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Annexure: Ramganga RBM Plan

October, 2023

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ANNEXURE A1: KWMI 1 – ADDITIONAL INFORMATION ON METHODOLOGY, RESULTS AND DATA

Table A1.1: Observed Data for The Surface Water Quality Index (WQI) – Yearly Average – Ramganga Basin (Data Source: UP-SPCB and SPMG-UK)

Years	B (mg/l)	BOD (mg/l)	COD (mg/)	DO (mg/l)	EC (µS/cm)	Na (%)	NH3-N (mg/l)	pH	Tcol (MPN per 100 ml)	TDS (mg/l)
Bareilly										
2012	0.21	-	16.46	5.03	576.67	13.30	0.38	8.10	-	350.00
2013	0.16	-	14.83	5.59	513.33	9.48	0.51	7.99	-	309.17
2014	0.14	-	30.58	3.62	544.17	12.43	0.43	8.08	-	323.83
2015	0.30	-	26.53	3.93	528.00	15.31	0.94	8.32	-	293.60
2016	0.37	-	30.00	1.75	496.36	15.27	0.92	8.14	7875.00	302.09
2017	0.44	-	24.30	1.96	1081.08	15.94	0.88	7.73	12776.92	586.73
2018	0.30	-	27.33	-	805.71	-	0.52	7.71	13333.33	482.64
2019	0.25	-	16.58	-	985.14	-	0.36	7.67	8491.67	583.86
2020	0.29	-	15.00	6.00	535.58	-	0.37	7.56	12425.00	300.08
2021	0.27	7.09	17.58	5.56	444.65	-	0.22	7.88	18419.23	244.92
2022	0.36	-	14.22	5.59	576.67	-	0.41	8.11	20022.22	327.78
Dabri										
2012	0.20	-	20.79	4.77	555.00	12.83	0.21	8.34	-	336.67
2013	0.15	-	16.33	5.34	456.67	10.22	0.41	8.13	-	275.67
2014	0.15	-	26.33	4.18	528.33	11.27	0.44	8.30	-	315.50
2015	0.43	-	18.73	4.16	487.33	16.43	0.94	8.42	-	274.60
2016	0.37	-	19.08	3.74	446.67	15.98	0.85	8.27	3280.00	280.92
2017	0.30	-	20.20	6.27	494.20	15.38	0.69	7.93	10453.85	296.08
2018	0.18	-	20.50	-	470.83	-	0.45	8.08	6008.33	284.50
2019	0.16	-	9.08	-	500.58	-	0.24	7.99	4041.67	298.17
2020	0.30	-	9.58	7.43	496.50	-	0.33	7.92	4141.67	272.50
2021	0.23	2.91	7.56	7.27	426.15	-	0.22	8.16	8955.56	233.48
2022	0.17	-	6.22	7.46	485.00	-	0.27	8.21	11088.89	265.44
Moradabad										
2012	0.12	-	27.17	3.56	459.17	16.44	0.26	7.95	-	260.08
2013	0.10	-	38.75	4.22	419.17	9.23	0.35	7.97	-	251.75
2014	0.32	-	34.75	3.94	457.50	13.32	0.55	8.03	-	274.25
2015	0.39	-	24.07	1.80	410.67	17.45	0.99	8.07	-	220.13
2016	0.33	-	27.67	1.42	370.83	17.20	1.04	7.64	17800.00	229.25
2017	0.48	-	29.46	0.00	500.73	22.28	0.80	7.70	43076.92	302.13
2018	0.32	-	23.82	-	645.00	-	0.50	7.58	10236.36	389.75
2019	0.26	-	17.00	3.45	551.00	-	0.39	7.51	10400.00	327.43
2020	0.33	-	19.92	3.98	464.33	-	0.32	7.40	20000.00	260.50
2021	0.23	11.98	25.00	3.86	343.03	-	0.23	7.58	20046.15	193.54
2022	0.20	-	22.56	-	425.11	-	0.20	7.72	21277.78	245.00

Table A1.2: Observed surface water quality data in drains at different sampling points (Data source: UP-SPCB)

Sr. No.	Drain – Sampling point	District	pH	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	Fecal Coliform (MPN per 100 ml)
1	Barbalan	Moradabad	7.6	72.2	248.4	294.6	3,003,333
2	Chakkar Ki Milak (Mukarampur)		7.5	82.1	264.0	313.9	2,650,000
3	Chandausi Road (L)		7.6	77.7	250.1	306.1	626,833
4	Chandausi Road (R)		7.8	78.6	250.1	302.0	1,083,500
5	Daheria/ Dateria Drain		7.5	83.5	265.7	302.9	3,048,333
6	Delhi Road (L)		7.7	73.6	246.6	276.9	867,000
7	Delhi Road (R)		7.6	70.4	239.7	287.9	792,667
8	Ghosiyan		7.6	78.3	259.6	303.6	2,365,000
9	Jama Masjid Right Drain		7.4	77.8	251.5	312.3	2,505,000
10	Jama Masjid-Left		7.5	82.9	263.3	308.4	2,471,667
11	Jhabbu Ka Nala		7.6	82.5	270.5	315.2	2,243,333
12	Jigar Colony		7.6	76.3	271.8	322.1	2,543,333
13	Karula drain		7.6	78.6	258.4	300.5	2,760,000
14	Katghar Railway Station Drain		7.7	82.3	284.9	322.9	2,620,000
15	Kudaghar Drain		7.7	77.4	258.7	305.1	2,886,667
16	Lalbagh Drain		7.6	84.8	260.1	320.1	2,670,000
17	MIT Drain		7.6	78.8	257.7	319.9	2,391,667
18	Moksh Dham Drain		7.7	77.7	265.7	309.1	2,728,333
19	Nawabpura drain -1		7.6	75.9	265.1	300.8	2,891,667
20	Nawabpura drain -2		7.6	75.9	265.1	311.3	2,706,333
21	Prabhat Market		7.6	83.3	268.9	310.1	2,955,000
22	TDI City Drain		7.5	73.5	253.7	303.5	2,563,333
23	Vivekanand Hospital-Right		7.7	74.3	260.2	319.3	2,358,333
24	Chaubari	Bareilly	7.3	31.4	180.7	130.1	915,000
25	Deveranaiya Nala (River)		7.4	48.3	157.0	253.3	3,553,333
26	Nakatia		7.4	53.8	167.9	271.7	5,294,000
27	Nasiya Drain	Bijnor	7.7	27.8	77.8	120.6	1,042,111
28	Rampur Drain	Rampur	7.8	82.5	67.7	84.7	2,716,667

Note: *This data represents the average of November 2022 – January 2023.*

Table A1.3: Ramganga River observed surface water quality data (Data source: UP-SPCB)

Sr. No.	River – Sampling point	District	pH	DO (mg/l)	BOD (mg/l)	EC (µS/cm)	Fecal Coliform (MPN per 100 ml)
1	D/S Ahirgautiya village, Faridpur road	Bareilly	7.6	8.6	2.9	429.7	8,781
2	U/S Kapoorpur village, meerganj	Bareilly	7.5	8.9	2.6	344.0	7,365
3	D/S Farrukhabad road, Allahganj	Shahjahanpur	7.5	9.9	2.6	390.8	4,146
4	Ramganga at Farrukhabad	Farrukabad	8.3	8.8	4.4	424.3	4,900
5	Moradabad Rampur Road Bridge Katghar	Moradabad	7.5	5.0	7.4	471.0	11,667
6	U/s Ramganga near Agwanpur,	Moradabad	7.5	7.7	2.4	418.7	427
7	Downstream, Shahbad	Rampur	7.7	5.3	7.1	454.3	12,867

Note: *This data represents the average of November 2022 – January 2023.*

Table A1.4: Observed surface water quality data at Moradabad STP - Ramganga River (Data source: UP-SPCB)

STP sampling point	Capacity MLD	Utilization MLD	River	Latitude	Longitude
58 MLD Moradabad	58	24	Ramganga	28.82	78.79

Months	pH	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	Fecal Coliform (MPN per 100 ml)
Nov 22	7.5	8.7	69.0	8.5	87.0
Dec 22	7.5	7.5	77.0	8.0	82.3
Jan 23	7.7	9.1	74.0	8.3	66.3

Table A1.5: Observed STP data for Uttarakhand – September 2022 (Data source: SPMG-UK)

Uttarakhand STP Data (September 2022)																
Sr. No	Districts	Locations	Existing capacity	Capacity being utilized	Percentage of Utilization	Operational Status	Inlet STP (MLD)			Outlet STP (MLD)				Compliance Status of STPs		Remarks
							pH	BOD (mg/l)	TSS (mg/l)	pH	BOD (mg/l)	TSS (mg/l)	Fecal Coliform	As per MoEF & CC notified Sstandard	As per NGT standard	
1	Nainital	Hari Nagar,	0.45	0.25	55.6	Operational	6.81	160	208	7.19	28	36	450	Non-Complying	Non-Complying	
2		Krishnapur,	0.8	0.45	56.3	Operational	6.62	120	152	7.53	20	24	220	Non-Complying	Non-Complying	
3		Bheemtal, Nainital	1.25	0.81	64.8	Operational	6.95	140	186	8.1	22	28	240	Non-Complying	Non-Complying	
4		Roosi, Nainital,	10	6.75	67.5	Non-Operational	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5		Transport Nagar, Ramnagar	7	2.5	35.7	Operational	7.13	120	152	7.29	10	14	430	Complying	Non-Complying	
6		Ramnagar, Puchdi,	1.5	0.15	10.0	Operational	6.75	120	125	7.66	6	8	350	Complying	Non-Complying	
7		Narayan Nagar,	0.45	NA	NA	Operational	7.11	140	186	7.43	18	24	280		Non-Complying	
8	Almora	Bakh, Almora	2	1.65	82.5	Operational	6.59	160	194	7.75	24	32	350	Complying	Non-Complying	

Table A1.6: Observed STP data for Uttarakhand – October 2022 (Data source: SPMG-UK)

Uttarakhand STP Data (October, 2022)																
Sr. No	Districts	Locations	Existing capacity	Capacity being utilized	Percentage of Utilization	Operational Status	Inlet STP (MLD)			Outlet STP (MLD)				Compliance Status of STPs		Remarks
							pH	BOD (mg/l)	TSS (mg/l)	pH	BOD (mg/l)	TSS (mg/l)	Fecal Coliform	As per MoEF & CC notified Sstandard	As per NGT standard	
1	Nainital	Hari Nagar,	0.45	0.25	55.6	Operational	6.75	180	233	7.31	27	35	430	Non-Complying	Non-Complying	
2		Krishnapur,	0.8	0.45	56.3	Operational	6.29	120	152	7.15	16	21	240	Non-Complying	Non-Complying	
3		Bheemtal, Nainital	1.25	0.81	64.8	Operational	7.11	220	276	8.15	30	42	220	Non-Complying	Non-Complying	
4		Roosi, Nainital,	10	6.75	67.5	Non-Operational	6.75	180	233	7.31	27	35	430	NA	NA	
5		Transport Nagar, Ramnagar	7	2.5	35.7	Operational	6.29	120	152	7.15	16	21	240	Complying	Non-Complying	
6		Ramnagar, Puchdi,	1.5	0.15	10.0	Operational	7.11	220	276	8.15	30	42	220	Complying	Non-Complying	
7		Narayan Nagar,	0.45	NA	NA	Operational	6.91	120	148	7.78	18	22	240		Non-Complying	
8	Almora	Bakh, Almora	2	1.65	82.5	Operational	6.87	130	169	7.92	22	28	280	Complying	Non-Complying	

Table A1.7: Standard threshold limits for water quality parameters

Standard		
Parameters	MoEFCC	NGT
PH	6.5 - 9	5.5 - 9
BOD **(mg/l)**	30	10
TSS **(mg/l)**	<100	20
Fecal Coliform (**(MPN per 100 ml)**)	<1000	230

Note:

MoEFCC: Ministry of Environment, Forest and Climate Change of India

NGT: National Green Tribunal

Table A1.8: List of under construction STPs with capacity (MLD) in Uttarakhand state (Data source: SPMG-UK)

UNDER CONSTRUCTIONS STP's (As of October 2022)						
Sr. No.	District	Locations	Capacity (MLD)	Physical Progress	Status	Completion Timeline
1	Chamoli	Marwari, Joshimath	2.7	99 %	Trail Run Started	December, 2022
2	Nainital	Haldwani (Indira Nagar)	28	99 %	Trail Run Started	December, 2022
3		Roosi Pond	17.5		Work Awarded and Review of Detailed Design is in Progress	DOC 7.05.2025
4	US Nagar	Kashipur	18	85 %		December, 2022
5		Kashipur (Proposed Under River Rejuvination of Dhella)	10	15 %	I&D 15%	DOC 6.01.2024
6		Mukundapur, Kashipur (Proposed Under River Rejuvination of River Kosi)	0.5		Land Purchasing & Work Started	DOC 6.01.2024
7		Gularia, Kashipur (Proposed Under River Rejuvination of Dhella)	0.3		Land Purchasing & Work Started	DOC 6.01.2024
8		Jashpur Khurd, Kashipur (Proposed Under River Rejuvination of Bhella)	1	15 %	I&D 15%	DOC 6.01.2024
9		Hempur Ismile, Kashipur (Proposed Under River Rejuvination of Bhella)	2		Proposal of transfer government land still under process	DOC 6.01.2024
10		Beljudi, Kashipur (Proposed Under River Rejuvination of Dhella)	0.5		Land Purchasing & Work Started	DOC 6.01.2024
11		Bazpur (Proposed Under River Rejuvination of Pilakhar)	10		Land Purchasing & Work Started	DOC 6.01.2024
12		Kichha, Rudrapur (Proposed Under River Rejuvination of Kichha)	3		Land Purchasing & Work Started	DOC 6.01.2024
13		Sitarganj (Proposed Under River Rejuvination of Nandhour)	3		Proposal of transfer government land still under process	DOC 6.01.2024

Table A1.9: List of under construction STPs with capacity (MLD) in Uttarakhand state (Data source: SPMG-UK)

Proposed STP as of October - 2022				
Sr. No.	District	Locations	Capacity of STP in Proposed MLD	Status of the Project
1	US Nagar	Rudrapur, (Proposed under the river rejuvination of Kalyani)	NA	DPR is being Prepared under 'Namami Gange' Programme
2	Almora	Pandey Khaula	1.5	DPR is approved and the Tender in Finalised
3	Pauri Garwal	Swargashram, Rishikesh	3	Approved During September 2022 by NMCG, Tender is being invited
4	Pauri Garwal	Neelkanth, Rishikesh District	1.5	Approved During September 2022 by NMCG, Tender is being invited
5	Nainital	Haldwani, Nainital Seepage Co-Treatment Plant	10.5	DPR under Preparation, (ADB funded Project)

Table A1.10: Average values of Water Quality Index parameters for stations located in Ramganga Basin (Data source: CPCB, CWC, Uttarakhand) – (Data years: 2017 – 2022)

Station - Average (2017-2022)	Tcol-MPN	BOD	pH	DO	NH3-N	EC	Na%	B	WQI
AMRITPUR	–	–	8.50	7.79	0.00	308.00	–	–	Worse than C
Bareilly	14,717	7.09	7.78	5.55	0.44	703.71	15.94	0.31	Worse than C
Baur Lake-1	–	0.70	7.90	9.70	0.18	363.00	–	–	Worse than C
Baur Lake-2	–	2.70	8.00	8.00	0.22	364.00	–	–	Worse than C
Baur Lake-3	–	0.90	7.90	8.50	0.18	373.00	–	–	Worse than C
Baur River, Inflow	–	0.30	7.70	7.20	0.24	411.00	–	–	Worse than C
BAZPUR	–	–	7.80	10.45	0.15	508.00	–	–	Worse than C
Bhakhara River, Inflow	–	0.80	7.60	7.20	0.26	231.00	–	–	Worse than C
BHEEMTAL LAKE	350	–	7.52	7.44	–	201.95	–	–	C
BHELLA RIVER AT LOHIYA BRIDGE D/S KASHIPUR	–	–	7.08	1.29	–	541.50	–	–	Worse than C
BHELLA RIVER U/S KASHIPUR	–	–	7.37	5.53	–	279.58	–	–	C
BHIMTAL	–	–	6.50	8.00	–	169.00	–	–	C
Bhimtal, Boat Stand (Lake Surface)	–	3.15	8.15	8.75	0.32	286.50	–	–	Worse than C
Bhimtal, Inflow Bhimtal Lake	–	1.70	7.80	6.15	0.12	287.50	–	–	Worse than C
Bhimtal, Lake Surface Chinoti	–	2.90	7.65	8.85	0.15	177.50	–	–	Worse than C
Bhimtal, Lake Surface Kamaltal	–	2.35	8.05	8.60	0.12	216.00	–	–	Worse than C
Bhimtal, Lake Surface, KMVN	–	1.85	8.05	8.80	0.11	167.00	–	–	Worse than C
Bhimtal, Outflow Bhimtal Lake	–	1.70	8.40	6.80	0.39	234.50	–	–	Worse than C
Bhimtal, Outflow Naukuchiatal	–	1.40	7.60	7.85	0.12	164.00	–	–	Worse than C
CHHOI	–	–	8.86	10.74	0.17	217.00	–	–	Worse than C
Dabri	7,621	2.91	8.06	7.31	0.35	468.63	15.38	0.23	Worse than C

Station - Average (2017-2022)	Tcol-MPN	BOD	pH	DO	NH3-N	EC	Na%	B	WQI
Dhaneta	7,361	4.26	7.98	6.25	0.22	625.22	–	0.19	Worse than C
DHELA AT ADAMPUR	282,667	–	7.55	1.23	2.77	960.00	–	–	Worse than C
DHELLA RIVER D/S AT THAKURDWARA	–	–	7.36	2.12	–	520.11	–	–	Worse than C
DHELLA RIVER U/S AT KASHIPUR MORADABAD	–	–	7.50	5.53	–	347.08	–	–	C
Gagan Moradabad	18,000	–	7.30	–	0.18	180.00	–	0.10	Worse than C
GANGA AT KANNAUJ U/S (RAJGHAT) U.P	3,769	–	8.15	8.63	–	266.62	–	–	C
GARJIA	–	–	8.40	8.39	0.17	229.00	–	–	Worse than C
Gola River at Amritpur	–	–	6.20	8.10	0.02	227.00	–	–	Worse than C
GOLA RIVER AT HALDWANI	170	–	7.63	7.36	–	248.33	–	–	C
Gola River Kathgodam	–	–	7.60	7.90	0.08	455.00	–	–	Worse than C
HAIDAKHAN	–	–	7.70	8.10	0.00	172.00	–	–	Worse than C
Haripura Lake-1	–	1.70	7.40	6.10	0.15	283.00	–	–	Worse than C
Haripura Lake-2	–	1.00	7.50	7.30	0.12	275.00	–	–	Worse than C
Haripura Lake-3	–	1.10	7.60	8.20	0.09	221.00	–	–	Worse than C
Kakrala Sluice, Outflow	–	0.80	7.70	5.80	0.50	411.00	–	–	Worse than C
KALINADI AT KANNAUJ (BEFORE CONF.) U.P	12,771	–	8.02	7.84	–	575.86	–	–	Worse than C
KALYANI RIVER AT D/S PANTNAGAR INDL AREA	–	–	7.26	2.78	–	559.50	–	–	Worse than C
KALYANI RIVER AT U/S PANTNAGAR INDL AREA	–	–	7.43	5.58	–	387.17	–	–	C
KATHGODAM	–	–	8.34	7.70	0.05	483.00	–	–	Worse than C
Katri Umrauli	8,062	2.21	7.99	6.87	0.29	306.77	–	0.20	Worse than C
Kazipura	11,547	4.46	7.80	6.96	0.33	304.40	–	0.21	Worse than C
Khairna Barrage Site	–	0.90	7.48	8.49	0.16	173.83	–	–	Worse than C
Khairna Barrage(DS)	–	0.82	7.56	8.78	0.17	177.09	–	–	Worse than C
Khairna Barrage(US)	–	1.20	7.52	8.26	0.17	161.85	–	–	Worse than C
Khajia Sluice, Outflow	–	1.20	7.30	6.60	0.14	273.00	–	–	Worse than C
KICCHA AT PULL BHATTA	328,775	–	7.78	5.00	1.08	834.75	–	–	Worse than C
KICHHA	–	–	7.83	10.36	–	1348.00	–	–	C
KICHHA RIVER AT KICHHA U.S. NAGAR	–	–	7.62	4.47	–	509.75	–	–	C
KOSHI RIVER AT KASHIPUR BAJPUR	–	–	7.50	6.00	–	387.45	–	–	C
KOSI AT DADIYAL BRIDGE UTTRAKHAND	1,238	–	7.84	6.24	0.50	572.25	–	–	Worse than C
Kosi River Near Garjia Temple	–	–	6.00	7.40	0.20	194.00	–	–	Worse than C
Kutchgad Drain	–	1.03	7.65	8.15	0.14	275.30	–	–	Worse than C
Moradabad	21,086	11.98	7.58	3.69	0.40	469.11	22.28	0.30	Worse than C
NAINI LAKE AT NAINITAL	620	–	7.59	7.50	–	425.00	–	–	C
Nainital	–	–	7.70	6.20	–	561.00	–	–	C
NANDOUR RIVER D/S SITARGANJ INDL AREA	–	–	7.67	5.63	–	342.92	–	–	C
NANDOUR RIVER U/S SITARGANJ INDL AREA	–	–	7.54	5.94	–	224.75	–	–	C
NAUKUCHIATAL	–	–	7.50	7.40	0.02	185.00	–	–	Worse than C

Station - Average (2017-2022)	Tcol-MPN	BOD	pH	DO	NH3-N	EC	Na%	B	WQI
Near Kosi Barrage Ramnagar	–	–	6.10	7.20	0.21	175.00	–	–	Worse than C
PILKHAR AT RAMPUR BHOT (U.P)	14,283	–	7.98	7.70	0.58	721.75	–	–	Worse than C
PILKHAR RIVER AFTER BILASPUR RAMPUR	–	–	7.54	5.61	–	396.22	–	–	C
RAMGANGA AT D/S KALAGARH DAM (U.K.)	245,390	–	7.17	8.73	0.17	190.00	–	–	Worse than C
RAMGANGA AT D/S SHERKOT KALAGARH	11,890	–	7.15	8.03	–	234.33	–	–	Worse than C
RAMGANGA AT KANNAUJ	16,744	–	8.28	8.55	–	470.78	–	–	Worse than C
SATTAL	–	–	7.60	7.80	0.01	107.00	–	–	Worse than C
Seohara	4,617	3.01	7.91	6.22	0.22	283.66	–	0.21	Worse than C
Shahjahanpur	5,508	18.59	7.70	4.05	0.30	371.61	–	0.22	Worse than C
Shipra river at Dhaniyakot bridge	–	0.88	7.88	8.25	0.14	226.80	–	–	Worse than C
SULTANPUR PATTI	–	–	7.89	9.80	0.16	509.00	–	–	Worse than C
Tiharkheda	13,515	4.69	7.69	5.72	0.22	482.87	–	0.21	Worse than C
Todarpur	7,177	3.31	7.91	6.49	0.36	387.42	–	0.31	Worse than C

***Note:** Only the available data is considered. If the data is missing, then it is represented as dash in the table.

Table A1.11 WQI evaluation based on SWAT data (only DO and BOD) – Ramganga River Basin

Note: This WQI is only based on DO and BOD values from SWAT. It is an additional information which should be interpreted with due caution as the WQI parameters are not complete.

