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Soil quality along the water course of selected distributary of D-7 shahapur branch canal of UKP Command area of Karnataka

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Abstract
The study was conducted from November 2015 to May 2017 at Shahapur taluk, Yadgir district, to prioritization of degraded lands in D-7 distributary of Upper Krishna Project (UKP) command area, Karnataka. Over exploitation of soil by mankind without giving importance to health has resulted in degradation of soil. Soil quality speaks about its capacity in nourishing and providing proper anchorage to crops besides keeping the health of land, air, water and animals including man. Bulk density (BD), Particle density (PD) and Total porosity (TP) the soil samples were drawn from three different depths at 0-15, 15-30 and 30-45 cm, during in the year 2016 and 2017, the maximum and minimum value of Bulk density (1.79-1.45) and Particle density (2.70-2.65) and Total porosity (46.1-33) are shown in Table 2.
The soil salinity (EC), soil reaction (pH) and ESP of soil samples were analysed during post-monsoon 2015 and 2016 and pre-monsoon of 2016 and 2017, at the head, middle and tail reach of D-7 command. The maximum and minimum value of EC during post-monsoon 2015 and 2016, (7.95-5.37 dSm^{-1} and 8.17-5.53 dSm^{-1}) and pre-monsoon of 2016 and 2017, (8.36-5.01 dSm^{-1} and 8.44-5.24 dSm^{-1}) are presented in Table 3. The analysis of soil reaction (pH) at the head, middle and tail reach of D-7 (L-1 to L-30). The maximum and minimum value of post-monsoon 2015 and 2016, (8.34-7.16 and 8.39-7.26) and pre-monsoon of 2016 and 2017, (8.32-7.19 and 8.57-7.41) are presented in Table 4. The analysis of exchangeable sodium percentage (ESP) at the head, middle and tail reach of D-7 (L-1 to L-30). The maximum and minimum ESP value of post-monsoon 2015 and 2016, (15.76-13.40 meq/100 g and 16.35-13.70 meq/100 g) and pre-monsoon of 2016 and 2017, (15.88-13.27 meq/100 g and 16.55-13.62 meq/100 g) are presented in Table 5.

Keywords: Soil quality, Soil salinity (EC), Soil reaction (pH) and ESP, Command area

Introduction
Irrigation continues to play an important role in contributing to the food and fiber production and is one of the vital factors to achieve food sufficiency across the world and at global level cultivable land under irrigation was very less (20 % of total cultivated land) and its contribution to the total food production of the world is 40 per cent and on an average crop yield from irrigated land is two times more than that of rain fed. Thus, irrigation was one of the factors for the success of green revolution in India and however, the success did not last long due to excessive use of water in addition to improper management of agricultural inputs. Excessive use of chemicals and water for irrigation lead to deterioration of physical, chemical and biological qualities of soil which in turn decreased productive capacity of soils in command areas.
Over exploitation of soil by mankind without giving importance to health has resulted in poor quality of soil. Soil quality speaks about its capacity in nourishing and providing proper anchorage to crops besides keeping the health of land, air, water and animals including man. Physical (Soil texture, bulk density, particle density and total porosity, Infiltration rate) chemical Soil salinity (EC), (Soil reaction (pH) and Exchangeable sodium percentage (ESP) quality indicators have tremendous influence on nutrients availability to crops and thus soil productivity. Thus, present investigation was taken up to know the impact of irrigation on soil quality.

Material and Methods
The study area is located between 16^0 29' N to 16^0 39' N latitude and $76^0$43' E to $76^0$54' E longitude. It is located 45 km away from the district headquarters and location map as showed below Fig. 1.The gross command area of D-7 distributary is 15647.49 ha with a cultivable command area of 10322 ha and with a discharge capacity of 5.876 cumecs. The canal command covers parts of three toposheets of survey of India namely E43W10, E43W14 and E43W15 in the scale of 1:50000.

The climate of the region is generally dry. The larger variations in rainfall from year to year both in quantity and distribution throughout the season render the region to drought. The hot season begins by middle of February and extends up to the end of May or beginning of June followed by South-West monsoon season extending up to the end of September when the weather is cool and damp. The North-East or the retreating monsoon season is the period from October to November, while the cold season is from December to the middle of February. As per Koppen's classification, the regions climate is semi-arid. The command area experiences an average annual rainfall of 656 mm. Though the total rainfall is not high, the area benefits both from the South-West and North-East monsoons. The region is having dry climate. The months from December to May are the driest. Relative humidity varies from 26 per cent in summer to 62 per cent in winter CGWB, (2013) [2].

