

3. SOIL AND WATER CONSERVATION ENGINEERING

Soil and water are two important natural resources and the basic needs for agricultural production. Soil and water should be given paramount priority from the conservation point of view and appropriate methods should be used to ensure their sustainability and future availability. This section containing 22 tables, which includes data on soil information and land degradation statistics of the country. Information about rainfall statistics and distribution is also provided. Recent data of water use statistics, water resources (Inland and Groundwater) of the country and storage capacity of large dam projects have been presented here. Data related to the area covered under drip irrigation, irrigation area statistics of different states regarding the source, crops, and classes are presented in this chapter. Data related to irrigation water quality and recommendations for use of water in irrigation systems have been provided.

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Table 3.1: Soil Groups of India and their Extent and Distribution

Major Soil	Extent		Distribution in states	Soil orders US soil taxonomy
	'000 ha	Percentage		
Alluvial	1,00,006	30.4	J&K, HP, Punjab, Haryana, Delhi, UP, Gujarat, Goa, MP, MH, AP, Karnataka, TN, Kerala, Puducherry, Bihar, Odisha, WB, AP, Assam, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, A&N	Inceptisols, Entisols, Alfisols, Aridisols
Coastal alluvial	10,049	3.1	AP, Karnataka, TN, Kerala, WB, Gujarat, Odisha, Puducherry, Lakshadweep, A&N	Aridisols, Inceptisols, Entisols
Red	87,989	26.8	AP, Karnataka, Kerala, TN, Puducherry, Rajasthan, MP, MH, Gujarat, Goa, AP, Assam, Manipur, Meghalaya, Nagaland, Mizoram, Tripura, Delhi, UP, HP, A&N	Alfisols, Ultisols, Entisols, Inceptisols, Mollisols, Aridisols
Laterites	18,094	5.5	AP, Karnataka, Kerala, TN, Puducherry, MS, Odisha, WB	Alfisols, Ultisols, Inceptisols
Brown forest	540	0.2	Karnataka, Maharashtra	Mollisols, Inceptisols
Hill	2,262	0.7	Manipur, Odisha, WB, Tripura, Nagaland	Inceptisols, Entisols
Terai	326	0.1	UP, Sikkim	Mollisols, Entisols
Mountain meadow	60	0.1	J&K	Mollisols
Sub-montane	104	0.1	J&K	Alfisols
Black	54,682	16.6	MP, MS, Rajasthan, Puducherry, TN, UP, Bihar, Odisha, AP, Gujarat	Vertisols, Mollisols, Inceptisols, Entisols, Aridisols
Desert	26,283	8.0	Rajasthan, Gujarat, Haryana, Punjab	Aridisols, Inceptisols, Entisols
Others*	28,305	8.6	–	–
Total	13,28,700	100	–	–

*Includes glaciers (0.4%), sand dunes (0.01%), mangrove swamps (0.04%), salt waste (0.01%), water bodies (0.1%), rock land (0.25%) and rock outcrops (7.8%).

Sources: 1. Bhattacharyya et al., 2013. Soils of India: historical perspective, classification and recent advances. Current Sciences, 104 (10): 1308-1323.
2. Bhattacharyya et al., 2009. Soil Taxonomic Database of India and the States (1: 250,000 scale), NBSSLUP Publ. 143, National Bureau of Soil Survey and Land Use Planning, Nagpur, p. 266.

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Table 3.2: State-Wise Extent of Various Kinds of Land Degradation in India (Mha) (TGA total ground area)

State	Water Erosion	Wind Erosion	Water Logging	Salinity/ Alkalinity	Soil Acidity	Complex Problem	Total Degraded Area	% of Degraded Area to TGA
Andhra Pradesh + Telangana	11.5	0	1.9	0.5	0.9	0.2	15.0	54.5
Goa	0.1	0	0.1	0	0	0	0.2	43.9
Karnataka	5.8	0	0.9	0.1	0.1	0.7	7.6	39.8
Kerala	0.1	0	2.1	0	0.1	0.3	2.6	67.1
Tamil Nadu	4.9	0	0.1	0.1	0.1	0.1	5.3	41.0
Manipur	0.1	0	0	0	1.1	0.7	1.9	42.6
Mizoram	0.1	0	0	0	1.1	0.7	1.9	89.2
Meghalaya	0.1	0	0	0	1.0	0	1.2	53.9
Assam	0.7	0	0	0	0.6	0.9	2.2	28.2
Arunachal Pradesh	2.4	0	0.2	0	2.0	0	0	53.8
Nagaland	0.4	0	0	0	0.1	0.5	1.0	60.0
Sikkim	0.2	0	0	0	0.1	0	0.2	33.0
Tripura	0.1	0	0.2	0	0.2	0.1	0.6	59.9
Himachal Pradesh	2.8	0	1.3	0	0.2	0	4.2	75.0
Jammu and Kashmir	5.5	0.1	0.2	0	0	0	7.0	31.6
Uttar Pradesh + Uttarakhand	11.4	0.2	2.4	1.4	0	0	15.3	52.0
Delhi	0.1	0	0	0	0	0.0	0.1	55.4
Haryana	0.3	0.5	0.1	0.3	0	0.2	1.5	33.2
Punjab	0.4	0.3	0.3	0.3	0	0	1.3	25.4
Bihar + Jharkhand	3.0	0	2.0	0.2	1.0	0	6.3	36.1
West Bengal	1.2	0	0.7	0.2	0.6	0.1	2.8	31.0
Union Territories	0.2	0	0	0	0	0	0.2	24.8
Gujarat	5.2	0.4	0.5	0.3	0	1.7	8.1	41.5
Rajasthan	3.2	6.7	0	1.4	0	0.1	11.4	33.2
Madhya Pradesh + Chhattisgarh	17.9	0	0.4	0	7.0	1.1	26.2	59.1
Maharashtra	11.2	0	0	1.1	0.6	0.3	13.1	42.4
Odisha	5.0	0	0.7	0	0.3	0.1	6.1	39.3
Grand Total (Mha)	93.7	9.5	14.3	5.9	16.0	7.4	146.8	-

Source:1. Bhattacharyya et al., 2013. Soils of India: historical perspective, classification and recent advances. Current Sciences, 104 (10): 1308-1323.

2. Bhattacharyya et al., 2009. Soil Taxonomic Database of India and the States (1: 250,000scale), NBSSLUP Publ. 143, National Bureau of Soil Survey and Land Use Planning, Nagpur, p. 266.

