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Anatomization of physical properties of flooded soil of Saharsa district, Bihar

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Abstract
Saharsa, one of Bihar's most flood-prone areas, was chosen as the sampling location. Soil degradation in the district is primarily caused by flooding. The current research was conducted at Sam Higginbottom University of Agriculture Technology and Sciences' Soil Science and Agricultural Chemistry lab. The goal of this research was to look at various soil physical properties. A total of 27 samples were gathered from various farmer's fields, with composite sampling taking place at three depths of 0-15, 15-30, and 30-45 cm. The texture was sandy loam to sandy clay, with bulk densities ranging from 1.11 to 1.59 Mg/m3, particle densities ranging from 2.22 to 2.85 Mg/m3, pore space ranging from 52.60 to 66.50 percent, and water content ranging from 52.60 to 66.50 percent. Water holding capacity ranged from 61.11 to 78.12%.

Keywords: Cropping pattern, physical properties. Saharsa district, soil degradation, soil health card

Introduction

Agriculture is one of the oldest economic pursuits on the planet. It has evolved into a technologically advanced industry that now contributes significantly to global sustainability (Harrell, 2014) [3]. Most plants require soil for their development because it provides physical support and nutrients. The roots of plants hold them in place in the earth. Nutrients are dissolved in soil water and are required for plant growth. Soils are made up of a variety of organic materials, including dead minerals from plants and animals, as well as organisms that choose to dwell in soil. Soil is a storehouse for numerous nutrients such as carbon and nitrogen, and it plays a critical role in global nutrient cycles, hydrological cycles, and the atmosphere (Hiscox, 2004) [4]. Soils need to be cared for, yet Due to increased pressure, soil exploitation has only become worse. Soil, crops, and vegetables now produce enough food for 7 billion people around the world. However, access is unevenly distributed, and one billion people are structurally undernourished. Food availability, both biophysical and socioeconomic, as well as food productive capability, must be greatly expanded by 2050 in order to feed 9-10 billion people. The ability of land users around the world to manage their soils sustainably and productively is critical (ISRIC, 2021) [6]. Soil health refers to the status of a soil's physical, chemical, and biological integrity, as well as its ability to support the growth and development of land plants (Idowu *et al*., 2019) [5]. Soil serves as both a filter and a buffer. for pollutants, but its capacity to deal with them is limited. When the soil's capacity to alleviate the effects of pollutants is exceeded, the pollutants damage other parts of the environment. Soil pollution triggers a chain reaction that begins with decreased soil biodiversity, then changes organic matter incorporation rates, and finally degrades soil structure and erosion resistance. Industrial operations, which release enormous amounts of chemicals into the environment during manufacturing, transportation, and usage, are the main contributors of soil contamination (Bhattacharyya *et al*., 2015) [1]. The most serious challenge facing Indian soil is soil degradation. Natural factors and human activity both contribute to the degradation of soil. India is now reaping the benefits of its decades of sowing (Supriya, 2021) [11]. Because food productivity and environmental quality are dependent on soil physico-chemical properties, it is critical to have a fundamental understanding of soil physico-chemical properties (Tale *et al*., 2015) [12].

Materials and Methods

The Gangetic Plain, which is the world's most fertile alluvial plain, runs across Bihar.

Latitude 24°-20'-10" 27°-31'-15" N, longitude 83°-19'-50" 88°-17'-40" E, longitude 83°-19'-50" 88°-17'-40" E Using a soil auger, screw auger, and khurpi, soil samples were gathered from farms in nine villages at depths of 0-15cm, 15-30cm, and 30-45cm. After composite sampling, the samples were air dried in the shade before being processed for various physical and chemical analysis. Using the Completely Randomized Design (CRD) technique and Opstat software, the data acquired throughout the investigation was statistically analysed. Table 1 shows the sampling sites in the Saharsa District, while Fig 1 shows the site specifications. The textural study of particles smaller than 2 mm in the soil was carried out by the hydrometer method (Bouyoucos, 1927) [2], The bulk density, particle density, pore space and water holding capacity was determined by the graduated 100 ml measuring cylinder method (Muthuvel *et al*., 1992) [9].

Results and Discussion

Variation in Physical Properties of Saharsa District at different depths.