The soil area under land use along the water course of Distributary-7, the head reach of SBC was selected for the study and from the distributary, each lateral was selected. Again each of these laterals was divided into head, middle and tail sections. Composite soil samples, one from each depth (0-15, 15-30 and 30-45 cm) were drawn from head, middle and tail reaches of each lateral and thus, soil samples were collected from the fields along the water from head, middle and tail reaches of each lateral of D-7 and geographical position of the sampling spots were recorded using GPS. Collected soil samples were air dried in shade, ground in wooden pestle and mortar, passed through 2.00 mm sieve and the mineral matter left on the sieve was washed, dried, weighed and expressed as per cent gravels content of total soil. Processed soil samples were analysed for Physical (Soil texture, bulk density, particle density and total porosity, Infiltration rate) chemical Soil salinity (EC), (Soil reaction (pH) and Exchangeable sodium percentage (ESP). Particle size analysis of soil was done by International pipette method (Piper, 1966) [5] based on the principle of Stoke's law. Bulk density of soil was determined by core sampler method (Black, 1965) [1].

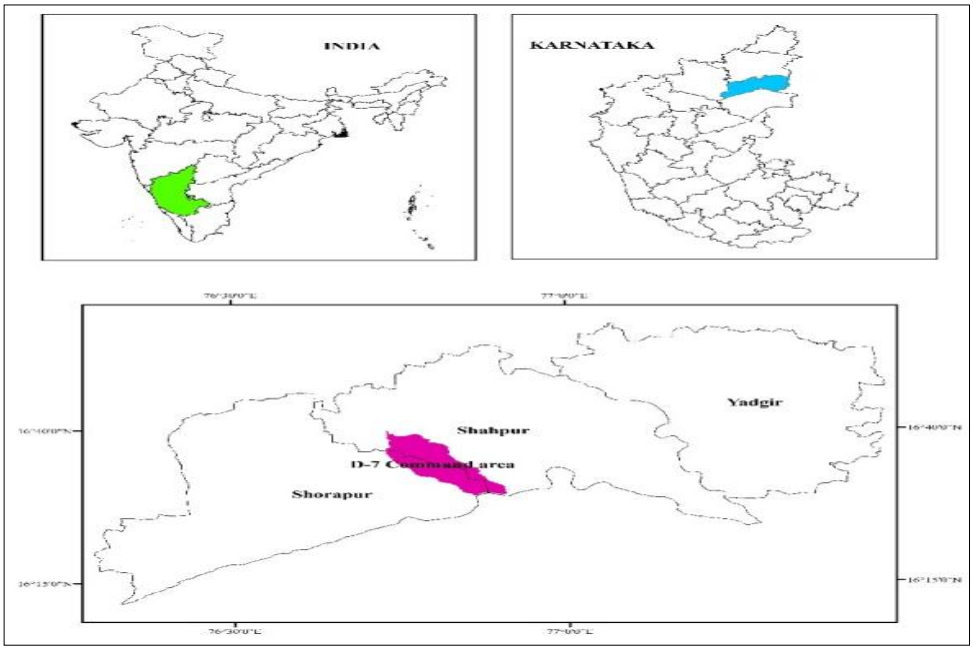

Fig 1: Location map of study area

Result and Discussions

Soil Physical Properties

Soil Texture

Soil texture was determined by International Pipette Method. Basic texture of both surface and sub-surface soils was sandy loam all along the water course and as appreciable amount of gravels (Table 1) were present, the basic textural class sandy loam was prefixed by gravel. As the gravels content was comparatively more in sub surface than in surface the texture of soil was comparatively coarser in sub surface than in surface soils all along the water course. Though soil texture was same in surface soils all along the water course of selected laterals, the content of finer soil particles like silt and clay was comparatively more in tail reach than in head and middle reach soils and this could be attributed to the physiography as it is sloppy towards tail reach and thus finer soil particles of surface layer were eroded from head reach leaving behind coarser particles and accumulated at tail reach via middle reach of distributary-7. These findings are in agreement with Pandey and Singh (2015) [4] soil texture particulars are presented in (Table 1).

