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Judging causes of soil degradation and remedial measures for reclamation in Kaithal district of Haryana state

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Abstract
Soil degradation is a point of evolution which leads to a reduction of resource potential. About 7.40 m ha arable lands globally turn to degraded lands as a result of climate change and deforestation. The problem of soil degradation has been ever since cultivation of soils started because of increasing population of India at the rate of about 1.8% requiring marginal areas to be brought under the plough to meet the growing food demand. The present study was conducted in Kaithal district in the year 2018-19. The study revealed that 'Excessive use of chemical fertilizers' (88.33%) followed by 'non- judicious use of insecticides/pesticides' (85.83%), 'less application of organic manure' (85.00%), 'deforestation (78.33%), and 'over uplifting of ground water' (75.83%) were found as most important causes of soil degradation. The most important remedial action for problematic soil were found as 'land for equal distribution of resources/irrigation' (90.83%) followed by 'application of Gypsum for sodic and saline soil' (85.83%), 'introduction of legumes in cropping system' (80.00%), 'recharge of ground water during rainy season' (78.33%), 'crop residue incorporation by happy seeder' (77.50%), 'application of green manuring/ organic manure' (75.00%) and 'leaching of salts in saline soil' (72.50%). Soil conservation is important for the future use and future generation. The study would be helpful in soils conservation which may otherwise cause damage to plant growth which in turn may adversely affect yield and there by food security also.

Keywords: Climate change, Deforestation, Organic manure and Soil degradation

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INTRODUCTION

Land is a non-renewable resource which is vital for all primary production systems. Pastures and crops are the two most extensive forms of land use, occupying 25% and 12% of the global land surface, respectively (Ramankutty and Foley, 1999; Asner *et al.*, 2004). As far as agricultural land is concerned, per capita land has declined from 0.48 hectare in 1951 to 0.16 hectare in 1991 and is likely to decline further to 0.08 hectare in 2035 (Yadav, 2000 and Nagaraja, 2009). Soil or land degradation which causes decline in soil's productivity, deterioration in vegetative cover, qualitative and quantitative decline of soil and water resources and pollution of air is rampant in India. It is estimated that out of 329 million hectare total geographical area of India, the area under agriculture is 179.9 M ha and 120.4 million hectarearea is degraded through one or more degradation types, which in turn, is affecting the country's productive resource base. It has been estimated a total of more than 5000 tonnes of top soil is being eroded every year. Of about 1600 million tonnes representing 30% of the total eroded area is permanently getting lost to the sea. The main causes of degradation are due to direct/ indirect human intervention (Aulakh *et al.*, 2015). Bush burning has been adopted by most farmers in northern Ghana for clearing land for cultivationannually, because of its ease and convenience. This exposes the surface soil layer to destruction.Higher infiltration rates were measured on burnt soils as compared to un-burnt soils and burning exerts some effects on soil physical and chemical properties(Salifu *et al.*, 2013).Urgent measures are required to arrest the degradation process and to restore productivity of degraded soils so that more food could be produced to provide livelihood and environmental security to the

increasing Indian population. This requires the systematic knowledge on the soils, characterization of basic resources like soil, water, climate and biodiversity problems and potentials for optimizing land use. Various remedies for reclamation should be put forward to restore the degradation of soil. Keeping these above facts in mind this study was undertaken to know the "causes of soil degradation and remedies for reclamation in Kaithal district".

MATERIALS AND METHODS

The present study on judging causes of soil degradation and remedial measures for reclamation in Kaithal district was conducted in Haryana state in 2018-19. Kaithal district was selected randomly. These villages namely Dherdu, Faral, Guhida, Bindrana, Jadaula, Siwan, Teontha, Rasina, Fatehpur, Mundri, MatrawaKheri, Teak, Anhu, Geong, Batta, Jajanpur, Khanoda, Peoda, Devigarh, Shergarh, and KheriSakra were selected purposively, where RAWE program of BSc (Hons) Agri. final year students were organized. One hundred and twenty respondents were selected randomly and they were personally interviewed with help of interview schedule specially prepared for this study. The statistical measures like mean, frequency, percentage and rank orders were used to draw meaningful inferences (Singh *et al,* 2012 a).