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
1	5	10.0	1.4	A
2	5	6.5	26.7	Worse than C
3	5	5.5	21.0	Worse than C
4	5	6.5	51.4	Worse than C
5	5	6.5	10.3	Worse than C
6	5	5.5	14.4	Worse than C
7	5	10.0	3.4	Worse than C
8	5	5.5	25.6	Worse than C
9	5	6.0	42.5	Worse than C
10	5	10.0	2.0	B
11	5	7.0	7.1	Worse than C
12	5	10.5	2.3	B
13	5	6.0	29.3	Worse than C
14	5	5.5	39.5	Worse than C
15	5	7.0	5.8	Worse than C
16	5	10.0	1.3	A
17	5	5.0	35.5	Worse than C
18	5	7.5	5.2	Worse than C
19	5	6.5	8.8	Worse than C
20	2	5.0	40.9	Worse than C
21	2	5.0	20.7	Worse than C
22	5	4.5	25.7	Worse than C
23	5	8.0	65.0	Worse than C
24	3	9.5	2.9	B
25	3	10.0	2.9	B
26	5	6.5	18.4	Worse than C
27	5	5.5	14.7	Worse than C
28	3	9.5	3.1	Worse than C
29	2	4.5	23.7	Worse than C
30	4	0.1	3285.4	Worse than C
31	5	5.5	13.5	Worse than C
32	4	10.0	2.4	B
33	2	0.1	1593.5	Worse than C
34	4	7.5	41.4	Worse than C
35	2	3.5	282.6	Worse than C
36	2	9.5	1.8	A
37	5	10.0	2.6	B
38	5	6.5	35.3	Worse than C
39	5	5.0	36.3	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
40	4	0.1	394.4	Worse than C
41	2	10.0	2.0	B
42	5	10.0	0.6	A
43	5	10.0	3.5	Worse than C
44	5	5.0	3.8	Worse than C
45	2	0.1	220.0	Worse than C
46	5	10.0	1.2	A
47	5	0.1	2004.1	Worse than C
48	5	0.8	12.6	Worse than C
49	5	5.5	29.2	Worse than C
50	4	7.5	16.5	Worse than C
51	3	10.0	2.0	A
52	3	9.5	2.8	B
53	5	0.1	61.1	Worse than C
54	2	0.1	126.7	Worse than C
55	4	10.0	1.5	A
56	5	6.0	24.5	Worse than C
57	5	10.0	1.4	A
58	5	5.0	32.6	Worse than C
59	4	10.0	1.2	A
60	4	0.1	140.0	Worse than C
61	4	10.0	1.8	A
62	4	10.0	2.3	B
63	4	6.0	22.5	Worse than C
64	3	10.0	3.3	Worse than C
65	3	6.0	13.8	Worse than C
66	4	10.0	1.3	A
67	5	6.5	23.0	Worse than C
68	8	9.5	1.5	A
69	3	0.1	919.2	Worse than C
70	5	4.5	2.6	C
71	5	6.5	11.8	Worse than C
72	2	9.5	1.5	A
73	4	0.1	44.2	Worse than C
74	3	5.0	38.2	Worse than C
75	3	7.5	4.1	Worse than C
76	5	5.5	28.0	Worse than C
77	5	5.0	2.9	B
78	3	10.0	3.2	Worse than C
79	4	10.0	1.2	A
80	4	10.0	1.9	A
81	3	3.5	82.1	Worse than C
82	5	4.5	2.8	C
83	3	5.5	12.5	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
84	4	7.0	8.8	Worse than C
85	3	7.5	23.0	Worse than C
86	3	7.0	16.3	Worse than C
87	2	10.0	0.8	A
88	2	0.2	14.8	Worse than C
89	5	5.0	2.1	B
90	4	6.5	1.2	A
91	8	9.5	0.7	A
92	4	6.0	1.8	A
93	4	6.5	1.4	A
94	3	0.1	265.1	Worse than C
95	3	0.1	506.6	Worse than C
96	3	3.0	8.8	Worse than C
97	3	4.5	6.5	Worse than C
98	3	5.0	5.3	Worse than C
99	3	0.1	245.4	Worse than C
100	4	6.0	1.6	A
101	3	6.0	12.6	Worse than C
102	3	6.5	3.1	Worse than C
103	3	0.1	83.0	Worse than C
104	4	9.5	1.1	A
105	3	7.0	2.6	B
106	3	5.5	3.7	Worse than C
107	3	5.5	21.2	Worse than C
108	2	10.0	0.4	A
109	2	9.5	0.7	A
110	4	6.0	2.2	B
111	2	9.5	0.3	A
112	3	6.0	40.2	Worse than C
113	3	10.0	1.8	A
114	3	7.0	7.7	Worse than C
115	2	6.0	1.7	A
116	2	10.0	0.5	A
117	3	2.5	17.4	Worse than C
118	3	0.1	33.3	Worse than C
119	4	11.0	1.5	A
120	4	9.5	1.4	A
121	4	9.5	0.5	A
122	4	9.5	1.1	A
123	3	7.5	2.1	B
124	10	9.0	2.0	B
125	3	5.0	29.3	Worse than C
126	3	9.5	1.9	A
127	4	10.0	1.5	A

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
128	8	8.5	1.4	A
129	8	9.5	0.4	A
130	3	9.5	2.1	B
131	3	9.5	2.7	B
132	2	9.5	0.6	A
133	2	3.0	14165.8	Worse than C
134	4	9.5	1.4	A
135	9	9.5	2.1	B
136	4	10.0	0.5	A
137	10	9.5	2.4	B
138	4	10.0	0.5	A
139	10	10.0	2.2	B
140	8	5.0	158.4	Worse than C
141	8	5.5	3.8	Worse than C
142	4	9.5	0.3	A
143	2	9.5	0.2	A
144	10	1.3	23.0	Worse than C
145	12	7.5	12.2	Worse than C
146	17	10.0	3.0	B
147	17	6.0	18.8	Worse than C
148	4	10.0	0.3	A
149	2	9.0	0.4	A
150	9	10.0	1.3	A
151	9	0.6	14.2	Worse than C
152	8	3.5	129.6	Worse than C
153	10	10.5	0.3	A
154	10	9.0	1.8	A
155	9	10.0	1.1	A
156	9	8.5	6.5	Worse than C
157	9	10.0	1.3	A
158	9	10.0	1.7	A
159	2	0.1	459.0	Worse than C
160	2	10.5	0.1	A
161	9	2.7	6.2	Worse than C
162	17	6.5	9.1	Worse than C
163	9	9.5	0.9	A
164	17	0.1	7927.1	Worse than C
165	17	0.1	2563.5	Worse than C
166	2	0.1	57.5	Worse than C
167	8	9.5	0.3	A
168	12	8.0	2.7	B
169	9	6.5	18.6	Worse than C
170	9	6.5	12.2	Worse than C
171	9	8.5	0.0	A

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
172	4	0.1	99.7	Worse than C
173	4	9.0	0.1	A
174	8	0.1	3436.6	Worse than C
175	8	10.0	0.4	A
176	17	0.1	527.8	Worse than C
177	17	9.5	1.9	A
178	12	10.0	1.0	A
179	17	10.0	2.4	B
180	17	9.5	1.8	A
181	17	0.1	1482.3	Worse than C
182	4	0.1	323.8	Worse than C
183	8	0.1	161.7	Worse than C
184	8	0.1	1096.5	Worse than C
185	8	7.5	2.0	B
186	17	7.5	5.3	Worse than C
187	9	9.5	0.2	A
188	12	9.5	1.6	A
189	17	0.1	1045.7	Worse than C
190	10	9.5	1.2	A
191	2	3.5	169.0	Worse than C
192	8	8.5	1.8	A
193	8	0.1	1031.0	Worse than C
194	10	4.0	49.0	Worse than C
195	10	10.0	0.8	A
196	17	9.5	2.7	B
197	17	9.0	3.4	Worse than C
198	4	4.0	14.6	Worse than C
199	9	5.5	8.0	Worse than C
200	9	0.1	5137.8	Worse than C
201	12	8.0	9.9	Worse than C
202	12	9.0	2.3	B
203	12	0.1	27622.7	Worse than C
204	9	7.5	3.9	Worse than C
205	9	0.1	78.2	Worse than C
206	12	3.5	71.2	Worse than C
207	17	10.0	1.7	A
208	9	6.5	16.3	Worse than C
209	12	3.5	54.4	Worse than C
210	12	3.5	131.0	Worse than C
211	10	5.0	25.1	Worse than C
212	12	-	-	No Data
213	9	9.5	0.3	A
214	8	9.5	0.5	A
215	9	0.1	3181.1	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
216	8	9.5	0.4	A
217	9	7.5	30.2	Worse than C
218	10	5.5	30.6	Worse than C
219	12	10.0	0.9	A
220	9	5.0	5.0	Worse than C
221	12	0.1	3308.6	Worse than C
222	10	4.0	60.5	Worse than C
223	12	9.5	1.1	A
224	15	7.5	8.7	Worse than C
225	12	-	-	No Data
226	15	10.0	2.0	B
227	17	0.1	2271.1	Worse than C
228	9	8.6	0.3	A
229	17	8.4	0.1	A
230	12	2.5	94.7	Worse than C
231	15	10.0	0.7	A
232	12	-	-	No Data
233	14	9.0	2.4	B
234	8	8.1	0.3	A
235	9	6.0	16.9	Worse than C
236	12	3.0	39.4	Worse than C
237	12	8.0	2.3	B
238	15	10.0	2.3	B
239	10	4.5	28.2	Worse than C
240	9	0.1	1358.5	Worse than C
241	10	7.5	1.7	A
242	8	4.0	34.2	Worse than C
243	12	0.1	1302.5	Worse than C
244	12	9.5	1.3	A
245	15	9.5	2.5	B
246	8	9.5	0.4	A
247	8	2.5	20.3	Worse than C
248	9	4.5	162.4	Worse than C
249	14	8.5	3.1	Worse than C
250	12	0.1	7584.0	Worse than C
251	9	6.0	34.5	Worse than C
252	15	8.5	4.8	Worse than C
253	9	0.1	44.7	Worse than C
254	8	8.2	0.2	A
255	9	6.0	16.6	Worse than C
256	12	6.0	7.7	Worse than C
257	9	7.2	0.7	A
258	12	0.1	483.7	Worse than C
259	14	8.5	2.5	B

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
260	9	5.0	8.9	Worse than C
261	8	10.0	0.2	A
262	8	6.5	2.1	B
263	12	3.5	50.1	Worse than C
264	10	9.5	1.0	A
265	8	0.1	712.0	Worse than C
266	12	3.0	42.6	Worse than C
267	17	8.7	0.2	A
268	17	0.1	666.9	Worse than C
269	15	10.0	1.9	A
270	9	4.5	4.1	Worse than C
271	17	3.0	85.9	Worse than C
272	12	2.5	78.4	Worse than C
273	9	5.0	15.1	Worse than C
274	8	4.5	3.4	Worse than C
275	9	5.5	10.7	Worse than C
276	12	2.5	45.7	Worse than C
277	12	0.1	699.6	Worse than C
278	12	10.0	0.4	A
279	12	5.0	59.8	Worse than C
280	17	2.5	117.6	Worse than C
281	15	9.5	0.6	A
282	15	9.0	2.5	B
283	15	9.0	2.7	B
284	15	9.0	1.7	A
285	9	4.0	11.4	Worse than C
286	9	6.5	2.1	B
287	15	9.5	1.1	A
288	10	0.1	56.5	Worse than C
289	10	0.1	101.5	Worse than C
290	12	5.0	20.1	Worse than C
291	14	9.5	1.5	A
292	9	8.0	45.8	Worse than C
293	15	9.5	1.6	A
294	15	9.5	1.8	A
295	10	10.0	1.2	A
296	9	0.1	643.6	Worse than C
297	12	3.5	42.2	Worse than C
298	12	8.5	2.3	B
299	12	0.1	9580.8	Worse than C
300	17	0.1	37613.4	Worse than C
301	15	9.0	1.6	A
302	10	7.5	28.3	Worse than C
303	8	7.5	1.5	A