Table 1: Particulars of soil texture at different depths in the study area

Soil depth (cm)	Sand (%)	Silt (%)	Clay (%)	Textural class
0-15	38	30	34	Clay loam
15-30	33	31	37	Clay loam
30-45	26	34	43	Clay

Bulk density (BD), Particle density (PD) and Total porosity (TP)

The soil samples were drawn from three different depths at 0-15, 15-30 and 30-45 cm, during in the year 2016 and 2017 are shown in Table 2.

Bulk density (BD): Higher soil BD (Table 2) in sub surface soil than in surface soil all along the water course of distributary-7 could be attributed to the high clay content and more compaction in the former than in the later and it was confirmed by the soil BD. The average depth BD was found with maximum 1.79 Mgm^{-3} and minimum was 1.45 Mgm^{-3} of distributary-7 could be attributed to more of coarser soil particles at the head reach as compared to the tail reach though soil texture was same all along the water course and high BD,

Thangasamy *et al.* (2005) [8]. Total porosity : Decreasing trend of soil porosity (Table 2) with depth as well as increasing trend of the same from head to tail reach along the water course of distributary-7 could be attributed to the decreasing and increasing trend Taha and Nanda (2003) [7].

Infiltration Rate

The infiltration rate was measured in the study area using double ring infiltrometer. The post-monsoon infiltration rate ranged from 0.28 to 4.8 mm h^{-1}. During pre-monsoon condition the minimum infiltration rate was 1.5 mm h^{-1} and maximum infiltration was 5.7 mm h^{-1}. The average infiltration rate during post-monsoon condition was 3.73 mm h^{-1}.

Soil Chemical Properties

The soil salinity (EC), soil reaction (pH) and ESP of soil samples during post-monsoon 2015 and 2016 and pre-monsoon of 2016 and 2017 are described as follows.

Average soil salinity during post-monsoon (2015 and 2016) and pre-monsoon (2016 and 2017)

The soil samples drawn from D-7 at three depths at 0-15, 15-30 and 30-45 cm and three locations (head, middle and tail reaches) were analysed for EC. The results of EC values along each lateral averaged over head, middle and tail reaches are presented in Table 3. It was observed that the maximum EC 7.95 dS m^{-1} and 8.17 dS m^{-1} and 8.36 dS m^{-1} and 8.44 dS m^{-1} and the minimum EC 6.79 dSm^{-1} and 6.99 dS m^{-1} and 7.15 dS m^{-1} and 7.21 dS m^{-1} across all the laterals (L1 to L30) respectively during post monsoon of 2015 and 2016 and pre monsoon of 2016 and 2017, EC at 15-30 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In lateral, L1 to L30, the maximum EC 7.61 dS m^{-1} and 7.42 dS m^{-1} and 7.87 dS m^{-1} and 7.68 dS m^{-1} respectively, the minimum EC 6.5 dSm^{-1} and 6.34 dS m^{-1} and 6.73 dS m^{-1} and 6.57 dS m^{-1} respectively.

The comparison value of mean for soil EC at 30-45 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In lateral, L1 to L30, the maximum EC 6.28 dS m^{-1} and 6.47 dS m^{-1} and 5.86 dS m^{-1} and 6.13 dS m^{-1} respectively, the minimum EC 5.37 dSm^{-1} and 5.53 dS m^{-1} and 5.01 dS m^{-1} and 5.24 dS m^{-1} respectively.

Table 2: Average Bulk density (Mg m^{-3}) Total porosity (%) Particle density (Mg m^{-3}) of different seasons and different depths