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Table 3.3: Distribution of Annual Rainfall according to Seasons

Rainfall	Duration	Approximate percentage of annual rainfall (%)
Pre-Monsoon	March-May	10.4
South-West Monsoon	June-September	73.7
Post- Monsoon	October-December	13.3
Winter or North-East Monsoon	January-February	2.6
Total		100.0

Source: <http://www.iasri.res.in/agridata/HOME.HTML>. Accessed on 28.10.2020.

Table 3.4: Sub Division/Season-Wise Annual and Normal Rainfall Statistics of India for Year 2020

Sub-Division	(In Millimeter)											
	Winter season (Jan-Feb 2020)			Pre-Monsoon Season (March-May 2020)			Monsoon Season (June-Sept. 2020)			Post Monsoon Season (Oct.-Dec. 2020)		
	Actual	Normal	% Dep.	Actual	Normal	% Dep.	Actual	Normal	% Dep.	Actual	Normal	% Dep.
Andaman and Nicobar Islands	6.0	75.4	-92	266.1	466.8	-43	1,712.4	1,653.8	4	858.5	675.8	27
Arunachal Pradesh	98.2	146.7	-33	599.9	772.9	-22	1,943.7	1,726.6	13	247.0	267.4	-8
Assam and Meghalaya	35.0	46.7	-25	663.7	587.8	13	2,147.5	1,773.7	21	215.0	196.5	9
Nagaland, Manipur, Mizoram and Tripura	44.1	37.8	17	303.8	483.0	-37	965.4	1,426.7	-32	213.5	221.0	-3
Sub-Himalayan, West Bengal and Sikkim	48.9	45.9	6	499.5	442.9	13	2,665.3	1,970.8	35	121.8	179.4	-32
Gangetic West Bengal	39.4	32.8	20	371.1	185.8	100	1,061.0	1,181.5	-10	80.6	156.4	-48
Odisha	63.1	29.2	116	265.4	128.4	107	1,140.9	1,155.3	-1	166.6	131.3	27
Jharkhand	41.3	28.2	46	216.5	83.3	160	899.2	1,054.7	-15	67.5	90.3	-25
Bihar	36.3	20.1	81	182.6	81.7	123	1,272.5	1,017.2	25	30.1	73.0	-59
East Uttar Pradesh	41.0	25.5	61	97.9	32.4	202	784.8	839.4	-7	9.1	47.7	-81
West Uttar Pradesh	44.4	29.3	51	88.8	29.9	197	455.3	721.3	-37	5.4	32.7	-83
Uttarakhand	170.8	101.4	68	241.3	155.3	55	943.2	1,176.9	-20	17.8	60.5	-71
Haryana, Chandigarh and Delhi	29.8	30.9	-4	118.3	39.3	201	379.8	444.0	-14	8.6	20.2	-57
Punjab	53.0	48.7	9	124.7	55.1	126	391.7	467.3	-16	20.7	26.3	-21
Himachal Pradesh	137.1	192.7	-29	270.9	243.4	11	565.5	763.5	-26	77.9	91.6	-15
Jammu and Kashmir	164.3	224.0	-27	330.5	335.2	-1	376.2	566.0	-34	108.1	133.5	-19
West Rajasthan	8.2	8.8	-7	50.8	22.5	126	331.0	265.3	25	3.8	11.6	-68
East Rajasthan	2.9	10.0	-71	46.4	19.0	144	591.7	602.9	-2	9.2	25.8	-64

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West Madhya Pradesh	13.5	12.5	8	27.4	12.9	113	970.9	857.7	13	21.3	50.9	-58
East Madhya Pradesh	52.7	32.9	60	82.7	23.6	250	1,031.6	1,048.4	-2	37.9	57.4	-34
Gujarat Region	0.0	1.5	-100	4.33	6.3	-31.3	1,035.0	922.9	12	23.7	29.8	-21
Saurashtra, Kutch & Diu	0.2	1.0	-77	1.1	4.0	-73	1,146.2	507.2	126	37.3	27.5	36
Konkan and Goa	0.0	0.7	-100	12.2	36.0	-66	3,662.7	2,875.3	27	254.2	139.6	82
Madhya Maharashtra	0.0	2.9	-100	32.5	32.5	0	966.6	751.2	29	170.0	103.1	65
Marathwada	3.0	6.9	-56	32.7	27.4	19	866.1	668.8	30	106.7	100.0	7
Vidarbha	25.5	17.8	43	41.8	27.4	53	851.9	943.1	-10	52.0	81.5	-36
Chhattisgarh	69.0	21.3	224	119.6	41.0	192	1,234.3	1,142.1	8	92.6	76.7	21
Coastal Andhra Pradesh & Yaman	31.1	22.4	39	82.3	98.7	-17	725.3	586.9	24	419.3	338.1	24
Telangana	13.9	14.5	-4	61.1	59.8	2	1,095.4	751.9	46	179.5	123.3	46
Rayalaseema	4.3	8.1	-47	65.4	82.1	-20	756.0	411.6	84	343.2	223.3	54
Tamil Nadu & Puducherry	9.9	28.1	-65	75.9	125.4	-39	437.0	342.0	28	477.5	449.7	6
Coastal Karnataka	0.6	2.5	-77	170.8	155.7	10	3,685.0	3,095.1	19	332.8	256.8	30
North Interior Karnataka	0.7	5.2	-86	110.9	80.0	39	739.3	497.1	49	179.8	138.1	30
South Interior Karnataka	0.4	5.8	-93	176.7	140.4	26	817.7	681.8	20	203.0	204.1	-1
Kerala & Mahe	9.6	22.4	-57	387.3	361.5	7	2,228.2	2,049.3	9	365.1	491.6	-26
Lakshadweep	8.1	25.2	-68	237.3	203.3	17	1,345.4	1,013.1	33	294.0	321.8	-9

Source:Annual Climate Summary, 2020; National Climate Centre, Climate Services Division, IMD-Pune.