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
304	15	9.0	1.9	A
305	15	8.5	2.0	A
306	12	2.5	17.2	Worse than C
307	12	6.5	24.0	Worse than C
308	8	3.5	8.2	Worse than C
309	8	5.5	23.5	Worse than C
310	17	11.0	0.1	A
311	9	7.0	2.8	B
312	12	5.5	12.6	Worse than C
313	17	5.0	34.2	Worse than C
314	12	8.0	4.3	Worse than C
315	9	0.1	40.6	Worse than C
316	9	4.5	5.0	Worse than C
317	17	4.0	12.9	Worse than C
318	17	-	-	No Data
319	8	3.5	41.7	Worse than C
320	17	10.5	0.3	A
321	17	11.5	1.1	A
322	9	7.0	9.8	Worse than C
323	8	8.0	2.6	B
324	8	10.5	1.2	A
325	17	4.0	681.6	Worse than C
326	15	9.5	1.5	A
327	12	0.1	926.2	Worse than C
328	17	3.0	13.2	Worse than C
329	14	9.5	1.4	A
330	17	5.0	10.7	Worse than C
331	17	4.0	19.6	Worse than C
332	17	4.5	135.0	Worse than C
333	17	4.5	92.4	Worse than C
334	10	7.0	8.5	Worse than C
335	15	7.0	3.5	Worse than C
336	10	7.0	28.0	Worse than C
337	10	5.0	5.1	Worse than C
338	10	8.3	0.8	A
339	9	8.0	6.6	Worse than C
340	15	7.5	4.1	Worse than C
341	12	7.0	1.9	A
342	12	8.5	1.9	A
343	15	10.0	1.2	A
344	15	7.0	3.2	Worse than C
345	12	5.0	13.6	Worse than C
346	12	0.1	284.5	Worse than C
347	12	3.5	5.9	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
348	12	0.1	33.4	Worse than C
349	11	0.1	1064.1	Worse than C
350	9	0.1	263.1	Worse than C
351	9	8.5	1.5	A
352	15	5.0	7.5	Worse than C
353	15	0.1	3109.9	Worse than C
354	11	0.1	1259.9	Worse than C
355	12	7.5	2.8	B
356	14	10.0	0.9	A
357	8	8.0	0.7	A
358	8	7.0	1.4	A
359	15	0.1	950.0	Worse than C
360	10	0.1	3872.5	Worse than C
361	8	8.0	19.9	Worse than C
362	8	4.0	139.9	Worse than C
363	11	9.0	64.3	Worse than C
364	12	4.5	4.8	Worse than C
365	17	5.5	13.2	Worse than C
366	12	7.5	3.6	Worse than C
367	12	8.5	18.7	Worse than C
368	15	8.1	0.6	A
369	17	5.0	10.8	Worse than C
370	17	5.0	109.7	Worse than C
371	8	7.0	13.5	Worse than C
372	14	6.5	10.0	Worse than C
373	17	5.0	4.5	Worse than C
374	15	0.1	398.9	Worse than C
375	11	0.1	1960.2	Worse than C
376	12	4.5	13.7	Worse than C
377	11	0.1	7072.1	Worse than C
378	17	5.0	2.4	B
379	15	4.5	19.5	Worse than C
380	10	7.5	1.4	A
381	12	6.0	3.4	Worse than C
382	15	5.5	4.8	Worse than C
383	12	0.1	250.9	Worse than C
384	11	0.1	587.9	Worse than C
385	15	7.0	2.1	B
386	15	0.1	122.7	Worse than C
387	10	1.6	23.8	Worse than C
388	11	0.1	3068.3	Worse than C
389	11	0.1	45546.1	Worse than C
390	11	0.1	196.3	Worse than C
391	12	5.0	3.5	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
392	12	7.5	8.5	Worse than C
393	10	9.0	7.6	Worse than C
394	17	4.0	388.1	Worse than C
395	17	6.5	5.0	Worse than C
396	10	-	-	No Data
397	17	8.0	2.8	B
398	11	0.1	624.5	Worse than C
399	10	9.5	13.0	Worse than C
400	17	7.5	1.5	A
401	11	0.1	1964.7	Worse than C
402	18	10.0	0.5	A
403	15	5.0	14.2	Worse than C
404	18	9.5	1.1	A
405	15	10.5	0.9	A
406	17	4.5	18.7	Worse than C
407	14	8.5	2.2	B
408	10	6.6	1.7	A
409	14	8.0	10.9	Worse than C
410	14	5.0	10.3	Worse than C
411	16	10.0	0.4	A
412	12	0.1	152.2	Worse than C
413	12	4.0	10.8	Worse than C
414	17	7.0	0.7	A
415	15	4.5	6.9	Worse than C
416	17	10.5	1.4	A
417	14	7.0	2.9	B
418	15	9.5	2.0	A
419	11	5.0	14.8	Worse than C
420	13	8.0	4.8	Worse than C
421	12	6.0	2.2	B
422	12	7.5	2.7	B
423	12	0.1	199628.0	Worse than C
424	17	6.5	5.7	Worse than C
425	17	8.0	1.3	A
426	17	8.0	8.4	Worse than C
427	11	3.5	6.0	Worse than C
428	11	0.1	225.6	Worse than C
429	17	7.5	7.2	Worse than C
430	10	0.1	203883.1	Worse than C
431	13	8.5	2.4	B
432	11	0.1	568.4	Worse than C
433	14	5.5	8.5	Worse than C
434	17	9.5	0.9	A
435	12	7.0	1.7	A

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
436	15	8.0	0.9	A
437	12	5.0	4.9	Worse than C
438	16	10.5	0.4	A
439	10	0.1	1538.4	Worse than C
440	16	10.0	0.3	A
441	17	10.0	1.6	A
442	11	0.1	230.9	Worse than C
443	11	8.5	5.3	Worse than C
444	11	8.5	4.4	Worse than C
445	15	11.0	0.4	A
446	14	0.1	90.6	Worse than C
447	13	6.5	6.4	Worse than C
448	18	10.5	0.9	A
449	13	8.5	1.8	A
450	18	4.0	163.6	Worse than C
451	18	9.5	1.2	A
452	17	0.1	273.9	Worse than C
453	11	8.5	6.3	Worse than C
454	17	0.1	302.3	Worse than C
455	14	8.0	1.1	A
456	11	0.1	472.4	Worse than C
457	17	10.0	1.6	A
458	11	3.0	11.9	Worse than C
459	17	5.0	29.3	Worse than C
460	16	3.5	91.4	Worse than C
461	12	7.5	1.3	A
462	12	0.1	1058.7	Worse than C
463	18	0.1	854.3	Worse than C
464	11	0.1	46.0	Worse than C
465	13	0.1	303.4	Worse than C
466	12	8.5	1.3	A
467	14	7.0	2.0	A
468	14	9.0	2.3	B
469	13	0.1	51109.4	Worse than C
470	13	9.0	1.6	A
471	17	0.3	12.8	Worse than C
472	13	0.1	980.5	Worse than C
473	18	8.5	4.0	Worse than C
474	18	8.0	4.8	Worse than C
475	17	8.5	7.2	Worse than C
476	14	10.5	2.0	A
477	14	9.5	1.5	A
478	12	5.0	26.1	Worse than C
479	18	5.5	39.0	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
480	18	5.5	5.8	Worse than C
481	18	11.0	0.7	A
482	17	0.9	11.0	Worse than C
483	17	9.0	3.7	Worse than C
484	13	0.5	14.6	Worse than C
485	13	9.0	15.7	Worse than C
486	12	6.0	15.9	Worse than C
487	11	0.1	51.4	Worse than C
488	11	0.1	3834.0	Worse than C
489	18	8.5	2.4	B
490	17	6.1	1.5	A
491	12	4.0	155.1	Worse than C
492	13	5.5	14.2	Worse than C
493	11	7.5	0.8	A
494	16	4.5	5.2	Worse than C
495	16	6.0	21.8	Worse than C
496	16	8.0	10.8	Worse than C
497	13	6.5	2.5	B
498	13	9.0	3.5	Worse than C
499	18	8.4	0.5	A
500	17	8.0	1.5	A
501	17	0.1	116.4	Worse than C
502	11	0.1	89.7	Worse than C
503	14	0.1	166.0	Worse than C
504	14	6.5	3.3	Worse than C
505	17	9.0	2.4	B
506	14	0.1	4262.5	Worse than C
507	14	0.1	65.4	Worse than C
508	13	8.0	2.2	B
509	17	0.1	559.4	Worse than C
510	11	0.1	80.8	Worse than C
511	17	0.1	206.1	Worse than C
512	13	9.0	1.3	A
513	18	9.0	2.5	B
514	14	0.1	182.0	Worse than C
515	13	9.5	3.7	Worse than C
516	18	8.0	6.1	Worse than C
517	18	1.3	18.6	Worse than C
518	16	8.0	5.5	Worse than C
519	13	10.0	1.1	A
520	13	9.0	4.1	Worse than C
521	13	9.0	1.3	A
522	14	6.5	7.3	Worse than C
523	13	10.0	1.2	A

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
524	13	8.0	12.6	Worse than C
525	17	0.1	161.5	Worse than C
526	17	0.1	32.2	Worse than C
527	17	7.5	2.8	B
528	13	8.0	18.6	Worse than C
529	17	0.1	178.0	Worse than C
530	14	0.1	161.0	Worse than C
531	17	0.9	23.1	Worse than C
532	13	9.0	1.4	A
533	13	10.0	0.9	A
534	16	9.0	2.2	B
535	16	7.0	1.7	A
536	18	8.5	2.5	B
537	17	8.0	5.8	Worse than C
538	18	8.9	0.1	A
539	18	10.0	0.7	A
540	13	10.5	0.9	A
541	14	6.7	1.0	A
542	18	7.0	1.1	A
543	17	0.1	3788.5	Worse than C
544	13	10.5	1.1	A
545	13	8.5	9.2	Worse than C
546	17	-	-	No Data
547	14	0.1	17.6	Worse than C
548	17	1.5	18.6	Worse than C
549	18	8.5	7.0	Worse than C
550	14	9.0	5.2	Worse than C
551	14	9.0	8.9	Worse than C
552	16	8.5	0.9	A
553	18	9.5	1.5	A
554	14	5.5	2.2	B
555	14	8.2	0.5	A
556	18	0.1	194.3	Worse than C
557	18	8.5	8.1	Worse than C
558	13	7.5	10.9	Worse than C
559	17	0.1	2415.9	Worse than C
560	13	0.1	1341.0	Worse than C
561	17	0.1	322.3	Worse than C
562	18	8.5	2.8	B
563	18	8.3	0.1	A
564	16	9.5	1.0	A
565	14	0.1	57.9	Worse than C
566	13	11.0	0.9	A
567	17	10.5	4.5	Worse than C