RESULTS AND DISCUSSION

Table 1 indicates that majority of respondents (88.33%) said that excessive use of chemical fertilizers is most important cause of soil degradation followed by non- judicious use of insecticides/ pesticides (85.83%), less application of organic manure (85.00%), deforestation (78.33%), over uplifting of ground water (75.83%), while on the other hand majority of respondents said that population growth is most important indirect cause of soil degradation (85.00%) followed by intensive cultivation due to land shortage and land fragmentation (81.66%), poor access to advisory services (76.66%) and climate change (75.83%) were other important causes of soil degradation. The results of the finding are in line with the work of Abdeta (2018) and Bhattacharyya (2015).

Table 2 indicates that majority of respondents (90.83%) said that land levelling for equal distribution of resources/irrigation is main remedy for problematic soil followed by application of Gypsum for sodic and saline soil (85.83%), balance use of fertilizers based on SHC status (81.66%),

Table 1. Causes/reasons responsible for soil degradation in Kaithal district of Haryana (n=120).

S. N.	Particulars	Yes	No
A.	**Direct causes/reason**		
1.	Excessive use of chemical Fertilizers	106(88.33)	14(11.66)
2.	Non judicious use of insecticides/pesticides	103(85.83)	17(14.16)
3.	Less application of organic manure (FYM or farm manure)	102(85.00)	18(15.00)
4.	Application of fertilizers without SHC/soil status	90(75.00)	30(25.00)
5.	Non-application of gypsum and lime in soil	77(64.16)	43(35.84)
6.	Intensive cropping system	89(74.16)	31(25.83)
7.	Continuous Mono-cropping system	90(75.00)	30(25.00)
8.	Lack of legume crops introduction in cropping system	90(75.00)	30(25.00)
9.	Straw burning of rice and wheat crop stubble	87(72.50)	33(27.50)
10.	Poor irrigation water	92(76.66)	28(23.34)
11.	Faulty irrigation method/ Surface (flood) Irrigation	80(66.66)	40(33.34)
12.	Rice based cropping system/ water logging	80(66.66)	40(33.34)
13.	Poor drainage system	87(72.50)	33(27.50)
14.	Over uplifting of ground water	91(75.83)	29(24.17)
15.	Deforestation	94(78.33)	26(21.67)
16.	Heavy tillage exposed the soil carbon to environment	73(60.83)	47(39.17)
17.	Erosion by wind/water	80(66.66)	40(33.34)
18.	Undulated land	77(64.16)	43(35.84)
19.	Increasing salinity and sodicity in soil surface	82(68.33)	38(31.67)
20.	Rising of soil surface underground water table	72(60.00)	48(40.00)
B.	**Other causes/reason**		
1.	Intensive cultivation due to land Shortage and land fragmentation	98(81.66)	22(18.34)
2.	Population growth so more pressure on land	102(85.00)	18(15.00)
3.	Limited access to conservation technologies	86(71.66)	34(28.34)
4.	Poor access to advisory services	92(76.66)	28(23.33)
5.	Climate change (Aberrant Monsoon/drought/flooding)	91(75.83)	29(24.16)
6.	Land tenure leads to over exploitation of resources	83(69.16)	37(30.83)
7.	Direct use of industrial effluent as irrigation	65(54.16)	55(45.84)
8.	Use of sewage water without treatment for irrigation	75(62.50)	55(37.50)
9.	Use of saline and sodic underground water for irrigation	89(74.16)	31(25.84)

Figures in parenthesis represent percentage

Table 2. Remedies for reclamation of problematic soil in Kaithal district of Haryana state (n=120).