Table 3.5: Broad Region-wise Monsoon (June-September) Rainfall Distribution from 2005 to 2019

(In Millimeter)												
Year	North-West India			Central India			South Peninsula			East & North-East India		
	Actual	Normal	% Dep.	Actual	Normal	% Dep.	Actual	Normal	% Dep.	Actual	Normal	% Dep.
2005	552.1	611.6	-10	1,094.9	993.2	10	808.9	722.6	12	1,140.9	1,430.7	-20
2006	573.7	611.6	-6	1,152.2	993.9	16	684.6	722.6	-5	1,177.6	1,427.3	-17
2007	520.8	611.6	-15	1,073.8	993.9	8	907.3	722.6	26	1,485.9	1,427.3	4
2008	651.7	611.6	7	956.9	993.9	-4	692.5	722.6	-4	1,346.0	1,427.3	-6
2009	392.1	611.6	-36	794.8	993.9	-20	693.0	722.6	-4	1,037.7	1,427.3	-27
2010	688.2	613.0	12	1,027.9	991.5	4	853.6	722.9	18	1,175.8	1,436.2	-18
2011	654.8	615.0	7	1,073.6	975.5	10	715.2	715.5	0	1,233.6	1,438.3	-14
2012	569.3	615.0	-7	934.6	974.2	-4	644.0	715.7	-10	1,275.3	1,437.8	-11
2013	671.8	615.0	9	1,195.3	974.2	23	825.6	715.7	15	1,037.9	1,437.8	-28
2014	483.1	615.0	-21	879.7	974.2	-10	665.4	715.7	-7	1,267.7	1,437.8	-12
2015	510.6	615.0	-17	815.5	975.5	-16	605.7	716.1	-15	1,317.5	1,438.3	-8
2016	584.2	615.0	-5	1,034.1	975.5	6	661.5	716.1	-8	1,281.5	1,438.3	-11
2017	552.9	615.0	-10	918.8	975.5	-6	717.6	716.1	0	1,386.4	1,438.3	-4
2018	603.2	615.0	-2	911.3	975.5	-7	704.4	716.1	-2	1,087.5	1,438.3	-24
2019	586.0	599.5	-2	1,262.8	976.6	29	840.9	726.2	16	1,240.7	1,410.4	-12

Source:Agricultural Statistics at a Glance 2019, p: 271, Department of Agriculture, Cooperation & Farmers Welfare, New Delhi.

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Table 3.6: Water Requirements for Different Uses in India

(in Billion Cubic Meter)										
Uses	Year 1997-98	Year - 2010			Year - 2025			Year – 2050		
		Low	High	%	Low	High	%	Low	High	%
Surface Water :										
Irrigation	318	330	339	48	325	366	43	375	463	39
Domestic	17	23	24	3	30	36	5	48	65	6
Industries	21	26	26	4	47	47	6	57	57	5
Power	7	14	15	2	25	26	3	50	56	5
Inland Navigation		7	7	1	10	10	1	15	15	1
Environment Ecology		5	5	1	10	10	1	20	20	2
Evaporation Losses	36	42	42	6	50	50	6	76	76	6
Total	399	447	458	65	497	545	65	641	752	64
Ground Water :										
Irrigation	206	213	218	31	236	245	29	253	344	29
Domestic & Municipal	13	19	19	2	25	26	3	42	46	4
Industries	9	11	11	1	20	20	2	24	24	2
Power	2	4	4	1	6	7	1	13	14	1
Total	230	247	252	35	287	298	35	332	428	36
Grand Total	629	694	710	100	784	843	100	973	1,180	100
Total Water Use :										
Irrigation	524	543	557	78	561	611	72	628	817	68
Domestic	30	42	43	6	55	62	7	90	111	9
Industries	30	37	37	5	67	67	8	81	81	7
Power	9	18	19	3	31	33	4	63	70	6
Inland Navigation	0	7	7	1	10	10	1	15	15	1
Environment (2) Ecology	0	5	5	1	10	10	1	20	20	2
Evaporation Losses	36	42	42	6	50	50	6	76	76	7
Total	629	694	710	100	784	843	100	973	1,180	100

Abbr.:BCM: Billion Cubic Meter.

Source:Water and Related statistics, 2013, Central Water Commission.

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Table 3.7: Basin-wise Water Resources Potential of India

Sl. No.	Name of the River Basin	Catchment area (Sq.km)	Average Water Resources Potential (BCM)	Utilisable Surface Water Resources (BCM)
1	Indus (up to Border)	3,17,708	45.53	46
2	a) Ganga	8,38,803	509.52	250
	b) Brahmaputra	1,93,252	527.28	24
	c) Barak& Others	86,335	86.67	-
3	Godavari	3,12,150	117.74	76.3
4	Krishna	2,59,439	89.04	58
5	Cauvery	85,167	27.67	19
6	Pennar	54,905	11.02	6.9
7	East Flowing Rivers Between Mahanadi & Pennar	82,073	26.41	13.1
8	East Flowing Rivers Between Pennar and Kanyakumari	1,01,657	26.74	16.5
9	Mahanadi	1,44,905	73	50
10	Brahmani & Baitarni	53,902	35.65	18.3
11	Subernarekha	26,804	15.05	6.8
12	Sabarmati	31,901	12.96	1.9
13	Mahi	39,566	14.96	3.1
14	West Flowing Rivers of Kutch, Sabarmati including Luni	1,92,112	26.93	15
15	Narmada	96,660	58.21	34.5
16	Tapi	65,806	26.24	14.5
17	West Flowing Rivers from Tapi to Tadri	58,360	118.35	11.9
18	West Flowing Rivers from Tadri to Kanyakumari	54,231	119.06	24.3
19	Area of Inland drainage in Rajasthan desert	1,44,836	Negl.	N.A
20	Minor River Basins Draining into Bangladesh & Burma	31,382	31.17	N.A
Total		32,71,953	1,999.2	690.1

Source:BP-I Directorate, Central Water Commission, Based on 'Reassessment of Water Use Availability in India using Space Inputs', June, 2019.

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Table 3.8: River Basin-wise Water Requirement (High Demand) for Irrigation in India -2050

Sl. No.	Basins	Water Requirement for Irrigation (Billion cubic metre)
1	Indus	57.1
2	Ganga	353.5
3	Brahmaputra	31.5
4	Barak	10
5	Subarnarekha	6
6	Brahman& Baitarni	15
7	Mahanadi	45.8
8	Godavari	69.9
9	Krishna	61.6
10	Pennar	9.4
11	Cauvery	23
12	Tapi	11.1
13	Narmada	18.9
14	Mahi	6
15	Sabarmati	5
16	West Flowing Rivers of Kuchh,Saurashtra and Luni	13
17	West Flowing Rivers from Tapi to Tadri	30.6
18	East Flowing Rivers Between Mahanadi & Cauvery	19.4
19	East Flowing Rivers Between Pennar and Kanyakumari	17.9
20	Minor River Draining into Bangladesh & Myanmar	2.4
Total		807

Source:Lok Sabha Unstarred Question No. 4029, dated on 21.03.2013.
<https://www.indiastat.com/table/agriculture-data/2/water-demand-requirement/450270/773309/data.aspx>. Accessed on 27/11/2020.