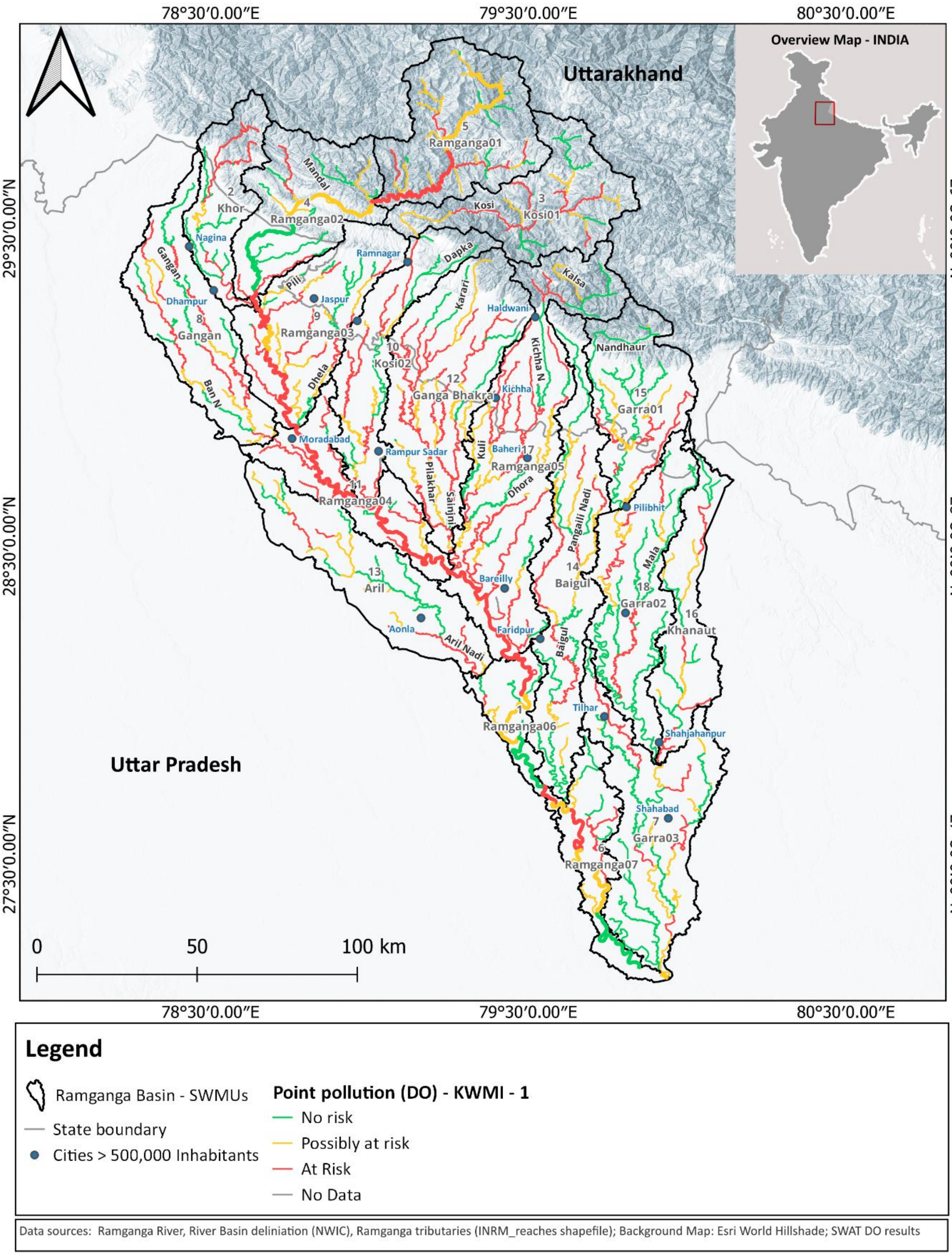
Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
568	14	9.5	11.3	Worse than C
569	13	0.1	823.8	Worse than C
570	17	0.1	86.6	Worse than C
571	13	0.1	388.8	Worse than C
572	13	0.2	35.7	Worse than C
573	17	0.1	440.3	Worse than C
574	17	0.1	44.8	Worse than C
575	18	0.8	9.5	Worse than C
576	18	10.5	1.2	A
577	14	9.5	5.4	Worse than C
578	16	8.5	7.8	Worse than C
579	14	11.0	1.9	A
580	16	4.0	44.0	Worse than C
581	16	8.5	7.1	Worse than C
582	14	0.1	80.8	Worse than C
583	16	8.5	4.5	Worse than C
584	18	9.5	3.7	Worse than C
585	18	10.5	1.0	A
586	18	8.4	0.0	A
587	18	0.1	35.8	Worse than C
588	18	10.5	1.4	A
589	13	7.5	7.7	Worse than C
590	13	4.8	3.5	Worse than C
591	7	8.9	2.5	B
592	14	10.0	3.5	Worse than C
593	1	9.5	30.8	Worse than C
594	18	11.0	1.6	A
595	14	3.9	6.2	Worse than C
596	16	9.0	1.9	A
597	16	5.5	2.1	B
598	1	8.1	0.8	A
599	1	4.5	10.8	Worse than C
600	1	10.0	2.8	B
601	16	8.0	6.3	Worse than C
602	7	0.1	1432.5	Worse than C
603	18	4.7	2.5	C
604	14	11.0	1.8	A
605	16	0.1	6447.0	Worse than C
606	14	3.1	9.3	Worse than C
607	1	8.5	9.4	Worse than C
608	18	8.3	0.2	A
609	16	5.5	6.3	Worse than C
610	16	0.1	293.1	Worse than C
611	1	6.0	6.6	Worse than C

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
612	1	8.0	26.6	Worse than C
613	18	12.0	1.0	A
614	1	0.1	57.5	Worse than C
615	16	8.5	3.8	Worse than C
616	18	8.5	0.1	A
617	14	9.0	13.9	Worse than C
618	14	7.3	0.7	A
619	1	5.5	5.1	Worse than C
620	14	8.0	7.2	Worse than C
621	16	8.5	1.0	A
622	7	7.5	16.8	Worse than C
623	7	8.5	4.1	Worse than C
624	7	0.1	804.7	Worse than C
625	1	5.4	2.7	B
626	7	8.0	10.3	Worse than C
627	1	9.5	2.8	B
628	18	8.5	5.7	Worse than C
629	1	7.3	1.7	A
630	7	8.5	4.1	Worse than C
631	16	0.1	37674.3	Worse than C
632	14	8.0	5.5	Worse than C
633	18	8.5	0.1	A
634	7	8.0	5.6	Worse than C
635	7	10.5	1.1	A
636	14	10.5	2.9	B
637	14	8.4	0.1	A
638	16	4.0	63.8	Worse than C
639	18	8.5	0.1	A
640	7	0.1	6165.6	Worse than C
641	14	8.0	5.7	Worse than C
642	6	10.0	3.1	Worse than C
643	7	0.3	25.5	Worse than C
644	7	12.0	1.2	A
645	1	8.0	0.6	A
646	7	8.5	1.9	A
647	6	10.5	4.1	Worse than C
648	7	0.1	253.9	Worse than C
649	7	8.5	13.8	Worse than C
650	7	8.0	13.3	Worse than C
651	14	8.5	2.8	B
652	14	8.4	0.1	A
653	7	10.5	1.4	A
654	7	6.2	2.8	B
655	1	8.3	0.5	A

Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
656	7	0.2	12.6	Worse than C
657	14	8.4	0.1	A
658	7	9.0	3.7	Worse than C
659	7	8.1	0.6	A
660	1	2.0	23.6	Worse than C
661	14	8.5	0.1	A
662	1	6.0	7.8	Worse than C
663	6	5.9	1.9	B
664	7	8.0	5.2	Worse than C
665	6	8.5	16.2	Worse than C
666	6	9.5	8.2	Worse than C
667	7	8.3	0.4	A
668	7	10.5	1.0	A
669	7	8.0	4.9	Worse than C
670	6	0.6	32.2	Worse than C
671	6	0.1	1364.7	Worse than C
672	6	0.2	24.2	Worse than C
673	6	10.0	2.5	B
674	7	8.2	0.2	A
675	7	8.0	2.6	B
676	7	8.2	0.3	A
677	7	0.1	262.6	Worse than C
678	6	2.2	6.8	Worse than C
679	7	0.4	13.2	Worse than C
680	6	0.1	217.8	Worse than C
681	7	3.1	14.7	Worse than C
682	6	5.4	2.7	B
683	7	9.5	1.1	A
684	7	7.0	1.5	A
685	7	6.1	1.8	A
686	7	9.0	6.2	Worse than C
687	7	10.0	1.7	A
688	6	1.5	9.4	Worse than C
689	6	7.2	1.3	A
690	6	7.5	20.4	Worse than C
691	7	9.0	9.8	Worse than C
692	7	8.0	6.1	Worse than C
693	7	8.0	11.1	Worse than C
694	7	8.0	4.9	Worse than C
695	7	11.0	2.4	B
696	7	8.6	0.4	A
697	6	8.0	8.9	Worse than C
698	6	8.0	0.7	A
699	7	7.9	0.2	A

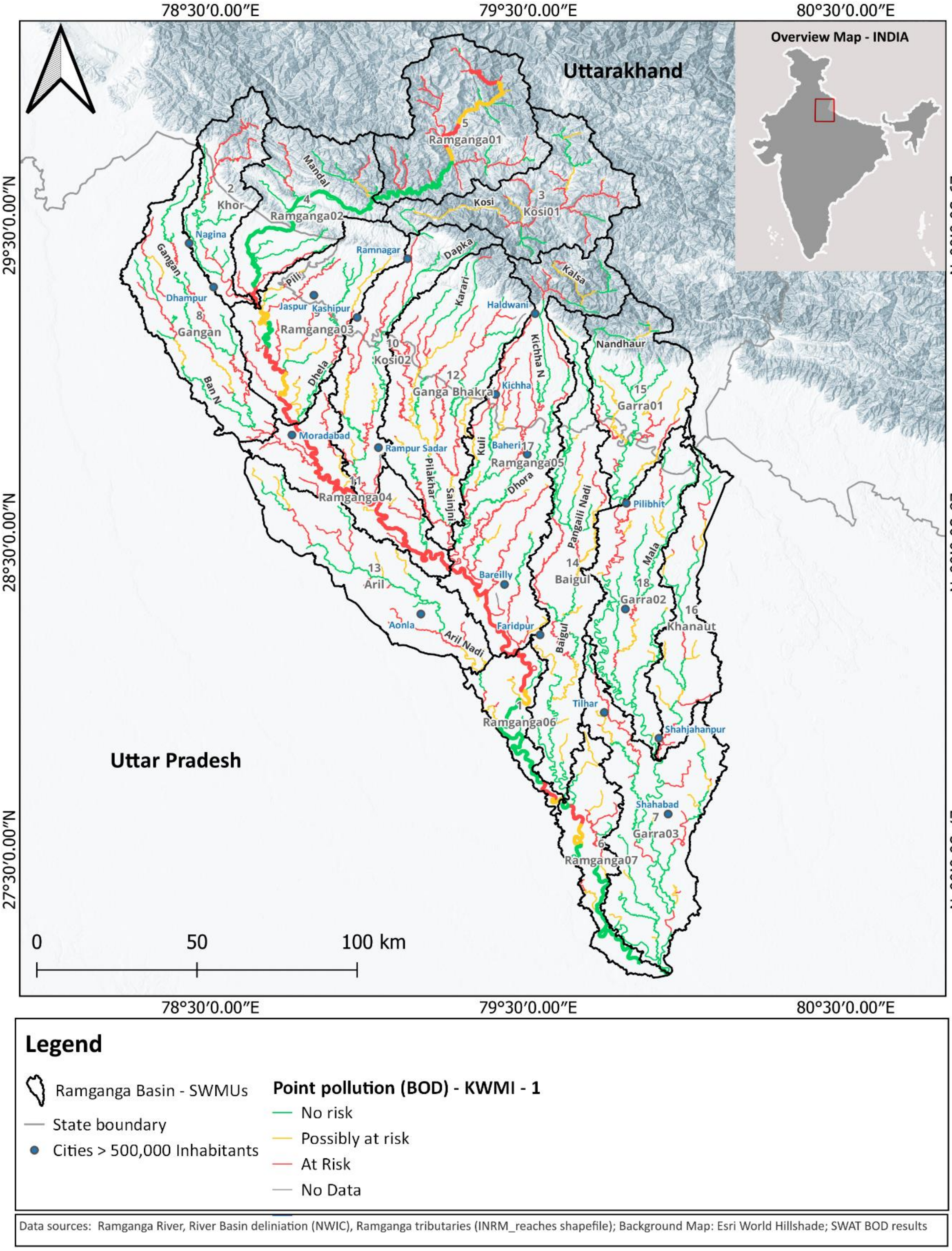
Subbasin	SWMUs	DO [mg/l]	BOD [mg/l]	Final WQI
700	7	9.0	4.0	Worse than C
701	7	10.0	1.2	A
702	7	10.0	1.9	A
703	7	1.7	26.5	Worse than C
704	6	8.3	0.3	A
705	7	9.0	8.2	Worse than C
706	7	11.0	1.8	A
707	7	11.0	0.8	A
708	7	11.5	0.8	A
709	6	8.4	0.2	A
710	7	11.5	1.3	A
711	7	5.1	1.9	B