Lateral. No.	Pre-monsoon (2016)			Pre-monsoon (2017)			Pre-monsoon (2016)			Pre-monsoon (2017)			Pre-monsoon (2016)			Pre-monsoon (2017)		
	Bulk density (BD) (Mg m^{-3}) Soil depth (cm)						Particle density (PD) (Mg m^{-3}) Soil depth (cm)						Total porosity (TP) (%) Soil depth (cm)					
	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45
1	1.49	1.52	1.61	1.50	1.53	1.60	2.69	2.68	2.67	2.67	2.67	2.68	44.5	43.2	39.8	43.9	42.8	40.1
2	1.50	1.54	1.62	1.50	1.54	1.62	2.65	2.67	2.68	2.67	2.70	2.68	43.3	42.3	39.4	43.7	42.8	39.6
3	1.55	1.58	1.67	1.56	1.59	1.67	2.67	2.66	2.65	2.66	2.66	2.67	41.8	40.4	37.0	41.5	40.3	37.5
4	1.56	1.60	1.69	1.56	1.60	1.68	2.68	2.67	2.67	2.68	2.66	2.68	41.6	40.1	36.9	41.7	39.8	37.3
5	1.63	1.66	1.76	1.63	1.67	1.75	2.67	2.67	2.66	2.67	2.69	2.68	39.1	37.7	34.1	39.1	37.9	34.6
6	1.58	1.62	1.70	1.59	1.62	1.70	2.67	2.66	2.67	2.68	2.68	2.68	40.7	39.3	36.1	40.8	39.5	36.6
7	1.66	1.70	1.79	1.66	1.70	1.79	2.69	2.67	2.67	2.66	2.68	2.67	38.3	36.4	33.0	37.6	36.5	33.2
8	1.66	1.69	1.78	1.66	1.69	1.78	2.67	2.66	2.66	2.68	2.67	2.68	38.0	36.6	33.1	38.0	36.7	33.6
9	1.70	1.73	1.73	1.70	1.73	1.73	2.69	2.68	2.68	2.68	2.66	2.68	36.9	35.4	35.4	36.5	34.9	35.4
10	1.67	1.70	1.70	1.67	1.70	1.70	2.67	2.68	2.66	2.68	2.68	2.67	37.7	36.5	36.0	37.6	36.4	36.3
11	1.67	1.70	1.71	1.67	1.71	1.70	2.68	2.66	2.67	2.68	2.68	2.67	37.8	36.0	35.9	37.5	36.4	36.3
12	1.56	1.59	1.60	1.56	1.59	1.59	2.69	2.66	2.67	2.68	2.68	2.67	42.0	40.3	40.3	41.8	40.4	40.3
13	1.58	1.61	1.61	1.58	1.61	1.61	2.68	2.67	2.68	2.69	2.68	2.67	41.3	39.9	39.9	41.3	39.9	39.8
14	1.62	1.65	1.65	1.62	1.65	1.65	2.68	2.69	2.67	2.67	2.67	2.69	39.6	38.7	38.0	39.2	38.1	38.5
15	1.45	1.48	1.48	1.45	1.48	1.48	2.69	2.67	2.66	2.67	2.66	2.69	46.1	44.6	44.3	45.5	44.4	45.1
16	1.53	1.57	1.65	1.53	1.57	1.65	2.67	2.68	2.68	2.67	2.67	2.67	42.5	41.5	38.4	42.6	41.3	38.2
17	1.55	1.58	1.67	1.55	1.59	1.67	2.68	2.68	2.67	2.67	2.67	2.67	42.2	40.9	37.4	42.1	40.6	37.6
18	1.52	1.55	1.64	1.52	1.55	1.63	2.69	2.69	2.65	2.69	2.66	2.66	43.7	42.4	38.4	43.7	41.5	38.6
19	1.53	1.57	1.65	1.53	1.57	1.65	2.68	2.68	2.68	2.68	2.68	2.68	42.8	41.6	38.4	42.8	41.4	38.4
20	1.55	1.58	1.67	1.55	1.59	1.67	2.68	2.67	2.68	2.67	2.67	2.68	42.3	40.8	37.7	42.1	40.6	37.9
21	1.49	1.52	1.53	1.50	1.53	1.52	2.66	2.66	2.68	2.68	2.70	2.68	44.0	42.8	43.0	44.2	43.5	43.2
22	1.61	1.65	1.74	1.61	1.65	1.73	2.66	2.67	2.67	2.67	2.67	2.68	39.6	38.5	34.9	39.8	38.2	35.4
23	1.57	1.61	1.69	1.57	1.61	1.69	2.66	2.67	2.66	2.69	2.67	2.69	41.0	39.8	36.4	41.5	39.8	37.2
24	1.60	1.64	1.72	1.60	1.64	1.72	2.68	2.69	2.67	2.66	2.65	2.68	40.2	39.3	35.4	39.9	38.2	35.7
25	1.51	1.54	1.63	1.51	1.54	1.62	2.69	2.68	2.66	2.67	2.67	2.69	43.7	42.5	38.9	43.3	42.2	39.7
26	1.59	1.63	1.72	1.59	1.63	1.71	2.68	2.66	2.66	2.69	2.67	2.68	40.7	38.8	35.5	40.9	38.9	36.1
27	1.63	1.67	1.76	1.63	1.67	1.76	2.68	2.69	2.68	2.67	2.69	2.68	39.1	38.1	34.4	39.0	37.9	34.6
28	1.48	1.51	1.59	1.48	1.51	1.59	2.67	2.68	2.67	2.66	2.68	2.68	44.6	43.7	40.3	44.3	43.6	40.6
29	1.50	1.53	1.61	1.50	1.53	1.61	2.67	2.67	2.67	2.66	2.67	2.69	44.0	42.9	39.6	43.6	42.7	40.3
30	1.48	1.51	1.59	1.48	1.51	1.59	2.67	2.66	2.67	2.68	2.68	2.68	44.8	43.5	40.4	44.8	43.6	40.9