S. N.	Particulars	Effective	Not effective
1.	Permanent soil cover by vegetation	083(69.16)	37(30.84)
2.	Leaching of salts in saline soil	087(72.50)	33(27.50)
3.	Application of Gypsum for sodic and saline soil	103(85.83)	17(14.17)
4.	Application of Lime for acidic soils	097(80.83)	23(19.17)
5.	Land levelling for equal distribution of resources/irrigation	109(90.83)	11(09.17)
6.	Land use configuration	082(68.33)	38(31.67)
7.	Minimum disturbance of soil/minimum tillage/zero tillage	084(70.00)	36(30.00)
8.	Contour farming for sloppy land	082(68.33)	38(31.66)
9.	Strip cropping with erosion resistant crops	84(70.00)	36(30.00)
10.	Shelter belt and wind break to control wind erosion	65(54.16)	55(45.84)
11.	Field bunding to control water erosion	67(55.83)	53(44.17)
12.	Growing deep rooted plantation in water logged soil	94(78.33)	26(21.67)
13.	Introduction of legumes in cropping system	96(80.00)	24(20.00)
14.	Crop diversification/ crop rotation	78(65.00)	42(35.00)
15.	Application of green manuring/ organic manure	90(75.00)	30(25.00)
16.	Irrigation with good quality water	95(79.16)	25(20.84)
17.	Integrated farming system	95(79.16)	25(20.84)
18.	Balance use of fertilizers based on SHC status	98(81.66)	22(18.34)
19.	Crop residue incorporation by Happy seeder	93(77.50)	27(22.50)
20.	Site specific soil management	81(67.50)	39(32.50)
21.	Furrow irrigated raised bed system	79(65.83)	41(34.16)
22.	Surface mulch (protect from rain drops)	80(66.66)	40(33.34)
23.	Use micro-irrigation method instead of surface irrigation	69(57.50)	51(42.50)
24.	Soil and water testing/Soil health card	77(64.16)	43(35.84)
25.	Adequate drainage system	88(73.33)	32(26.67)
26.	Minimum use of pesticides	77(64.16)	43(35.84)
27.	Salt tolerant crop in problematic soil(barley, cotton and dhaincha)	91(75.83)	29(24.17)
28.	Deep ploughing for salt affecting soil	86(71.66)	34(28.33)
29.	Rain water harvesting	85(70.83)	35(29.17)
30.	Recharge of ground water during rainy season	94(78.33)	26(21.67)
31.	Timely geospatial information on soil requirements	75(62.50)	45(37.50)
32.	Adding of Sulphur and $FeSO_4$in Alkaline soil	79(65.83)	41(34.17)

Figures in parenthesis represent percentage

introduction of legumes in cropping system (80.00%), irrigation with good quality water and integrated farming system (79.16%), recharge of ground water during rainy season (78.33%), crop residue incorporation by happy seeder (77.50%), application of green manuring/ organic manure (75.00%) and leaching of salts in saline soil (72.50%). The results of the study were partially supported by Singh *et. al*. (2012b) and Rathore *et al.* (2011) who reported that application of gypsum for sodic and saline soil is main remedy for problematic soil.

Conclusion

It was concluded that 'Excessive use of chemical fertilizers' (88.33%) followed by 'non- judicious use of insecticides/pesticides' (85.83%), 'less application of organic manure' (85.00%), 'deforestation (78.33%), and 'over uplifting of ground water' (75.83%) were found as most important causes of soil degradation. The most important remedial action for problematic soil were found as 'land for equal distribution of resources/ irrigation' (90.83%) followed by 'application of Gypsum for sodic and saline soil' (85.83%), 'introduction of legumes in cropping system' (80.00%), 'recharge of ground water during rainy season' (78.33%), 'crop residue incorporation by happy seeder' (77.50%), 'application of green manuring/ organic manure' (75.00%) and 'leaching of salts in saline soil' (72.50%). The work would be helpful in application of remedial action for upgrading the soil leading to increase productivity of crops and fruits.

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