Ramganga River Basin - Point pollution - DO - Risk Assessment (KWMI-1)



Map A1.1: Reach-wise Dissolved Oxygen (DO) risk assessment – Ramganga River Basin

Ramganga River Basin - Point pollution - BOD - Risk Assessment (KWMI-1)



Map A1.2: Reach-wise Biological Oxygen Demand (BOD) risk assessment – Ramganga River Basin

ANNEXURE A2: KWMI 2- ADDITIONAL INFORMATION ON METHODOLOGY, RESULTS AND DATA

Table A2.1: Land Use Class Levels With Grid Codes And Priority Risk Class

Land use grid codes	Land use class levels	Risk class
1	Built-Up	1
2	Kharif Crop	2
3	Rabi Crop	2
4	Zaid Crop	2
5	Double / Triple Crop	1
6	Fallow Land	2
7	Agriculture Plantation	1
8	Evergreen Forest	3
9	Deciduous Forest	3
10	Degraded / Scrub Forest	3
11	Littoral Swamp	3
12	Grassland	3
14	Wasteland	3
16	Waterbodies Min.	3
17	Waterbodies Max.	3

Table A2.2: District wise Fertilizer Uses Data of Ramganga Basin

DISTRICTWISE FERTILIZER USES DATA OF RAMGANGA BASIN										
STATE	DISTRICT	UNITS	YEAR	NITROGEN PER HA	PHOSPHATE PER HA	POTASH PER HA	GCA in H.A ('000)	Total Nitrogen (in '000 KG)	Total Phosphate (in '000 KG)	Total Potash (in '000 KG)
Uttarakhand	Almora	Kg / ha of total cropped area	2015	2.02	0.54	0.14	144.7	292.3	78.1	20.3
Uttarakhand	Bageshwar	Kg / ha of total cropped area	2015	5.94	2.01	0.58	42.4	251.9	85.2	24.6
Uttarakhand	Chamoli district	Kg / ha of total cropped area	2015	2.4	1.22	0	75.4	180.8	91.9	0.0
Uttarakhand	Champawat	Kg / ha of total cropped area	2015	13.75	3.67	1.03	39.3	540.4	144.2	40.5
Uttarakhand	Nainital	Kg / ha of total cropped area	2015	144.47	22.39	7.18	353.8	51109.2	7920.9	2540.1
Uttarakhand	Pauri	Kg / ha of total cropped area	2015	4.87	1.29	0.1	72.9	355.2	94.1	7.3
Uttarakhand	US Nagar	Kg / ha of total cropped area	2015	495.38	50.88	16.68	316.3	156688.7	16093.3	5275.9
Uttar Pradesh	Amroha	Kg / ha of total cropped area	2014	127.68	37.15	7.67	260.6	33274.1	9681.5	1998.8
Uttar Pradesh	Bareilly	Kg / ha of total cropped area	2014	126.68	36.58	7.48	543.4	68843.0	19879.0	4064.9
Uttar Pradesh	Bijnor	Kg / ha of total cropped area	2014	181.23	52.52	10.79	432.0	78296.8	22690.2	4661.6
Uttar Pradesh	Budaun	Kg / ha of total cropped area	2014	121.93	35.15	7.18	729.7	88977.2	25650.4	5239.5
Uttar Pradesh	Farrukhabad district	Kg / ha of total cropped area	2014	110.21	32.12	6.65	589.2	64939.0	18926.1	3918.4
Uttar Pradesh	Hardoi	Kg / ha of total cropped area	2014	123.24	35.59	7.28	660.2	81356.9	23494.7	4805.9
Uttar Pradesh	Kannauj district	Kg / ha of total cropped area	2014	114.04	33	6.77	222.0	25316.9	7326.0	1502.9
Uttar Pradesh	Kheri	Kg / ha of total cropped area	2014	155.04	44.59	9.08	686.1	106369.8	30592.3	6229.6
Uttar Pradesh	Moradabad	Kg / ha of total cropped area	2014	124.72	36.06	7.39	793.6	98977.8	28617.2	5864.7
Uttar Pradesh	Pilibhit	Kg / ha of total cropped area	2014	130.4	37.59	7.68	395.4	51560.2	14863.1	3036.7
Uttar Pradesh	Rampur	Kg / ha of total cropped area	2014	129.09	37.31	7.64	341.0	44019.7	12722.7	2605.2
Uttar Pradesh	Sambhal	Kg / ha of total cropped area	2014	111.16	32.08	6.56	366.8	40773.5	11766.9	2406.2
Uttar Pradesh	Shahjahanpur	Kg / ha of total cropped area	2014	134.71	38.83	7.92	589.9	79465.4	22905.8	4672.0

All NPK fertilizer data is collected from the ICRISAT (2015 for UK, and 2014 for UP). And all Disticts Gross Cultivated Area data is collected from the ICRISAT (2015 FOR UK and, 2014 for UP), other than Bageswar, Champavat, and Udham Singh Nagar districts in UK and Amroha, Kannauj and Sambhal districts from UP. From the above-mentioned districts, the Gross Cultivated Area data is collected from district contengency plan, Department of Agriculture and Farmers Welfare (2008-09)

Table A2.3: Insecticide Aerosols (K.G) uses in Ramganga River Basin

Insecticide Aerosols (K.G)								
Sr. No	States	Districts	2019-20	2020-21	2021-22	3 years Average	GCA'000 H.A	Uses of Aerosol Insecticide/'000 HA
1	Uttar Pradesh	Bareilly	130600	91725	130500	117608	478.5	245.80
2		Budaun	164582	137090	132720	144797	651.9	222.13
3		Shahjahanpur	136425	115892	119073	123797	582.9	212.38
4		Pilibhit	141000	203000	164000	169333	368.3	459.75
5		Moradabad	115766	99100	79500	98122	679.1	144.49
6		Amroha	67350	97560	61800	75570	260.6	289.98
7		Rampur	47205	87120	179095	104473	327.6	318.88
8		Bijnor	174234	203031	214853	197373	418.0	472.15
9		Sambhal	7740	29661	35970	24457	298.5	81.94
10		Farrukhabad district	61360	58500	51700	57187	418.7	136.57
11		Kannauj district	63413	49941	53249	55534	186.0	298.57
12		Hardoi	153970	138970	131420	141453	639.3	221.27
13		Kheri	157255	126300	137200	140252	688.6	203.68
Average in Ramganga Basin in UP:								254.43
14	Uttarakhand	Nainital	6655	24164	10323	13714	348.0	39.41
15		US Nagar	37109	48869	20555	35511	316.0	112.38
16		Almora	1048	12804	13574	9142	137.4	66.55
17		Bageshwar	6652	5475	3156	5094	42.4	120.15
18		Champawat	2332	3470	1070	2291	39.3	58.29
19		Pauri	13531	7163	5670	8788	62.0	141.65
20		Chamoli district	7380	5860	18750	10663	75.7	140.88
Average in Ramganga Basin in UK								97.04

All NPK fertilizer data is collected from the ICRISAT (2015 for UK, and 2014 for UP). And all Disticts Gross Cultivated Area data is collected from the ICRISAT (2015 FOR UK and, 2014 for UP), other than Bageswar, Champavat, and Udham Singh Nagar districts in UK and Amroha, Kannauj and Sambhal districts from UP. From the above-mentioned districts, the Gross Cultivated Area data is collected from district contengency plan, Department of Agriculture and Farmers Welfare (2008-09)

Table A2.4: Uses of Fungicide (K.G) in Ramganga River Basin

Fungicide (K.G)								
Sr. No	States	Districts	2019-20	2020-21	2021-22	3 years Average	GCA'000 H.A	Uses of Fungicide/'000 HA
1	Uttar Pradesh	Bareilly	85080	19360	27972	44137	478.5	92.24
2		Budaun	34658	32680	33140	33493	651.9	51.38
3		Shahjahanpur	20146	26434	25731	24104	582.9	41.35
4		Pilibhit	80171	78000	54840	71004	368.3	192.78
5		Moradabad	30883	66918	60257	52686	679.1	77.58
6		Amroha	11906	30937	11638	18160	260.6	69.69
7		Rampur	7575	42736	37920	29410	327.6	89.77
8		Bijnor	8505	14186	45734	22808	418.0	54.56
9		Sambhal	10585	24328	11770	15561	298.5	52.13
10		Farrukhabad district	10777	15213	13589	13193	418.7	31.51
11		Kannauj district	28788	28448	33621	30286	186.0	162.83
12		Hardoi	36245	27750	37950	33982	639.3	53.16
13		Kheri	26130	23300	35800	28410	688.6	41.26
Average in Ramganga Basin in UP:								77.71
14	Uttarakhand	Nainital	5894	22066	9528	12496	348.0	35.91
15		US Nagar	17208	29816	42878	29967	316.0	94.83
16		Almora	6662	19332	22883	16292	137.4	118.60
17		Bageshwar	8327	7118	3137	6194	42.4	146.08
18		Champawat	13908	14492	450	9617	39.3	244.70
19		Pauri	5321	54688	3056	21022	62.0	338.84
20		Chamoli district	4754	19428	27577	17253	75.7	227.94
Average in Ramganga Basin in UK:								172.42
Data Source: Insecticide uses data: Agricultural Department UP & UK, Gross Cultivated Area: ICRISAT, 2017 & Agriculture Contingency Plan for District 2008-09 (Where ICRISAT Data was unavailable, namely, Amroha, Kannauj, US Nagar, Bageshwar, Champavat data was collected from District Contingency Plan 2008-09 & for Sambhal the Data is Collected from UP agricultural department. ***UP Data contains Chemical Insecticides only, While UK Data Contains Both Chemical and Biological Insecticides.								

Table A2 5: Uses of Insecticide Liquide (Litre) in Ramganga River Basin

Insecticide Liquid (Litre)								
Sr. No	States	Districts	2019-20	2020-21	2021-22	3 years Average	GCA'000 H.A	Uses of Insecticide Liquid/'000 HA
1	Uttar Pradesh	Bareilly	17850	15813	22650	18771	478.5	39.23
2		Budaun	23386	26760	26460	25535	651.9	39.17
3		Shahjahanpur	15899	20829	23423	20050	582.9	34.40
4		Pilibhit	69043	84367	61010	71473	368.3	194.05
5		Moradabad	24644	45330	26800	32258	679.1	47.50
6		Amroha	10678	16600	10216	12498	260.6	47.96
7		Rampur	11752	11673	33534	18986	327.6	57.95
8		Bijnor	16121	25291	30378	23930	418.0	57.24
9		Sambhal	9546	10246	38540	19444	298.5	65.14
10		Farrukhabad district	8489	11610	10840	10313	418.7	24.63
11		Kannauj district	51753	27914	11953	30540	186.0	164.19
12		Hardoi	25492	42010	42480	36661	639.3	57.35
13		Kheri	55545	48200	39185	47643	688.6	69.19
Average in Ramganga Basin in UP:								69.08
14	Uttarakhand	Nainital	5948	17830	9309	11029	348.0	31.69
15		US Nagar	13030	27534	17144	19236	316.0	60.87
16		Almora	6696	13528	7305	9176	137.4	66.80
17		Bageshwar	9385	6243	3050	6226	42.4	146.84
18		Champawat	9560	8970	630	6387	39.3	162.51
19		Pauri	13557	10616	13043	12405	62.0	199.96
20		Chamoli district	5913	11005	21998	12972	75.7	171.38
Average in Ramganga Basin in UK:								**120.01**

Data Source: Insecticide uses data: Agricultural Department UP & UK, Gross Cultivated Area: ICRISAT, 2017 & Agriculture Contingency Plan for District 2008-09 (Where ICRISAT Data was unavailable, namely, Amroha, Kannauj, US Nagar, Bageshwar, Champavat data was collected from District Contingency Plan 2008-09 & for Sambhal the Data is Collected from UP agricultural department. ***UP Data contains Chemical Insecticides only, While UK Data Contains Both Chemical and Biological Insecticides.