Table 3: Average soil salinity (EC) during different seasons and at different depths

Lateral. No.	Post-monsoon-2015			Pre-monsoon-2016			Post-monsoon-2016			Pre-monsoon-2017		
	Soil depth (cm)			Soil depth (cm)			Soil depth (cm)			Soil depth (cm)		
	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45
1	7.00	6.70	5.53	7.37	6.93	5.17	7.20	6.53	5.70	7.43	6.77	5.40
2	7.07	6.77	5.59	7.44	7.00	5.22	7.27	6.6	5.76	7.51	6.83	5.45
3	7.28	6.97	5.75	7.66	7.21	5.37	7.49	6.79	5.93	7.73	7.04	5.62

4	7.35	7.03	5.81	7.73	7.28	5.42	7.56	6.86	5.98	7.80	7.10	5.67
5	7.65	7.32	6.04	8.05	7.57	5.64	7.87	7.14	6.23	8.12	7.39	5.90
6	7.43	7.11	5.87	7.81	7.35	5.48	7.64	6.93	6.05	7.89	7.18	5.73
7	7.80	7.47	6.17	8.21	7.73	5.76	8.02	7.28	6.35	8.28	7.54	6.02
8	7.76	7.43	6.13	8.17	7.69	5.73	7.98	7.24	6.32	8.24	7.50	5.99
9	7.95	7.61	6.28	8.36	7.87	5.86	8.17	7.42	6.47	8.44	7.68	6.13
10	7.81	7.48	6.17	8.22	7.74	5.77	8.03	7.29	6.36	8.29	7.55	6.03
11	7.82	7.48	6.18	8.23	7.74	5.77	8.04	7.30	6.37	8.30	7.56	6.03
12	7.31	7.00	5.78	7.69	7.24	5.4	7.52	6.82	5.95	7.76	7.07	5.64
13	7.38	7.07	5.84	7.77	7.31	5.45	7.59	6.89	6.01	7.84	7.14	5.70
14	7.58	7.26	5.99	7.98	7.51	5.60	7.80	7.08	6.17	8.05	7.33	5.85
15	6.79	6.50	5.37	7.15	6.73	5.01	6.99	6.34	5.53	7.21	6.57	5.24
16	7.20	6.89	5.69	7.58	7.13	5.31	7.40	6.72	5.86	7.64	6.96	5.55
17	7.27	6.96	5.75	7.65	7.20	5.37	7.48	6.79	5.92	7.72	7.03	5.61
18	7.13	6.82	5.63	7.50	7.06	5.26	7.33	6.65	5.80	7.57	6.89	5.50
19	7.20	6.89	5.69	7.58	7.13	5.31	7.40	6.72	5.86	7.64	6.96	5.55
20	7.27	6.96	5.75	7.65	7.20	5.37	7.48	6.78	5.92	7.72	7.03	5.61
21	7.00	6.70	5.53	7.36	6.93	5.16	7.20	6.53	5.70	7.43	6.76	5.40
22	7.56	7.24	5.98	7.96	7.49	5.58	7.78	7.06	6.16	8.03	7.31	5.83
23	7.38	7.06	5.83	7.76	7.31	5.45	7.59	6.89	6.01	7.84	7.13	5.69
24	7.51	7.19	5.94	7.91	7.44	5.55	7.73	7.01	6.12	7.98	7.26	5.8
25	7.08	6.78	5.60	7.46	7.02	5.23	7.29	6.61	5.77	7.52	6.85	5.46
26	7.48	7.16	5.91	7.87	7.41	5.52	7.70	6.98	6.09	7.94	7.23	5.77
27	7.66	7.34	6.06	8.06	7.59	5.66	7.88	7.15	6.24	8.14	7.41	5.91
28	6.94	6.64	5.49	7.31	6.88	5.12	7.14	6.48	5.65	7.37	6.71	5.36
29	7.01	6.71	5.54	7.38	6.94	5.18	7.21	6.54	5.71	7.45	6.78	5.41
30	6.92	6.62	5.47	7.28	6.85	5.11	7.12	6.46	5.64	7.35	6.69	5.34