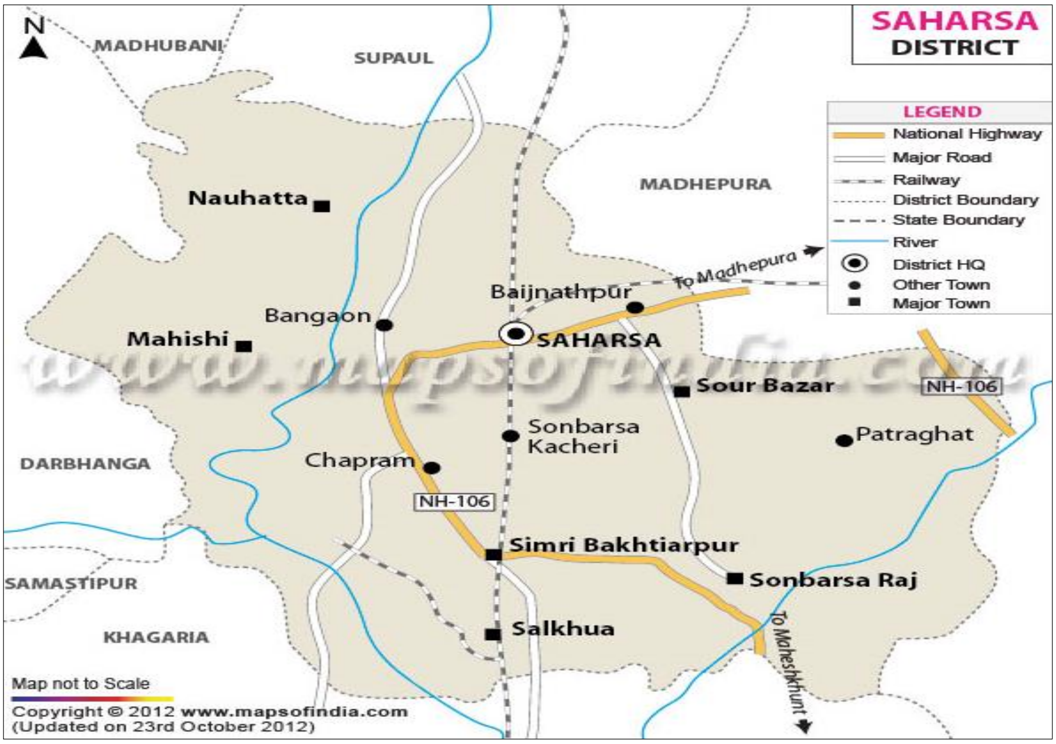
The texture of the Saharsa district ranges from sandy loam to sandy clay. During Experiment, the percentages of sand, silt, and clay were found to range from 71.40-30.35 percent, 41.50-10.33 percent, and 34.08-17.20 percent, respectively (Marbaniang *et al*., 2021) [8]. The bulk density ranged between 1.11 and 1.59 Mg/m3. S9 (30-45 cm depth) had the highest value of 1.59 Mg/m3, whereas S4 (0-15 cm depth) had the lowest value of 1.11 Mg/m3. With increasing soil depth, the Bulk Density rises. The reason for this is soil compactness, which will be greater at greater depths; a similar result was observed by another researcher (Singh *et al*., 2020) [10]. The density of the particles ranged from 2.22 to 2.85 Mg/m3. The highest value is 2.85 Mg/m3 for S5 (30-45 cm depth). S1 recorded the lowest value of 2.22 Mg/m3 (0-15 cm depth) Particle Density fluctuates depending on the mineral concentration of soil particles, as revealed by a similar study (Majhi *et al*., 2020) [7]. Pore Space (percentage) ranged from 52.60 to 66.50. (Percent). The greatest figure was 66.50 percent for S1 (0-15 cm depth), while the lowest was 52.60 percent for S4 (30-45 cm depth) (percent) Pore Space was observed to decrease when depth was increased, owing to increased subsurface compaction. Due to the presence of significant organic matter, surface soils have a higher number of macro and micro pores than subsurface soils. A similar conclusion was observed by (Yuvarani *et al*., 2019) [13]. The water storage capacity (percentage) ranged from 61.11 to 78.12. The greatest figure was 78.12 percent for S4 (0-15 cm depth), while the lowest was 61.11 percent for S1 (30-45 cm depth). Because of soil compaction and pore space loss, the WHC value drops with depth. A similar finding was reported by (Tale *et al*., 2015) [12].

