613	0.5063	0.2367	6.0490	170.0891
Gurgoan	7.5618	0.5003	0.2165	7.3345	85.2163
Hissar	7.5570	0.4799	0.2447	6.8188	167.1761
Jhajjar	7.5658	0.7212	0.2066	5.0883	135.5260
Jind	7.8495	0.7673	0.2115	15.7294	169.5453
Kaithal	7.5193	0.4810	0.2616	5.4587	159.4505
Karnal	8.0000	0.4147	0.2170	5.0529	143.2275
Kurukshetra	7.6859	0.4262	0.2529	5.6937	130.5092
Mahendergarh	8.1258	0.5116	0.2094	5.0530	156.3362
Panchkula	7.2892	0.4000	0.4029	9.2488	0.0000
Panipat	7.6362	0.4847	0.2329	5.1194	170.1955
Rewari	7.5976	0.4874	0.2001	5.0057	0.0000
Rohtak	7.5563	0.4749	0.2268	5.8145	168.7964
Sirsa	7.6940	0.5106	0.2297	6.3113	150.4906
Sonipat	7.6492	0.5112	0.2670	6.1122	150.6895
Yamuna Nagar	7.5500	0.4162	0.2498	5.1613	30.2185
Average X	**7.6519**	**0.5037**	**0.2445**	**6.5598**	**121.7204**
S. D.	**0.1895**	**0.0954**	**0.0463**	**2.5561**	**57.7644**
C.V.	**2.48**	**18.94**	**18.94**	**38.97**	**47.46**

Table 5 (b): Soil Quality Found in Percentage of Samples

PH			EC			OC			PO			K		
Acidic	Normal	Alkaline	Normal	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
0.10	94.10	5.31	91.32	7.37	1.27	90.70	8.92	0.56	77.56	18.93	1.38	5.84	26.81	52.96

Source: Computed by Researcher Based on data taken from CSSRI, KARNAL, www.agriharyana.nic.in.com

It is necessary to report the results of similar data collected by the researcher herself from three districts of Haryana namely, - Kurukshetra, Jind and Hissar in her primary survey through a questionnaire and Soil Helath Cards issued to the farmers by Agriculture Department, Haryana. We can compare

Table 6: Soil Quality Found in Percentage of Samples only For Kurukshetra, Jind & Hisar

	PH			EC			OC			PO			K		
	Ac.	N	Alk	N	M	H	L	M	H	L	M	H	L	M	H
P	0.00	100.00	0.00	86.47	11.88	1.65	65.0	18.81	16.2	36.3	36.30	27.4	2.64	45.87	51.49
S	0.00	87.36	9.60	84.89	10.56	3.27	91.5	7.26	0.00	32.9	54.74	4.87	0.02	18.14	81.85

P-Primary Data S-Secondary Data; Ac.-Acidic N-Normal Alk-Alkaline; M-Medium, H-High, L-Low

Source: Computed by Researcher Based on data taken from CSSRI, KARNAL, www.agriharyana.nic.in.com and Primary Survey

Table 7: Average Values of Soil Quality Indicators

		pH	EC mili Siemens per centimeter	OC %	P_2O_5 Kg/Acre	K Kg/Acre
PRIMARY DATA	N=303	7.77	0.80	0.57	20.93	227.51
SECONDARY DATA	N=32927	7.79	0.63	0.23	10.20	155.24

It can be observed from the Tables 6 and 7 that the soils in the primary survey depict better soil quality than the survey in the secondary data. The reason is that researcher has selected advanced farmers who are more aware as compared to an average farmer of Haryana.

5. Conclusion

This paper reveals a general state of soil quality in Haryana using averages computed from soil samples collected by CSSRI, Karnal. The data and results indicate that the pH value of the agri-soil in Haryana is slightly on alkaline side and therefore it has the capacity to absorb more phosphate and potash whose availability is low. The abysmally low organic carbon may be the cause of high salinity and deficiency of all other micro (Zn, Fe) and macro (P_2O_5, K) nutrients. The nature of this data distribution also suggests that within the given ranges a monotonic increase (decrease) in OC (EC) shall lead to higher crop yields and vice-versa in Haryana.

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