Average soil reaction pH during post-monsoon of (2015 and 2016) and pre-monsoon (2016 and 2017)

The soil samples drawn from D-7 at three depths at 0-15, 15-30 and 30-45 cm and three locations (head, middle and tail reaches) were analysed for pH. The results of pH values along each lateral averaged over head, middle and tail reaches are presented in Table 4 revealed that the comparison value of mean for soil pH at 0-15 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In case of lateral, L1 to L30, the maximum mean pH value was 8.34 and 8.39 and 8.32 and 8.52 respectively, and minimum mean pH value was found 7.41 and 7.45 and 7.45 and 7.68 respectively. The comparison value of mean for soil pH at 15-30 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In lateral, L1 to L30, the maximum pH 8.10 and 8.35 and 8.27 and 8.52 respectively, the minimum pH 7.25 and 7.41 and 7.42 and 7.58 respectively. The comparison value of mean for soil pH at 15-30 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In lateral, L1 to L30, the maximum pH 7.99 and 8.10 and 8.03 and 8.27 respectively, the minimum pH 7.16 and 7.26 and 7.19 and 7.41 respectively.

Average exchangeable sodium percentage (meq/100 g) during post-monsoon (2015 and 2016) and pre-monsoon of (2016 and 2017)

The soil samples drawn from D-7 at three depths at 0-15, 15-30 and 30-45 cm and three locations (head, middle and tail reaches) were analysed for ESP. The results of ESP values along each lateral averaged over head, middle and tail reaches are presented in Table 5 revealed that the comparison value of mean for soil ESP at 0-15 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In case of lateral, L1 to L30, the maximum mean ESP value was 15.71 and 16.35 and 15.88 and 16.55 meq/100 g respectively, the minimum mean ESP value was 13.43 and 13.98 and 13.58 and 14.15 meq/100 g respectively. The comparison value of mean for soil ESP at 15-30 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In lateral, L1 to L30, the maximum ESP 15.67 meq/100 g and 16.02 meq/100 g and 15.70 meq/100 g and 16.10 meq/100 g respectively, the minimum ESP 13.40 meq/100 g and 13.70 meq/100 g and 13.42 meq/100 g and 13.76 meq/100 g respectively. The comparison value of mean for soil ESP at 30-45 cm depth during post-monsoon of 2015 and 2016 and pre-monsoon of 2016 and 2017. In lateral, L1 to L30, the maximum ESP 15.76 meq/100 g and 16.03 meq/100 g and 15.52 meq/100 g and 15.94 meq/100 g respectively, the minimum ESP 13.47 meq/100 g and 13.71 meq/100 g [1] and 13.27 meq/100 g and 13.62 meq/100 g respectively.