Table 1: Representing the Sampling site of Saharsa District

Sr. No.	Block	Village	Latitude(^{0}N)	Longitude (^{0}E)
01	Kehra	S_1 – Kahra	25.8978	86.5866
		S_2 – Chainpur	25.8972	86.5873
		S_3 - Rohua mani	25.7246	86.6041
02	Mahishi	S_4 – Jajori	25.8395	86.4669
		S_5 – Bijwar	25.8679	86.4858
		S_6 – Gamrahu	25.8648	86.5009
03	Simri Bakhtiyarpur	S_7 – Teghra	25.4195	86.3526
		S_8 – Chapram	25.4259	86.3459
		S_9 – Baghwa	25.4208	86.3483

Table 3: Soil texture of Saharsa District

Farmer's site / Treatment	% Sand	% Silt	% Clay	Textural class
S_1: (Kahra)	70.00	12.8	17.2	Sandy Loam
S_2: (Chainpur)	44.5	21.6	33.6	Clay Loam
S_3: (Rohua mani)	67.2	10.4	22.40	Sandy Loam
S_4: (Jajori)	31.6	38.4	30.00	Sandy Clay
S_5: (Bijwar)	30.4	41.5	28.1	Sandy Clay
S_6: (Gamrahu)	56.6	15.4	28	Sandy Clay Loam
S_7: (Teghra)	68.2	12.6	19.2	Sandy Loam
S_8: (Chapram)	71.4	11.2	17.4	Sandy Loam
S_9: (Baghwa)	69.2	12.8	18	Sandy Loam



Site Specification

Table 4: Evaluation of Physical properties of soils Saharsa District

	P_b (Mg/m^3)		D_p (Mg/m^3)		Pore Space (%)		WHC (%)	
Treatment/ Farmer's site	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Range**
S_1: (Kahra)	1.31-1.42	1.37	2.22-2.78	2.53	66.51-61.5	63.55	65.15-61.11	63.29
S_2: (Chainpur)	1.32-1.45	1.39	2.35-2.82	2.60	61.15-57.25	58.90	65.15-64.66	64.97
S_3:(Rohua mani)	1.33-1.44	1.39	2.68-2.85	2.77	64.02-58.5	61.19	69.14-67.77	68.37
S_4: (Jajori)	1.11-1.28	1.21	2.41-2.78	2.57	54.12-52.6	53.34	78.12-72.09	75.16
S_5: (Bijwar)	1.17-1.22	1.19	2.60-2.85	2.76	54.80-53.2	53.86	76.66-64.61	70.61
S_6: (Gamrahu)	1.38-1.45	1.41	2.45-2.71	2.6	62.11-52.8	58.98	70.58-68.16	68.99
S_7: (Teghra)	1.31-1.39	1.35	2.31-2.80	2.58	56.41-55.05	55.78	64.45-63.08	63.62
S_8: (Chapram)	1.41-1.47	1.41	2.32-2.75	2.58	57.91-56.2	57.20	71.14-69.71	70.5
S_9: (Baghwa)	1.51-1.59	1.55	2.35-2.76	2.56	56.21-54.45	55.24	66.77-64.74	65.73
	Due to depth	Due to site	Due to depth	Due to site	Due to depth	Due to site	Due to depth	Due to site
F-test	S	NS	S	NS	S	NS	NS	NS
S.Ed (±)	0.019918	0.132554	0.1853	0.087704	1.326729	3.106753	2.186522	3.636299
C.D @5%	0.594333	0.000246	1.61006	0.051458	0.182575	0.016482	0.025598	0.006429
P_b= Bulk Density, D_p= Particle Density, WHC= Water Holding Capacity.								