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Table 3.9: State-Wise Ground Water Resources of India

(In Billion Cubic Metre)

States/ Union Territories	Total Annual Ground Water Recharge	Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
				Irrigation	Industrial	Domestic	Total			
Andhra Pradesh	21.22	1.07	20.15	7.85	0.14	0.9	8.9	1.48	12.31	44.15
Arunachal Pradesh	3.02	0.36	2.67	0	0	0.01	0.01	0.03	2.64	0.28
Assam	28.67	4.42	24.26	1.97	0.06	0.69	2.73	0.79	21.43	11.25
Bihar	31.41	2.43	28.99	10.78	0.66	1.83	13.26	1.83	15.78	45.76
Chhattisgarh	11.57	1	10.57	3.98	0.05	0.67	4.7	0.79	5.76	44.43
Delhi	0.32	0.02	0.3	0.09	0.02	0.24	0.36	0.29	0.02	119.61
Goa	0.27	0.11	0.16	0.02	*	0.03	0.05	0.04	0.07	33.5
Gujarat	22.37	1.12	21.25	12.84	0.11	0.63	13.58	0.9	7.98	63.89
Haryana	10.15	1.01	9.13	11.53	0.34	0.63	12.5	0.72	0.87	136.91
Himachal Pradesh	0.51	0.05	0.46	0.2	0	0.19	0.39	0.34	0.16	86.37
Jammu & Kashmir	2.89	0.29	2.6	0.2	0.07	0.5	0.76	0.5	1.84	29.47
Jharkhand	6.21	0.52	5.69	0.8	0.22	0.56	1.58	0.56	4.13	27.73
Karnataka	16.84	2.05	14.79	9.39	*	0.95	10.34	1.14	5.41	69.87
Kerala	5.77	0.56	5.21	1.22	0.01	1.44	2.67	1.57	2.41	51.27
Madhya Pradesh	36.42	1.95	34.47	17.43	0.22	1.24	18.88	1.72	15.84	54.76
Maharashtra	31.64	1.74	29.9	15.1	0.003	1.22	16.33	2.28	12.91	54.62
Manipur	0.43	0.04	0.39	0	0	0	0.01	0.04	0.34	1.44
Meghalaya	1.83	0.19	1.64	0.03	0	0.01	0.04	0.02	1.59	2.28
Mizoram	0.21	0.02	0.19	0	0	0.01	0.01	0.01	0.18	3.82
Nagaland	2.2	0.22	1.98	0	0	0.02	0.02	0.02	1.96	0.99

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Odisha	16.74	1.17	15.57	5.28	0.14	1.15	6.57	1.3	8.85	42.18
Punjab	23.93	2.35	21.58	34.56	0.2	1.01	35.78	1.41	1.09	165.77
Rajasthan	13.21	1.22	11.99	14.85	0	1.92	16.77	2.67	0.88	139.88
Sikkim	5.63	4.11	1.52	0	0	0	0	0.01	1.51	0.06
Tamil Nadu	20.22	2.02	18.2	13.06	0	1.67	14.73	1.85	5.66	80.94
Telangana	13.62	1.25	12.37	7.09	*	1	8.09	1.39	4.26	65.45
Tripura	1.53	0.29	1.24	0.02	0	0.08	0.1	0.11	1.11	7.88
Uttar Pradesh	69.92	4.6	65.32	40.89	*	4.95	45.84	5.96	20.36	70.18
Uttarakhand	3.04	0.15	2.89	1.3	0.13	0.22	1.64	0.22	1.25	56.83
West Bengal**	29.33	2.77	26.56	10.84	*	1	11.84	1.53	14.19	44.6
Andaman &Nicobar	0.37	0.04	0.33	0	0	0.01	0.01	0.01	0.32	2.74
Chandigarh	0.04	0	0.04	0	*	0.03	0.03	0.03	0	89
Dadra & Nagar Haveli	0.07	0	0.07	0.01	*	0.01	0.02	0.01	0.04	31.34
Daman & Diu	0.02	0	0.02	0.01	0	0	0.01	0	0	61.4
Lakshadweep	0.01	0.01	0.004	0	0	0.002	0.002	0	0	65.99
Puducherry	0.23	0.02	0.2	0.11	*	0.04	0.15	0.04	0.05	74.33
Grand Total	431.86	39.16	392.7	221.46	2.38	24.87	248.69	31.62	173.25	63.33

*Industrial and domestic draft has not been estimated separately in Goa, Himachal Pradesh, Karnataka, Rajasthan, Tamil Nadu, Uttar Pradesh, Chandigarh, Dadra & Nagar Haveli and Puducherry.

**The Ground Water resources assessment as on 2013 has been considered for the state of West Bengal.

Source: Central Water Commission. 2019. Water and related statistics.

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Table 3.10: State-wise Inland Water Resources in the Country

States / Union Territories	Rivers & Canals (kms.)	Reservoirs (M.ha)	Tanks & Ponds (M.ha)	Flood plain Derelict Water bodies (M.ha)	Brackish Water (M.ha)	Total Water Bodies (M.ha)
Andhra Pradesh	11,514	0.234	0.517	-	0.060	0.811
Arunachal Pradesh	2,000	-	0.276	0.042	-	0.318
Assam	4,820	0.002	0.023	0.110	-	0.135
Bihar	3,200	0.060	0.095	0.005	-	0.160
Chhattisgarh	3,573	0.084	0.063	-	-	0.147
Goa	250	0.003	0.003	-	Neg.	0.006
Gujarat	3,865	0.243	0.071	0.012	0.100	0.426
Haryana	5,000	Neg.	0.010	0.010	-	0.020
Himachal Pradesh	3,000	0.042	0.001	-	-	0.043
Jammu & Kashmir	27,781	0.007	0.017	0.006	-	0.030
Jharkhand	4,200	0.094	0.029	-	-	0.123
Karnataka	9,000	0.440	0.290	-	0.010	0.740
Kerala	3,092	0.030	0.030	0.243	0.240	0.543
Madhya Pradesh	17,088	0.227	0.060	-	-	0.287
Maharashtra	16,000	0.299	0.072	-	0.012	0.383
Manipur	3,360	0.001	0.005	0.004	-	0.010
Meghalaya	5,600	0.008	0.002	Neg.	-	0.010
Mizoram	1,395	-	0.002	-	-	0.002
Nagaland	1,600	0.017	0.050	Neg.	-	0.067
Odisha	4,500	0.256	0.123	0.18	0.430	0.989
Punjab	15,270	Neg.	0.007	-	-	0.007
Rajasthan	5,290	0.12	0.180	-	-	0.300
Sikkim	900	-	-	0.003	-	0.003
Tamil Nadu	7,420	0.57	0.056	0.007	0.060	0.693
Tripura	1,200	0.005	0.013	-	-	0.018
Uttar Pradesh	28,500	0.138	0.161	0.133	-	0.432
Uttarakhand	2,686	0.020	Neg	Neg	-	0.021
West Bengal	2,526	0.017	0.276	0.042	0.210	0.545
A & N Island	-	Neg	Neg	-	0.033	0.034
Chandigarh	2	-	Neg.	Neg.	-	Neg
D & N Haveli	54	0.005	-	-	-	0.005
Daman & Diu	12	-	Neg.	-	Neg.	Neg
Delhi	150	0.004	-	-	-	0.004
Lakshadweep	-	-	-	-	-	Neg
Puducherry	247	-	Neg.	0.001	Neg.	0.001
Total	1,95,095	2.926	2.433	0.798	1.155	7.312