Table 4: Average soil reaction (pH) during different seasons and at different depths

Lateral. No.	Post-monsoon-2015			Pre-monsoon-2016			Post-monsoon-2016			Pre-monsoon-2017		
	Soil depth (cm)			Soil depth (cm)			Soil depth (cm)			Soil depth (cm)		
	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45
1	7.50	7.33	7.57	7.70	7.63	7.70	7.53	7.50	7.40	7.87	7.67	7.63
2	7.60	7.30	7.17	7.93	7.53	7.43	7.70	7.50	7.33	8.00	7.70	7.43
3	7.87	7.63	7.53	8.03	7.80	7.57	8.11	7.87	7.64	8.27	8.03	7.79
4	7.71	7.48	7.38	7.68	7.64	7.42	7.76	7.72	7.49	7.91	7.87	7.64
5	7.95	7.71	7.61	7.92	7.88	7.64	7.99	7.95	7.71	8.16	8.11	7.87
6	8.10	7.86	7.76	8.08	8.03	7.79	8.15	8.11	7.87	8.32	8.28	8.03
7	8.18	7.94	7.83	8.15	8.11	7.87	8.23	8.19	7.94	8.40	8.36	8.11
8	8.26	8.02	7.91	8.24	8.19	7.95	8.31	8.27	8.02	8.48	8.44	8.19

9	8.34	8.10	7.99	8.32	8.27	8.03	8.39	8.35	8.10	8.57	8.52	8.27
10	8.06	7.82	7.72	8.03	7.99	7.75	8.11	8.07	7.82	8.27	8.23	7.98
11	8.18	7.94	7.84	8.16	8.11	7.87	8.23	8.19	7.95	8.40	8.36	8.11
12	7.82	7.59	7.49	7.80	7.76	7.53	7.87	7.83	7.60	8.03	7.99	7.75
13	8.03	7.79	7.69	8.00	7.96	7.72	8.07	8.03	7.79	8.24	8.20	7.95
14	7.95	7.72	7.62	7.93	7.89	7.65	8.00	7.96	7.72	8.16	8.12	7.88
15	7.68	7.46	7.36	7.66	7.62	7.39	7.73	7.69	7.46	7.89	7.85	7.61
16	7.56	7.33	7.24	7.53	7.49	7.27	7.60	7.56	7.34	7.76	7.72	7.49
17	7.63	7.40	7.31	7.60	7.57	7.34	7.68	7.64	7.41	7.83	7.79	7.56
18	7.48	7.26	7.16	7.45	7.42	7.19	7.52	7.49	7.26	7.68	7.64	7.41
19	7.55	7.33	7.23	7.53	7.49	7.27	7.60	7.56	7.33	7.75	7.72	7.48
20	7.63	7.40	7.31	7.60	7.56	7.34	7.67	7.64	7.41	7.83	7.79	7.56
21	7.91	7.68	7.58	7.89	7.85	7.61	7.96	7.92	7.68	8.12	8.08	7.84
22	7.93	7.70	7.60	7.91	7.87	7.63	7.98	7.94	7.70	8.14	8.10	7.86
23	7.74	7.51	7.42	7.72	7.68	7.45	7.79	7.75	7.52	7.95	7.91	7.67
24	7.89	7.65	7.55	7.86	7.82	7.58	7.93	7.89	7.66	8.09	8.05	7.81
25	7.59	7.42	7.66	7.79	7.72	7.79	7.62	7.59	7.49	7.96	7.76	7.72
26	7.85	7.62	7.52	7.83	7.79	7.55	7.90	7.86	7.62	8.06	8.02	7.78
27	8.04	7.80	7.70	8.01	7.97	7.74	8.09	8.05	7.81	8.25	8.21	7.97
28	7.44	7.27	7.50	7.64	7.57	7.64	7.47	7.44	7.34	7.80	7.60	7.57
29	7.51	7.35	7.58	7.71	7.65	7.71	7.55	7.51	7.41	7.88	7.68	7.65
30	7.41	7.25	7.48	7.61	7.55	7.61	7.45	7.41	7.32	7.78	7.58	7.55

Table 5: Average exchangeable sodium percentage (ESP) during different seasons and at different depths