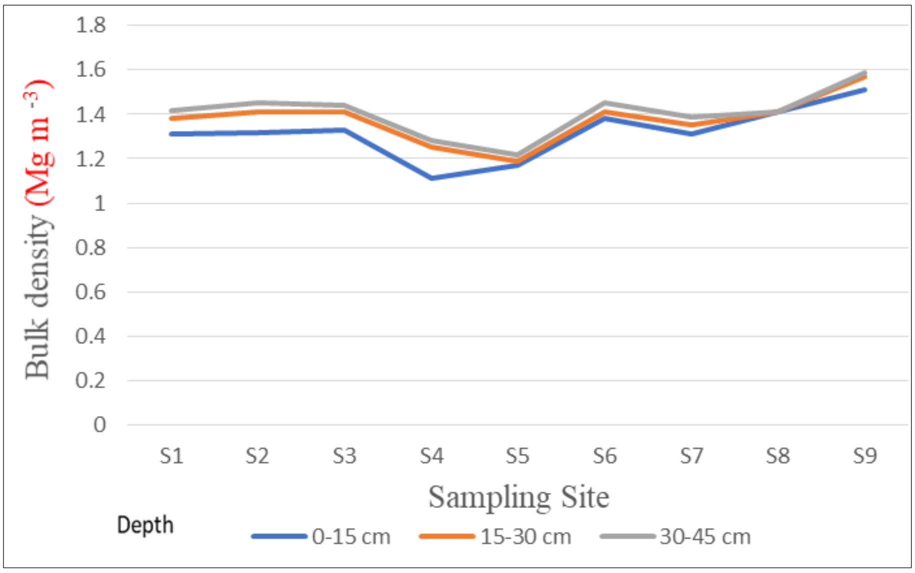


Fig 1: Graphical representation of Bulk density (Mg m^{-3}) of Saharsa District

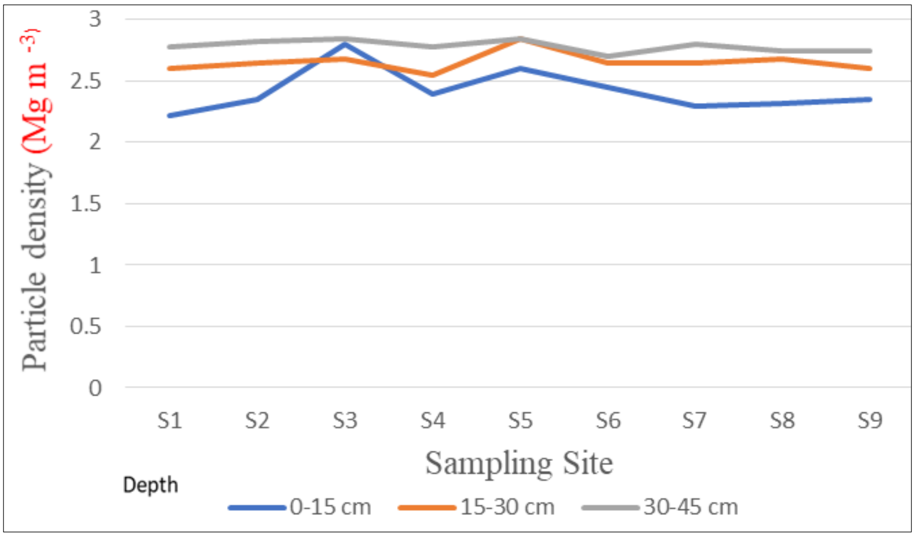


Fig 2: Graphical representation of Particle density (Mg m^{-3}) of Saharsa District