Source:Central Water Commission. 2019. Water and Related Statistics.

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Table 3.11: State-wise Live Storage Capacities of Large Dams/Reservoirs/ Projects

Sl. No.	States / Union Territories	Total Live Storage capacity (In Billion Cubic Metre)		
		Completed	Under Construction	Total*
1	Andhra Pradesh	7.513	6.98	14.493
2	Arunachal Pradesh	15.129	0	15.129
3	Assam	6.066	0.082	6.148
4	Bihar	0.010	0.241	0.241
5	Chhattisgarh	0.012	0.547	0.559
6	Goa	2.613	0.436	3.049
7	Gujarat	6.736	0.877	7.613
8	Haryana	0.290	0	0.290
9	Himachal Pradesh	18.359	8.175	26.534
10	Jammu & Kashmir	13.792	0.100	13.891
11	Jharkhand	0.029	Neg	0.029
12	Karnataka	2.436	6.039	8.475
13	Kerala	31.896	0.736	32.632
14	Madhya Pradesh	9.768	1.264	11.032
15	Maharashtra	33.075	1.695	34.770
16	Manipur	37.358	10.736	48.094
17	Meghalaya	0.407	8.509	8.916
18	Mizoram	0.479	0.007	0.486
19	Nagaland	0	0.663	0.663
20	Odisha	1.220	0	1.220
21	Punjab	23.934	0.896	24.83
22	Rajasthan	2.402	Neg	2.402
23	Sikkim	9.708	0.443	10.152
24	Tamil Nadu	0.007	0	0.007
25	Tripura	7.859	0.013	7.872
26	Uttar Pradesh	0.312	0	0.312
27	Uttarakhand	14.263	0.724	14.987
28	West Bengal	5.670	1.613	7.283
29	All states	2.027	0.184	2.212
30	Andaman	0.019	0	0.019
	All-India	253.38	50.96	304.34

* Sum of Completed and Under Construction may not match with Total.

Source:Water & Related Statistics (2015), Central Water Commission.

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Table 3.12: State-wise Area Covered under Drip and Sprinkler Irrigation System in India (as on 31.03.2019)

(Area in ha)				
Sl. No.	Name of the State/UT	Drip	Sprinkler	Total
1	Andhra Pradesh	12,95,658	4,89,560	1,78,5218
2	Arunachal Pradesh	613	0	613
3	Assam	373	2,448	2,821
4	Bihar	10,502	1,04,998	1,15,500
5	Chhattisgarh	24,751	2,91,521	3,16,272
6	Goa	1,186	1,129	2,315
7	Gujarat	7,23,222	6,98,692	14,21,914
8	Haryana	32,758	5,72,622	6,05,380
9	Himachal Pradesh	5,389	4,323	9,712
10	J & K	23	57	80
11	Jharkhand	20,633	15,757	36,390
12	Karnataka	6,58,171	8,63,322	15,21,493
13	Kerala	23,610	8,683	32,293
14	Madhya Pradesh	3,13,887	2,42,733	5,56,620
15	Maharashtra	11,99,963	5,05,365	17,05,328
16	Manipur	358	30	388
17	Meghalaya	308	307	615
18	Mizoram	3,064	1,364	4,428
19	Nagaland	444	5,005	5,449
20	Odisha	24,786	97,944	1,22,730
21	Punjab	35,593	13,195	48,788
22	Rajasthan	2,45,301	16,45,431	18,90,732
23	Sikkim	6,044	3,042	9,086
24	Tamil Nadu	4,87,511	1,88,140	6,75,651
25	Telangana	1,91,722	70,569	2,62,291
26	Tripura	444	1,651	2,095
27	Uttar Pradesh	25,583	1,28,530	1,54,113
28	Uttarakhand	7,078	5,041	12,119
29	West Bengal	964	65,723	66,687
30	Others	15,169	30,636	45,805
	All India	53,55,108	60,57,818	1,14,12,926

Source: Pocket Book of Agricultural Statistics 2019, pp:61, Department of Agriculture, Cooperation & Farmers Welfare.

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Table 3.13: State-Wise Details of Physical Performance under PMKSY- Per Drop More Crop

(Area in ha)

Sl. No.	States	2015-16	2016-17	2017-18	2018-19	2019-20	Total
1	Andhra Pradesh	94,104	1,41,098	1,86,441	2,00,269	60,616	6,82,528
2	Bihar	5,155	4,228	3,143	924	1,668	15,118
3	Chhattisgarh	8,056	19,227	13,087	18,929	14,913	74,212
4	Goa	92	123	236	0	0	451
5	Gujrat	1,42,681	1,65,948	1,43,134	1,40,778	96,877	6,89,418
6	Haryana	3,117	5,701	10,751	10,469	1,102	31,140
7	Himachal Pradesh	3,306	937	1,197	422	977	6,839
8	Jharkhand	4,528	5,810	1,544	3,978	4,345	20,205
9	J&K	0	0	0	0	0	0
10	Karnataka	64,220	1,39,405	2,36,107	2,34,853	1,31,372	80,5957
11	Kerala	561	310	358	965	80	2,274
12	Madhya Pradesh	75,224	54,323	39,761	35,195	312	2,04,815
13	Maharashtra	35,242	1,06,172	1,32,829	1,59,959	60,383	4,94,585
14	Odisha	2,907	4,611	3,036	10,081	8,498	29,133
15	Punjab	1,799	1,950	600	507	161	5,017
16	Rajasthan	56,346	47,650	48,205	53,982	0	2,06,183
17	Tamil Nadu	32,288	44,778	1,05,695	1,72,445	1,71,830	5,27,036
18	Telangana	39,864	61,980	89,474	40,381	1,588	2,33,287
19	Uttarakhand	721	3,199	2,182	4,256	6,248	16,606
20	Uttar Pradesh	1,598	32,511	28,235	55,086	31,528	1,48,958
21	West Bengal	0	0	2,137	13,370	177	15,684
22	Arunachal Pradesh	0	0	0	0	0	0
23	Assam	0	0	782	70	0	852
24	Manipur	0	0	0	1,600	560	2,160
25	Meghalaya	0	0	0	0	0	0
26	Mizoram	398	0	0	0	2,348	2,746
27	Nagaland	0	0	0	0	0	0
28	Sikkim	773	0	0	0	0	773
29	Tripura	0	0	0	0	0	0
	Grand Total	5,72,980	8,39,961	10,48,934	11,58,519	5,95,583	4,21,5977