Lateral. No.	Post-monsoon-2015			Pre-monsoon-2016			Post-monsoon-2016			Pre-monsoon-2017		
	Soil depth (cm)			Soil depth (cm)			Soil depth (cm)			Soil depth (cm)		
	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45
1	13.84	13.81	13.88	13.99	13.83	13.67	14.40	14.12	14.12	14.58	14.18	14.04
2	13.98	13.94	14.02	14.13	13.97	13.81	14.55	14.26	14.26	14.73	14.33	14.18
3	14.40	14.36	14.44	14.55	14.39	14.22	14.98	14.68	14.69	15.17	14.75	14.6
4	14.53	14.49	14.57	14.68	14.52	14.35	15.11	14.81	14.82	15.30	14.88	14.73
5	15.12	15.08	15.16	15.28	15.11	14.93	15.73	15.42	15.43	15.93	15.49	15.34
6	14.69	14.65	14.72	14.84	14.67	14.50	15.28	14.97	14.98	15.47	15.05	14.89
7	15.43	15.38	15.47	15.59	15.41	15.23	16.05	15.73	15.74	16.25	15.80	15.64
8	15.35	15.31	15.39	15.51	15.33	15.15	15.97	15.65	15.66	16.17	15.72	15.56
9	15.71	15.67	15.76	15.88	15.70	15.52	16.35	16.02	16.03	16.55	16.10	15.94
10	15.45	15.41	15.49	15.61	15.44	15.25	16.07	15.75	15.76	16.27	15.83	15.67
11	15.46	15.42	15.50	15.63	15.45	15.27	16.09	15.77	15.78	16.29	15.84	15.68
12	14.46	14.42	14.50	14.61	14.45	14.28	15.04	14.74	14.75	15.23	14.81	14.66
13	14.60	14.56	14.64	14.76	14.59	14.42	15.19	14.89	14.9	15.38	14.96	14.81
14	15.00	14.96	15.04	15.15	14.98	14.81	15.6	15.29	15.30	15.80	15.36	15.21
15	13.43	13.40	13.47	13.58	13.42	13.27	13.98	13.70	13.71	14.15	13.76	13.62
16	14.24	14.20	14.27	14.39	14.23	14.06	14.81	14.52	14.52	15.00	14.59	14.44
17	14.38	14.34	14.42	14.53	14.37	14.2	14.96	14.66	14.67	15.15	14.73	14.58
18	14.09	14.06	14.13	14.24	14.08	13.92	14.66	14.37	14.38	14.85	14.44	14.29
19	14.24	14.2	14.27	14.39	14.22	14.06	14.81	14.52	14.52	15.00	14.58	14.44
20	14.38	14.34	14.41	14.53	14.37	14.2	14.96	14.66	14.67	15.14	14.73	14.58
21	13.84	13.8	13.87	13.98	13.83	13.66	14.4	14.11	14.12	14.58	14.18	14.03
22	14.95	14.91	14.99	15.11	14.94	14.76	15.56	15.25	15.25	15.75	15.32	15.16
23	14.59	14.55	14.63	14.75	14.58	14.41	15.18	14.88	14.89	15.37	14.95	14.8
24	14.86	14.82	14.9	15.02	14.85	14.67	15.46	15.15	15.16	15.65	15.22	15.07
25	14.01	13.97	14.05	14.16	14.00	13.83	14.58	14.29	14.29	14.76	14.35	14.21
26	14.80	14.76	14.84	14.95	14.79	14.61	15.39	15.09	15.10	15.59	15.16	15.01
27	15.16	15.12	15.20	15.32	15.15	14.97	15.77	15.46	15.46	15.97	15.53	15.37
28	13.73	13.69	13.77	13.87	13.72	13.56	14.28	14.00	14.01	14.46	14.07	13.92
29	13.87	13.83	13.90	14.01	13.86	13.69	14.43	14.14	14.15	14.61	14.21	14.06
30	13.69	13.65	13.72	13.83	13.68	13.51	14.24	13.96	13.96	14.42	14.02	13.88

Conclusion

Physical quality indicator, soil bulk density increased with depth and decreased along the water course from head to tail reaches while total porosity experienced the reverse trend. As the amount of water discharged at the head reach soils was comparatively more than that of tail reach soils and thus, soil quality was comparatively better in later soils. Chemical quality indicator pH, EC and ESP showed increasing trend with depth as well as along the water course from head to tail reach (Prasad and Govardhan, 2011) [6] and (Kambale and Rudramurthy, 2017) [3]. In irrigation, quality of soils along the water course of distributary-7 of SBC was deteriorated as much as expected because of the land use as the bellow ground portion of the paddy is being incorporated into the soil has improved organic matter content of the soils and in addition to that the soils were basically loamy textured. In spite of continuous irrigation for longer period soils were saline or sodic as the soil texture was coarser, that provided better leaching environment and encourage the accumulation of salt.

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