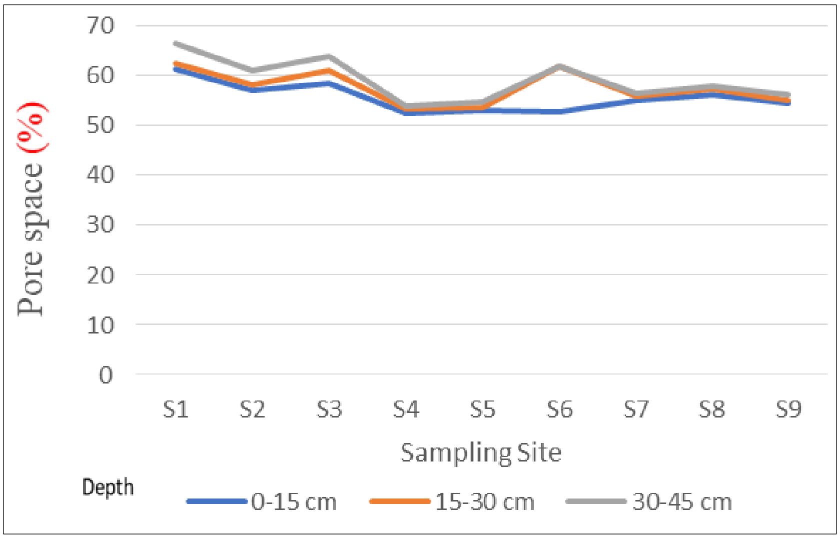


Fig 3: Graphical representation of Pore space (%) of Saharsa District

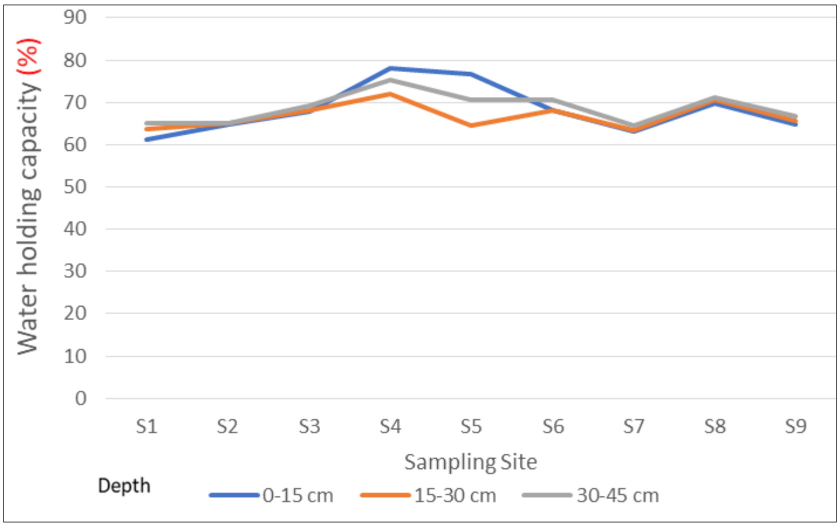
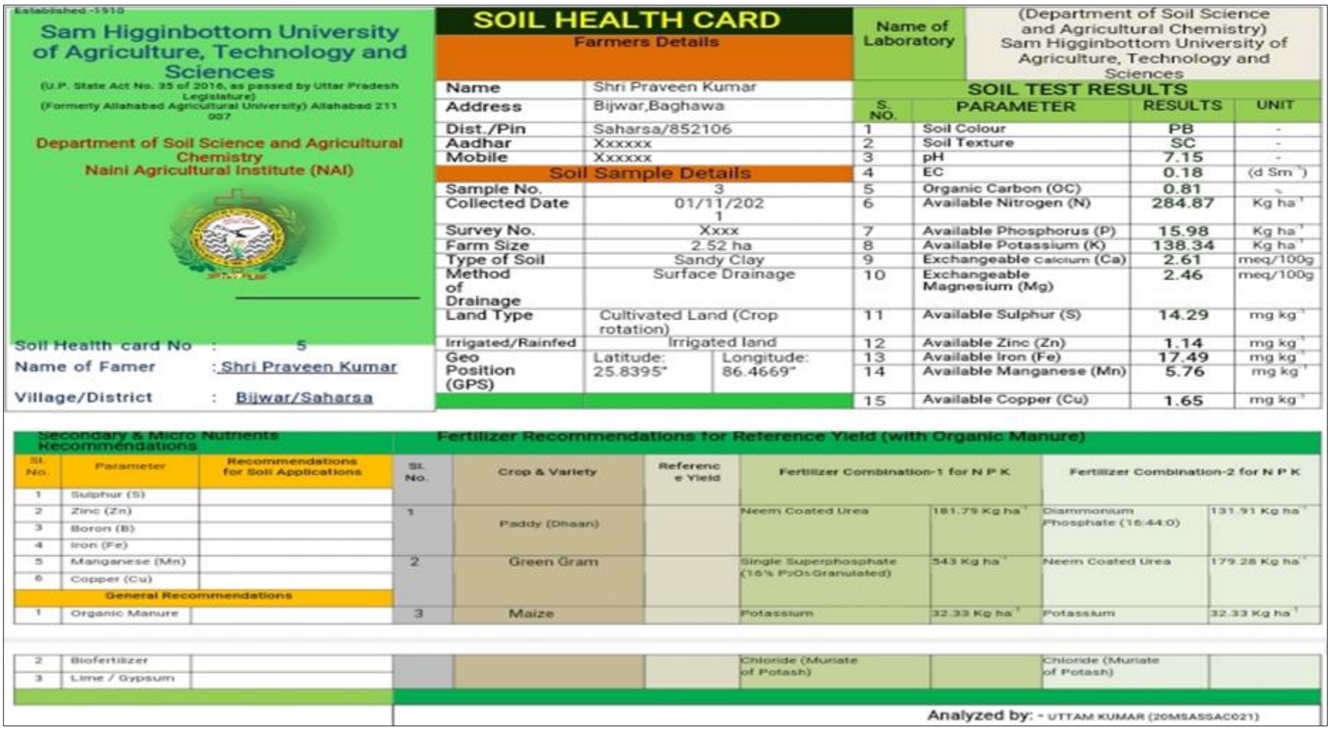