Source: Standing Committee on Agriculture (2019-20), Ninth report, Ministry of Agriculture and Farmers Welfare, Demands for grants (2020-21).

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Table 3.14: Energization of Pump Sets (as on 30.09.2017)

Sl. No	States/UTs	Estimated ultimate ground water potential in terms of electrical pump sets	Effective Number of Pump sets (Cumulative)	
			Grid	Off-grid
1	Haryana	4,70,800	6,14,279	0
2	Himachal Pradesh	14,200	29,377	0
3	J & K	67,200	9,714	0
4	Punjab	7,51,000	12,68,252	0
5	Rajasthan	6,30,600	13,29,639	0
6	U.P.	26,10,000	9,96,010	0
7	Uttarakhand	0	28,054	0
	Total North Region	45,43,800	42,75,325	0
8	Chhattisgarh		3,76,450	0
9	Goa	7,800	8,499	0
10	Gujrat	7,79,800	20,81,156	2,026
11	Madhya Pradesh	27,73,600	14,24,192	0
12	Maharashtra	24,49,800	43,06,381	0
	Total West Region	60,11,000	81,96,678	2,026
13	Andhra Pradesh	9,70,690	13,20,480	5,503
14	Karnataka	13,57,000	23,99,439	0
15	Kerala	4,35,600	5,14,896	0
16	Tamil Nadu	16,62,600	20,82,946	0
17	Telangana	10,10,310	18,06,569	0
	Total South Region	54,36,200	80,14,462	2,235
18	Bihar	13,52,200	2,85,501	0
19	Jharkhand		9,453	0
20	Odisha	12,14,000	78,200	0
21	Sikkim	5,000	0	0
22	West Bengal	6,50,000	2,89,941	0
	Total East Region	32,21,200	6,46,084	0
23	Arunachal Pradesh	1,200	0	0
24	Assam	2,54,000	3,675	0
25	Manipur	37,600	108	0
26	Meghalaya	14,200	24	0
27	Mizoram		0	0
28	Nagaland	10,000	194	0
29	Tripura	14,800	5,746	0
	Total North East Region	3,31,800	9,747	0
30	A & N Island		0	0
31	Chandigarh		421	0
32	Delhi		30,575	0
33	Dadra & Nagar Haveli	50,000	935	0
34	Daman & Diu		1,243	0
35	Lakshadweep		0	0
36	Puducherry		9,225	0
	UTs	50,000	42,417	0
	Total	1,95,94,000	2,11,84,713	4,261

Source: http://cea.nic.in/reports/monthly/electrification/2017/pumpset_energization-09.pdf.

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Table 3.15: Source-Wise Net-Irrigated Area

Year	Source of Irrigation							Net Irrigated Area
	Canals			Tanks	Tube-Wells	Other Wells	Other Sources	
	Government	Private	Total					
2006-07	16.80	0.22	17.02	2.08	26.94	10.70	6.00	62.74
2007-08	16.53	0.22	16.75	1.97	28.50	9.86	6.11	63.19
2008-09(p)	16.69	0.20	16.89	1.98	28.37	10.39	6.02	63.64
2009-10(p)	14.79	0.19	14.98	1.59	28.37	9.99	7.02	61.95
2010-11(p)	15.48	0.17	15.65	1.98	28.54	10.63	6.87	63.67
2011-12(p)	15.84	0.17	16.01	1.92	29.94	10.59	7.25	65.71
2012-13(p)	15.51	0.17	15.68	1.75	30.54	10.76	7.55	66.29
2013-14(p)	16.12	0.16	16.28	1.84	31.13	11.31	7.56	68.12
2014-15 (p)	16.02	0.17	16.19	1.72	31.61	11.35	7.52	68.38
2015-16 (p)	15.02	0.16	15.18	1.74	32.16	10.96	7.27	67.30

Note:(p) Provisional

Source:Agriculture Research Data Book, IASRI, New Delhi (p.27); Land Use Statistics at a Glance 2006-07 to 2015-16, Directorate of Economics & Statistics, Ministry of Agriculture & Farmers Welfare, Govt. of India.

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Table 3.16: State-Wise Irrigated Area in India

('000 ha)

State/Union Territory	Net irrigated area					
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Andhra Pradesh	5,034	5,090	4,575	3,014	2,927	2,743
Arunachal Pradesh	56	57	57	57	56	56
Assam	162	161	321	303	296	297
Bihar	3,030	3,052	3,053	2,933	2,987	2,958
Chhattisgarh	1,356	1,415	1,449	1,462	1,468	1,476
Goa	36	41	36	38	39	39
Gujarat*	4,233	4,233	4,233	4,233	4,233	4,233
Haryana	2,887	3,073	3,102	2,931	2,974	2,956
Himachal Pradesh*	110	113	113	114	117	120
Jammu & Kashmir	321	319	325	323	325	356
Jharkhand	125	153	210	217	207	213
Karnataka	3,490	3,440	3,421	3,556	3,589	3,243
Kerala	415	409	396	397	414	414
Madhya Pradesh	7,140	7,887	8,550	9,455	9,584	9,284
Maharashtra*	3,256	3,252	3,244	3,248	3,244	3,215
Manipur *	73	69	49	69	69	73
Meghalaya	63	65	65	68	81	80
Mizoram	12	13	14	16	16	16
Nagaland	83	84	85	91	97	104
Orissa	1,284	1,259	1,248	1,245	1,259	1,230
Punjab	4,070	4,086	4,115	4,143	4,118	4,137
Rajasthan	6,661	7,122	7,499	7,650	7,882	7,938
Sikkim*	15	14	13	13	12	16
Tamil Nadu	2,912	2,964	2,643	2,679	2,726	2,833
Telangana	-	-	-	2,289	1,726	1,486
Tripura*	62	62	62	78	79	81
Uttarakhand	336	339	338	328	330	330
Uttar Pradesh*	13,440	13,809	13,929	14,027	14,389	14,231
West Bengal *	2,955	3,078	3,082	3,099	3,102	3,105
A. & N. Islands*	0	0	0	0	0	0
Chandigarh*	1	1	1	0	0	0
D. & N. Haveli	4	4	4	4	4	5
Daman and Diu	0	0	0	0	0	0
Delhi	22	22	22	22	22	22
Lakshadweep*	0	0	0	0	0	0
Puducherry	15	15	14	13	13	13
Total	63,659	65,697	66,266	68,117	68,384	67,300