Table A2 6: Uses of Weed Control in (K.G) in Ramganga River Basin

Weed Control (K.G)								
Sr. No	States	Districts	2019-20	2020-21	2021-22	3 years Average	GCA'000 H.A	Uses of Weed Killer'000 HA
1	Uttar Pradesh	Bareilly	52628	56908	82288	63941	478.5	133.63
2		Budaun	125464	106228	102995	111562	651.9	171.14
3		Shahjahanpur	49272	71284	76950	65835	582.9	112.94
4		Pilibhit	165463	167118	155800	162794	368.3	441.99
5		Moradabad	32479	95417	50610	59502	679.1	87.62
6		Amroha	20371	38168	31659	30066	260.6	115.37
7		Rampur	17977	13639	32493	21370	327.6	65.22
8		Bijnor	21202	31044	61820	38022	418.0	90.96
9		Sambhal	5761	10503	18450	11571	298.5	38.77
10		Farrukhabad district	27345	35773	35403	32840	418.7	78.43
11		Kannauj district	32605	23919	25620	27381	186.0	147.21
12		Hardoi	60513	90400	100920	83944	639.3	131.31
13		Kheri	145917	106500	103010	118476	688.6	172.05
Average in Ramganga Basin in UP:								137.43
14	Uttarakhand	Nainital	12669	14521	4260	10483	348.0	30.12
15		US Nagar	56398	94125	27777	59433	316.0	188.08
16		Almora	1780	2704	1493	1992	137.4	14.50
17		Bageshwar	2192	1638	1270	1700	42.4	40.09
18		Champawat	3603	2881	1500	2661	39.3	67.72
19		Pauri	4050	4165	1254	3156	62.0	50.88
20		Chamoli district	390	160	150	233	75.7	3.08
Average in Ramganga Basin in UK:								56.35

Data Source: Insecticide uses data: Agricultural Department UP & UK, Gross Cultivated Area: ICRISAT, 2017 & Agriculture Contingency Plan for District 2008-09 (Where ICRISAT Data was unavailable, namely, Amroha, Kannauj, US Nagar, Bageshwar, Champavat data was collected from District Contingency Plan 2008-09 & for Sambhal the Data is Collected from UP agricultural department. ***UP Data contains Chemical Insecticides only, While UK Data Contains Both Chemical and Biological Insecticides.

Table A2 7: Uses of Mouse Killer in Ramganga River Basin

Mouse Control (K.G)								
Sr. No	States	Districts	2019-20	2020-21	2021-22	3 years Average	GCA'000 H.A	Uses of Mouse Killer/'000 HA
1	Uttar Pradesh	Bareilly	3740	3376	3650	3589	478.5	7.50
2		Budaun	3824	3659	3698	3727	651.9	5.72
3		Shahjahanpur	2633	3402	3352	3129	582.9	5.37
4		Pilibhit	5351	5800	3300	4817	368.3	13.08
5		Moradabad	800	1600	3500	1967	679.1	2.90
6		Amroha	1175	1070	1300	1182	260.6	4.53
7		Rampur	443	415	720	526	327.6	1.61
8		Bijnor	570	1012	1349	977	418.0	2.34
9		Sambhal	476	792	1188	819	298.5	2.74
10		Farrukhabad district	849	845	880	858	418.7	2.05
11		Kannauj district	1001	309	275	528	186.0	2.84
12		Hardoi	4318	3590	6680	4863	639.3	7.61
13		Kheri	3955	3725	4270	3983	688.6	5.78
Average in Ramganga Basin in UP:								4.93
14	Uttarakhand	Nainital	284	278	161	241	348.0	0.69
15		US Nagar	150	290	348	263	316.0	0.83
16		Almora	289	323	428	347	137.4	2.52
17		Bageshwar	216	95	107	139	42.4	3.29
18		Champawat	0	4	47	17	39.3	0.43
19		Pauri	1311	609	643	854	62.0	13.77
20		Chamoli district	125	315	89	176	75.7	2.33
Average in Ramganga Basin in UK:								3.41

Data Source: Insecticide uses data: Agricultural Department UP & UK, Gross Cultivated Area: ICRISAT, 2017 & Agriculture Contingency Plan for District 2008-09 (Where ICRISAT Data was unavailable, namely, Amroha, Kannauj, US Nagar, Bageshwar, Champavat data was collected from District Contingency Plan 2008-09 & for Sambhal the Data is Collected from UP agricultural department. ***UP Data contains Chemical Insecticides only, While UK Data Contains Both Chemical and Biological Insecticides.

Table A2 8: Uses of Bio pesticide (K.G) in Ramganga River Basin

Bio pesticide (K.G)								
Sr. No	States	Districts	2019-20	2020-21	2021-22	3 years Average	GCA'000 H.A	Uses of Biopesticide/'000 HA
1	Uttar Pradesh	Bareilly	115761	79567	115225	103518	478.5	216.35
2		Budaun	107951	106131	107154	107079	651.9	164.27
3		Shahjahanpur	111705	94120	105292	103706	582.9	177.91
4		Pilibhit	59768	67085	95896	74250	368.3	201.59
5		Moradabad	26271	20867	47694	31611	679.1	46.55
6		Amroha	27259	35144	39417	33940	260.6	130.24
7		Rampur	23238	24316	52697	33417	327.6	102.00
8		Bijnor	70159	43489	64977	59542	418.0	142.43
9		Sambhal	15784	62100	47591	41825	298.5	140.12
10		Farrukhabad district	43916	42673	50039	45543	418.7	108.77
11		Kannauj district	35566	30882	39612	35353	186.0	190.07
12		Hardoi	106095	99467	171305	125622	639.3	196.50
13		Kheri	128271	143094	150910	140758	688.6	204.41
Average in Ramganga Basin in UP:								155.48

Data Source: Insecticide uses data: Agricultural Department UP & UK, Gross Cultivated Area: ICRISAT, 2017 & Agriculture Contingency Plan for District 2008-09 (Where ICRISAT Data was unavailable, namely, Amroha, Kannauj, US Nagar, Bageshwar, Champavat data was collected from District Contingency

Plan 2008-09 & for Sambhal the Data is Collected from UP agricultural department. ***UP Data contains Chemical Insecticides only, While UK Data Contains Both Chemical and Biological Insecticides.

Table A2.9: Land Use Class Levels With Grid Codes And Priority Risk Class

Land use grid codes	Land use class levels	Risk class
1	Built-Up	1
2	Kharif Crop	2
3	Rabi Crop	2
4	Zaid Crop	2
5	Double / Triple Crop	1
6	Fallow Land	2
7	Agriculture Plantation	1
8	Evergreen Forest	3
9	Deciduous Forest	3
10	Degraded / Scrub Forest	3
11	Littoral Swamp	3
12	Grassland	3
14	Wasteland	3
16	Waterbodies Min.	3
17	Waterbodies Max.	3

Table A2.10: Historic Pesticide Usage Indicators For India

Year	Pesticide consumption (kg/ha)	Year	Pesticide consumption (kg/ha)
1990	0.44	2006	0.22
1991	0.42	2007	0.16
1992	0.42	2008	0.09
1993	0.39	2009	0.17
1994	0.36	2010	0.24
1995	0.36	2011	0.33
1996	0.33	2012	0.31
1997	0.31	2013	0.27
1998	0.29	2014	0.33
1999	0.27	2015	0.33
2000	0.26	2016	0.35
2001	0.26	2017	0.38
2002	0.25	2018	0.35
2003	0.24	2019	0.37
2004	0.21	2020	0.37
2005	0.21		
Average (1990-2020)			0.30

Table A2.11: MMPW and plastic loads for the top-ten ranked catchments sorted by MMPW

River	Receiving Sea	Continent	Catchment Area [km²]	MMPW Generation per capita [kg d⁻¹]	Population	Population density [per km²]	MMPW generated in the catchment [tons y⁻¹]	Microp. load Model 1 [tons y⁻¹]	Microp. load Model 2 [tons y⁻¹]	Macrop. load [tons y⁻¹]
Chang Jiang (Yangtze River)	East China Sea (Yellow Sea)	Asia	1907295	0.092	503258473	264	16883704	85440	1469481	69282
Indus	Arabian Sea	Asia	854106	0.069	191277131	224	4809288	12378	164332	11977
Huang He (Yellow River)	Yellow Sea	Asia	761437	0.092	122167489	160	4098569	9678	124249	9561
Hai He	Yellow Sea	Asia	211489	0.092	102782394	486	3448223	7434	91858	7515
Nile	Mediterranean	Africa	2851708	0.049	182955620	64	3293385	6919	84792	7043
Meghna, Bramaputra, Ganges	Bay of Bengal	Asia	1571571	0.013	620596218	395	3017170	6039	72845	6230
Zhujiang (Pearl River)	South China Sea	Asia	388705	0.092	74999426	193	2515374	4577	52958	4823
Amur	Sea of Okhotsk	Asia	2004785	0.089	64344272	32	2086763	3429	38267	3708
Niger	Gulf of Guinea	Africa	2090967	0.059	92689954	44	1989695	3185	35196	3469
Mekong	South China Sea	Asia	771941	0.086	61740094	80	1931483	3044	33431	3330

Table A2.12: Land use percentage for different SWMUs

SWMUs	Agricultural Land	Built-up	All others
	Percentage (%)		
1	81.1	5.5	13.4
2	45.1	2.9	52.0
3	18.9	0.6	80.4
4	28.3	0.9	70.7
5	29.2	0.4	70.3
6	82.3	4.2	13.5
7	88.2	5.4	6.4
8	91.3	6.1	2.6
9	68.4	4.2	27.4
10	65.7	4.7	29.6
11	87.0	8.2	4.7
12	72.4	4.0	23.7
13	93.0	6.4	0.6
14	82.8	5.3	11.9
15	45.7	3.5	50.8
16	69.6	5.3	25.1
17	65.4	7.6	26.9
18	77.7	4.8	17.5