Fig 4: Graphical representation of Water holding capacity (%) of Saharsa District



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(U.P. State Act No. 35 of 2016, as passed by Uttar Pradesh Legislature)
(Formerly Allahabad Agricultural University) Allahabad 211 007

Department of Soil Science and Agricultural Chemistry
Naini Agricultural Institute (NAI)

Soil Health card No : 5
Name of Famer : Shri Praveen Kumar
Village/District : Bijwar/Saharsa

SOIL HEALTH CARD

Farmers Details

Name	Shri Praveen Kumar	
Address	Bijwar,Baghawa	
Dist./Pin	Saharsa/852106	
Aadhar	Xxxxxx	
Mobile	Xxxxxx	
Soil Sample Details		
Sample No.	3	
Collected Date	01/11/2021	
Survey No.	Xxxx	
Farm Size	2.52 ha	
Type of Soil	Sandy Clay	
Method of Drainage	Surface Drainage	
Land Type	Cultivated Land (Crop rotation)	
Irrigated/Rainfed	Irrigated land	
Geo Position (GPS)	Latitude: 25.8395"	Longitude: 86.4669"

Name of Laboratory: (Department of Soil Science and Agricultural Chemistry) Sam Higginbottom University of Agriculture, Technology and Sciences

SOIL TEST RESULTS

S. NO.	PARAMETER	RESULTS	UNIT
1	Soil Colour	PB	-
2	Soil Texture	SC	-
3	pH	7.15	-
4	EC	0.18	(d Sm^{-1})
5	Organic Carbon (OC)	0.81	%
6	Available Nitrogen (N)	284.87	Kg ha^{-1}
7	Available Phosphorus (P)	15.98	Kg ha^{-1}
8	Available Potassium (K)	138.34	Kg ha^{-1}
9	Exchangeable Calcium (Ca)	2.61	meq/100g
10	Exchangeable Magnesium (Mg)	2.46	meq/100g
11	Available Sulphur (S)	14.29	mg kg^{-1}
12	Available Zinc (Zn)	1.14	mg kg^{-1}
13	Available Iron (Fe)	17.49	mg kg^{-1}
14	Available Manganese (Mn)	5.76	mg kg^{-1}
15	Available Copper (Cu)	1.65	mg kg^{-1}

Secondary & Micro Nutrients Recommendations

Sl. No.	Parameter	Recommendations for Soil Applications
1	Sulphur (S)	
2	Zinc (Zn)	
3	Boron (B)	
4	Iron (Fe)	
5	Manganese (Mn)	
6	Copper (Cu)	
General Recommendations		
1	Organic Manure	
2	Biofertilizer	
3	Lime / Gypsum	

Fertilizer Recommendations for Reference Yield (with Organic Manure)

Sl. No.	Crop & Variety	Reference Yield	Fertilizer Combination-1 for N P K		Fertilizer Combination-2 for N P K	
1	Paddy (Dhaan)		Neem Coated Urea	181.79 Kg ha^{-1}	Diammonium Phosphate (18:46:0)	131.91 Kg ha^{-1}
2	Green Gram		Single Superphosphate (16% P_2O_5 Granulated)	543 Kg ha^{-1}	Neem Coated Urea	179.28 Kg ha^{-1}
3	Maize		Potassium Chloride (Muriate of Potash)	32.33 Kg ha^{-1}	Potassium Chloride (Muriate of Potash)	32.33 Kg ha^{-1}

Analyzed by: - UTTAM KUMAR (20MSASSAC021)

Fig 5: Soil heath card for farmer of Saharsa District

Conclusion

The testing revealed that the texture of the soils in the district of Saharsa ranges from sandy loam to sandy clay, with acceptable BD, PD, pore space, and water holding capacity. It demonstrates that the soils are suitable for growing paddy, wheat, maize, millet, pulses, potato, sugarcane, and other crops. Farmers must keep a Soil Health Card in accordance with federal and state government rules for crop production, and are advised to use appropriate management practises and supply proper nourishment to soil health. Inventory should be kept on a regular basis to combat the polluting effect in their respective soil. It suggests that further improvement can be made by improving cropping patterns, decomposition of organic waste, mulching and tillage practises, and irrigation water quality through management practises based on the knowledge and experience gained through the study, which could be developed in the future to assist farmers in producing high-quality produce, conserving soil and water, and protecting the environment.

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Conflict of interest

I, Uttam Kumar, as a Researcher, confirm that none of the other authors have any conflicts of interest related to this publication.

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