Note: '0' relates to the area below 500 hectares; *Estimated or repeated.

Source: Directorate of Economics and Statistics 2020, Ministry of Agriculture.

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Table 3.17: State-Wise Ultimate Irrigation Potential

State/ Union Territories	Major & Medium	Minor			Total
		Surface	Ground	Sub-total	
Andhra Pradesh	5,000	2,300	3,960	6,260	11,260
Arunachal Pradesh	0	150	18	168	168
Assam	970	1,000	900	1,900	2,870
Bihar	5,224	1,544	4,120	5,664	10,888
Chhattisgarh	1,147	81	490	571	1,718
Goa	62	25	29	54	116
Gujarat	3,000	347	2,756	3,103	6,103
Haryana	3,000	50	1,462	1,512	4,512
Himachal Pradesh	50	235	68	303	353
Jammu & Kashmir	250	400	708	1,108	1,358
Jharkhand	1,276	354	830	1,184	2,460
Karnataka	2,500	900	2,574	3,474	5,974
Kerala	1,000	800	879	1,679	2,679
Madhya Pradesh	4,853	2,111	9,250	11,361	16,214
Maharashtra	4,100	1,200	3,652	4,852	8,952
Manipur	135	100	369	469	604
Meghalaya	20	85	63	148	168
Mizoram	0	65	5	70	70
Nagaland	10	70	5	75	85
Odisha	3,600	1,000	4,203	5,203	8,803
Punjab	3,000	50	2,917	2,967	5,967
Rajasthan	2,750	600	1,778	2,378	5,128
Sikkim	20	50	0	50	70
Tamil Nadu	1,500	1,200	2,832	4,032	5,532
Tripura	100	100	81	181	281
Uttar Pradesh	12,154	1,186	16,295	17,481	29,635
Uttarakhand	346	14	504	518	864
West Bengal	2,300	1,300	3,318	4,618	6,918
All states	58,367	17,317	64,066	81,383	1,39,750
All Uts	98	20	26	46	144
All-India	58,465	17,337	64,092	81,429	1,39,894

Source: Water and Related Statistics, 2019, Central Water Commission, P-73.

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Table 3.18: Size Class-Wise Estimated Irrigated and Unirrigated Area under Different Crops for All Social Group in India

(Number in '000 Units;Area in '000 ha)

Size Class (in ha)	Total Holdings		Gross Cropped Area		
	No.	Area	Irrigated	Un Irrigated	Total
Below 0.5	70,469	16,473	12,654	9,227	21,881
(0.5-1.0)	29,783	21,450	13,824	13,360	27,184
Marginal	1,00,251	37,923	26,478	2,25,88	49,065
(1.0-2.0)	25,809	36,151	20,297	23,233	43,530
Small	25,809	36,151	20,297	23,233	43,530
(2.0-3.0)	9,828	23,375	13,075	14,693	27,768
(3.0-4.0)	4,166	14,245	8,313	8,803	17,116
Semi Medium	13,993	37,619	21,387	23,496	44,884
(4.0-5.0)	2,366	10,458	6,578	6,207	12,785
(5.0-7.5)	2,352	14,147	8,623	8,244	16,867
(7.5-10.0)	843	7,206	4,363	4,230	8,592
Medium	5,561	31,810	19,564	18,681	38,245
(10.0-20.0)	693	9,067	5,286	5,186	10,472
20 & Above	145	5,247	2,567	2,993	5,561
Large	838	14,314	7,853	8,179	16,032
All Classes	1,46,454	1,57,817	95,579	96,178	1,91,756

Source:All India Report on Agriculture Census 2015-16, Department of Agriculture and Co-Operation, Ministry of Agriculture Govt. of India. (p.137).

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Table 3.19: State-Wise Estimated Irrigated and Unirrigated Area under Different Crops for All Social Group in India

(Number in '000 Units;Area in '000 ha)

States/UTs	Total Holdings		Gross Cropped Area		
	Number	Area	Irrigated	Unirrigated	Total
Andhra Pradesh	85,239	80,045	36,852	37,742	74,594
Arunachal Pradesh	1,133	3,799	567	2,469	3,035
Assam	27,417	29,763	1,889	30,063	31,953
Bihar	1,64,129	64,571	52,058	24,263	76,321
Chhattisgarh	40,108	49,917	16,668	40,176	56,845
Goa	746	821	239	575	814
Gujarat	53,206	99,778	54,566	50,669	1,05,235
Haryana	16,280	36,086	65,053	3,206	68,259
Himachal Pradesh	9,968	9,442	2,037	7,259	9,296
Jammu & Kashmir	14,165	8,423	4,550	5,023	9,573
Jharkhand	28,029	30,907	2,637	15,032	17,669
Karnataka	86,807	1,18,051	36,677	83,909	1,20,587
Kerala	75,835	13,949	3,464	10,391	13,855
Madhya Pradesh	1,00,031	1,56,702	1,06,690	1,24,378	2,31,068
Maharashtra	1,52,854	2,05,064	44,531	1,83,601	2,28,133
Manipur	1,505	1,722	451	1,718	2,169
Meghalaya	2,324	3,001	692	2,288	2,980
Mizoram	898	1,125	156	972	1,129
Nagaland	1,965	9,564	982	4,482	5,465
Odisha	48,659	46,193	14,203	37,627	51,830
Punjab	10,927	39,537	77,652	283	77,935
Rajasthan	76,546	2,08,733	1,00,988	1,43,483	2,44,471
Sikkim	715	909	104	736	840
Tamil Nadu	79,379	59,707	36,599	22,144	58,744
Telangana	59,477	59,718	19,594	27,483	47,078
Tripura	5,732	2,818	1,269	3,370	4,639
Uttar Pradesh	2,38,216	1,74,504	2,13,693	55,021	2,68,714
Uttarakhand	8,813	7,473	5,475	5,390	10,865
West Bengal	72,427	54,869	54,844	37,552	9,2395
Andaman & Nicobar Islands	120	212	3	139	142
Chandigarh	7	9	17	0	17
Dadra & Nagar Haveli	151	207	26	185	211
Daman & Diu	80	29	3	24	26
Delhi	208	290	354	45	399
Lakshadweep	100	27	0	23	23
Puducherry	338	209	205	52	257
All India	14,64,537	15,78,173	9,55,788	9,61,776	19,17,564

Source:All India Report on Agriculture Census 2015-16, Department of Agriculture and Co-operation, Ministry of Agriculture Govt. of India. (p.241).

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Table 3.20: Guidelines for Interpretations of Water Quality for Irrigation

Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
Salinity (affects crop water availability)							
	EC_w			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	TDS			mg/l	< 450	450 – 2,000	> 2,000
Infiltration (affects infiltration rate of water into the soil. Evaluate using EC _w and SAR together)							
SAR	= 0 – 3	and EC_w	=		> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6		=		> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12		=		> 1.9	1.9 – 0.5	< 0.5
	= 12 – 20		=		> 2.9	2.9 – 1.3	< 1.3
	= 20 – 40		=		> 5.0	5.0 – 2.9	< 2.9
Specific Ion Toxicity (affects sensitive crops)							
	Sodium (Na)						
	surface irrigation			SAR	< 3	3 – 9	> 9
	sprinkler irrigation			me/l	< 3	> 3	
	Chloride (Cl)						
	surface irrigation			me/l	< 4	4 – 10	> 10
	sprinkler irrigation			me/l	< 3	> 3	
	Boron (B)						
				mg/l	< 0.7	0.7 – 3.0	> 3.0
	Trace Elements						
Miscellaneous Effects (affects susceptible crops)							
	Nitrogen (NO₃ - N)						
				mg/l	< 5	5 – 30	> 30
	Bicarbonate (HCO₃)						
	(overhead sprinkling only)			me/l	< 1.5	1.5 – 8.5	> 8.5
	pH				Normal Range 6.5 – 8.4		

Abbr.:SAR: Sodium adsorption ratio; EC: Electrical Conductivity, dS/m: deciSiemens per metre, me/l: milliequivalent per litre.

Source:Food and Agriculture Organization (<http://www.fao.org/3/t0234e/T0234E01.htm>).Accessed on 30.04.2021.

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Table 3.21: Recommended Maximum Concentrations of Trace Elements in Irrigation Water

Element	Recommended Maximum Concentration (mg/l)	Remarks
Al(aluminium)	5.0	Can cause non-productivity in acid soils (pH < 5.5), but more alkaline soils at pH > 7.0 will precipitate the ion and eliminate any toxicity.
As (arsenic)	0.10	Toxicity to plants varies widely, ranging from 12 mg/l for Sudan grass to less than 0.05 mg/l for rice.
Be (beryllium)	0.10	Toxicity to plants varies widely, ranging from 5 mg/l for kale to 0.5 mg/l for bush beans.
Cd (cadmium)	0.01	Toxic to beans, beets and turnips at concentrations as low as 0.1 mg/l in nutrient solutions. Conservative limits recommended due to its potential for accumulation in plants and soils to concentrations that may be harmful to humans.
Co (cobalt)	0.05	Toxic to tomato plants at 0.1 mg/l in nutrient solution. Tends to be inactivated by neutral and alkaline soils.
Cr (chromium)	0.10	Not generally recognized as an essential growth element. Conservative limits recommended due to lack of knowledge on its toxicity to plants.
Cu (copper)	0.20	Toxic to a number of plants at 0.1 to 1.0 mg/l in nutrient solutions.
F (fluoride)	1.0	Inactivated by neutral and alkaline soils.
Fe (iron)	5.0	Not toxic to plants in aerated soils, but can contribute to soil acidification and loss of availability of essential phosphorus and molybdenum. Overhead sprinkling may result in unsightly deposits on plants, equipment and buildings.
Li (lithium)	2.5	Tolerated by most crops up to 5 mg/l; mobile in soil. Toxic to citrus at low concentrations (<0.075 mg/l). Acts similarly to boron.
Mn (manganese)	0.20	Toxic to a number of crops at a few-tenths to a few mg/l, but usually only in acid soils.
Mo (molybdenum)	0.01	Not toxic to plants at normal concentrations in soil and water. Can be toxic to livestock if forage is grown in soils with high concentrations of available molybdenum.
Ni (nickel)	0.20	Toxic to a number of plants at 0.5 mg/l to 1.0 mg/l; reduced toxicity at neutral or alkaline pH.
Pd (lead)	5.0	Can inhibit plant cell growth at very high concentrations.
Se (selenium)	0.02	Toxic to plants at concentrations as low as 0.025 mg/l and toxic to livestock if forage is grown in soils with relatively high levels of added selenium. An essential element to animals but in very low concentrations.
Ti (titanium)	----	Effectively excluded by plants; specific tolerance unknown.
V (vanadium)	0.10	Toxic to many plants at relatively low concentrations.
Zn (zinc)	2.0	Toxic to many plants at widely varying concentrations; reduced toxicity at pH > 6.0 and in fine textured or organic soils.

Source:Food and Agriculture Organization (<http://www.fao.org/3/t0234e/T0234E06.htm>). Accessed on 30.04.2021.

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Table 3.22: Recommended Water Quality Parameter for Clogging Problems in Localized (Drip) Irrigation Systems

Potential Problem	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
Physical				
Suspended Solids	mg/l	< 50	50 – 100	> 100
Chemical				
pH		< 7.0	7.0 – 8.0	> 8.0
Dissolved Solids	mg/l	< 500	500 – 2,000	> 2,000
Manganese	mg/l	< 0.1	0.1 – 1.5	> 1.5
Iron	mg/l	< 0.1	0.1 – 1.5	> 1.5
Hydrogen Sulphide	mg/l	< 0.5	0.5 – 2.0	> 2.0
Biological				
Bacterial populations	maximum number/ml	<10,000	10,000 – 50,000	>50,000

Source: Food and Agriculture Organization (<http://www.fao.org/3/t0234e/T0234E06.htm#tab23>). Accessed on 30.04.2021.