ANNEXURE A3: KWMI 3- ADDITIONAL INFORMATION ON METHODOLOGY, RESULTS AND DATA

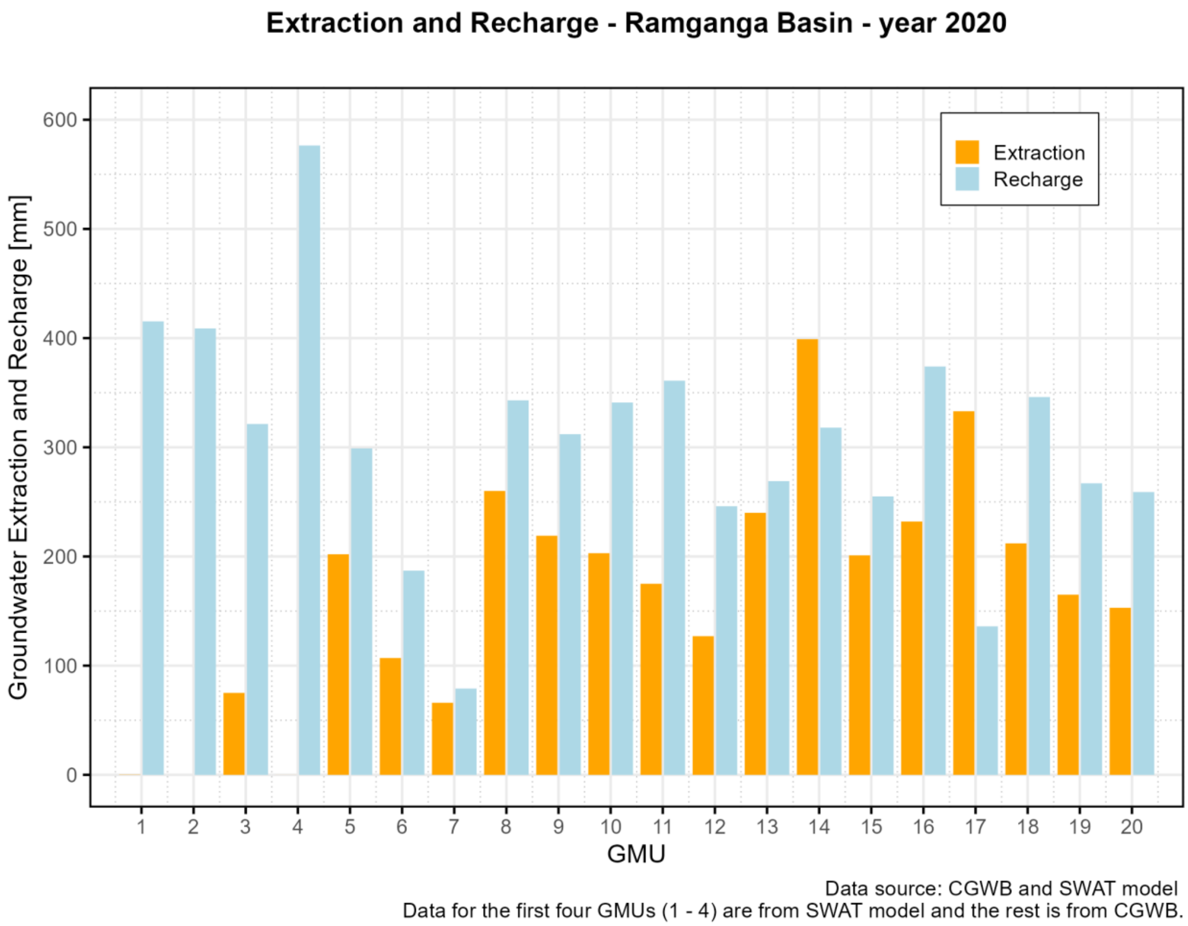
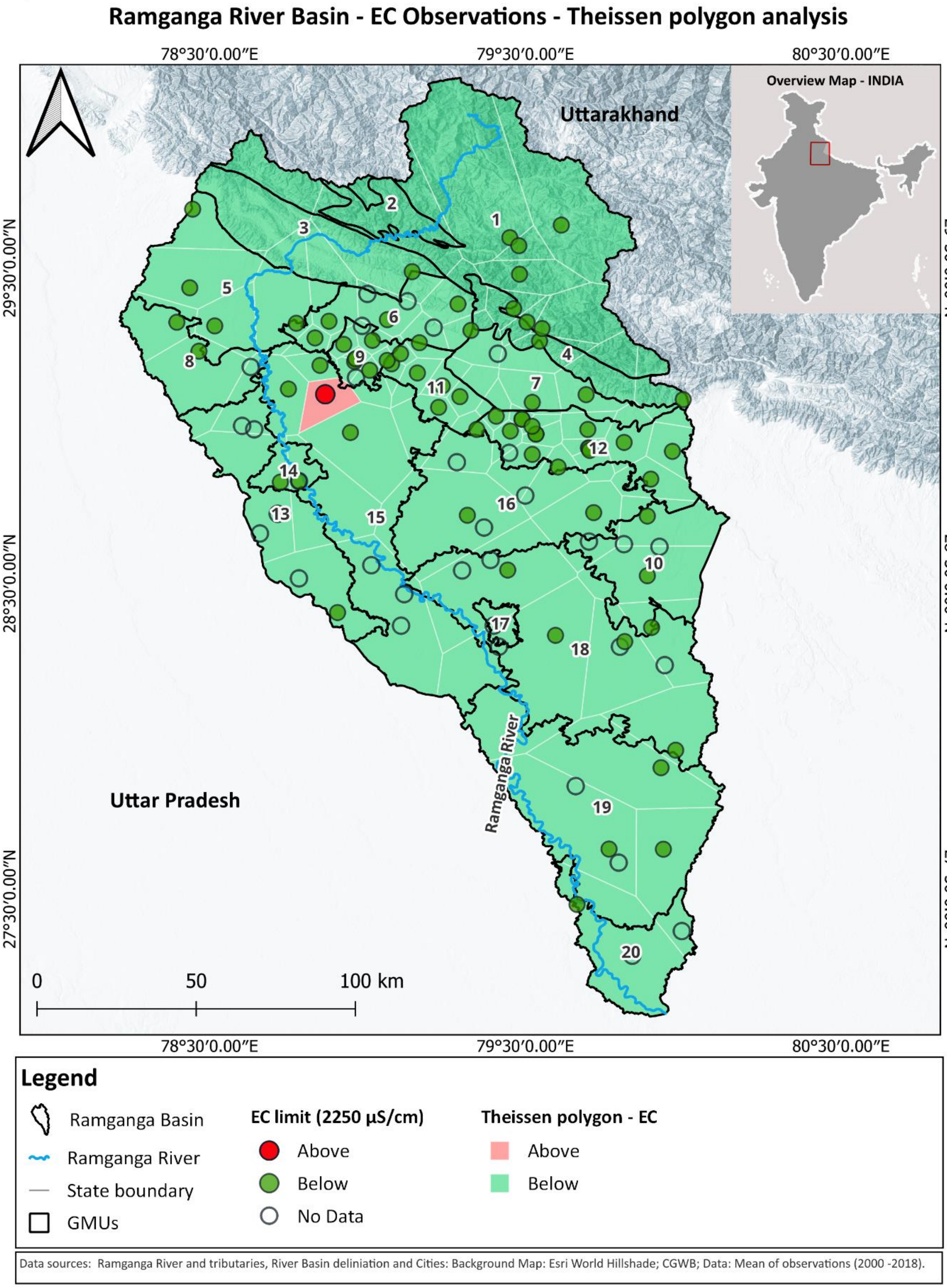
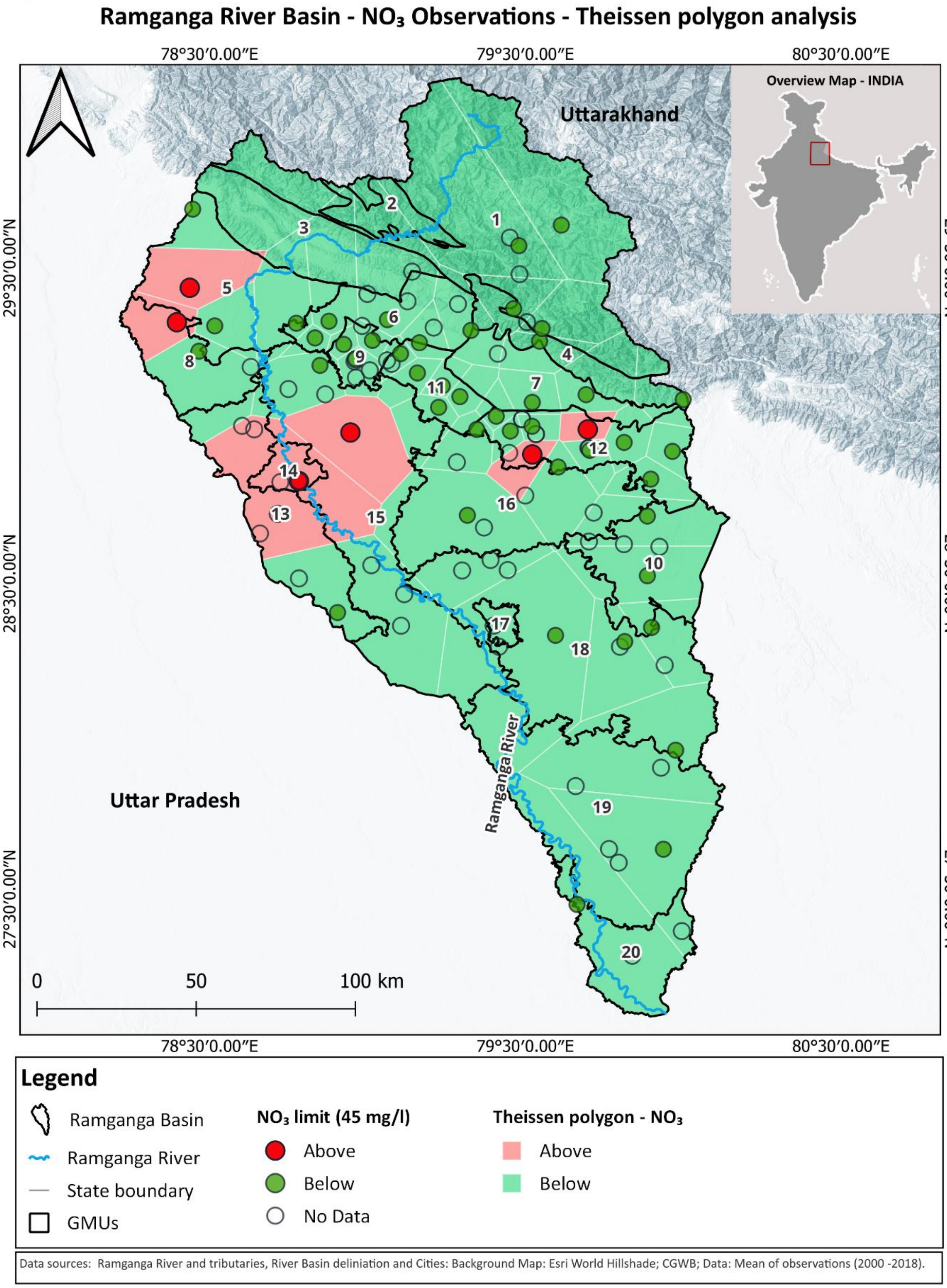


Figure A3 1. Annual Ground Water Extraction and Recharge by GMU



Map A3.1Thiessen polygon analysis for the electrical conductivity observations



Map A3.2: Thiessen Polygon Analysis For The Nitrate Observations

Table A3. 1: Percentage of Clubbed Land Use And Risk Assessment Classification

GMU	Percentage (%) of clubbed land use			Land use risk assessment		
	Class 1	Class 2	Class 3	Class 1	Class 2	Interim Risk
1	12.4	10.8	76.8	Low risk	No risk	Low risk
2	12.3	16.5	71.1	Low risk	No risk	Low risk
3	1.6	0.8	97.6	No risk	No risk	No risk
4	2.5	1.4	96.0	No risk	No risk	No risk
5	43.8	36.6	19.6	Moderate risk	Low risk	Moderate risk
6	33.2	5.6	61.2	Moderate risk	No risk	Moderate risk
7	32.8	4.9	62.3	Moderate risk	No risk	Moderate risk
8	68.3	30.3	1.3	High risk	Low risk	High risk
9	72.8	13.3	13.9	High risk	No risk	High risk
10	48.2	21.2	30.5	Moderate risk	No risk	Moderate risk
11	79.7	10.7	9.5	High risk	No risk	High risk
12	54.1	10.3	35.6	High risk	No risk	High risk
13	83.8	15.6	0.5	High risk	No risk	High risk
14	77.7	19.6	2.6	High risk	No risk	High risk
15	83.7	11.9	4.3	High risk	No risk	High risk
16	77.9	18.2	3.8	High risk	No risk	High risk
17	76.1	13.4	10.5	High risk	No risk	High risk
18	70.5	24.0	5.5	High risk	No risk	High risk
19	76.5	16.4	7.0	High risk	No risk	High risk
20	68.7	17.0	14.2	High risk	No risk	High risk

ANNEXURE A4: KWMI 4- ADDITIONAL INFORMATION ON METHODOLOGY, RESULTS AND DATA

Table A4. 1: Parameters Influencing Hazards resulting from Hydrological Alterations, analytical procedure for their estimation, data requirements and the sources from which the data can be obtained

No.	Hazards (a)	Data required	Source from which it can be obtained	Analytical procedure to estimate the values
1	**Extent of flow alteration**: ratio of the total annual water diversion/annual flow.	Flow data of the basin + virgin flow data for different stretches of the basin	Outputs from hydrological simulation study by INRM consultants	The extent of flow alteration is estimated by taking the ratio of the 'difference between the current annual flows and the mean annual virgin flows' and the mean annual virgin flows
2	**Aridity**: increases irrigation water demand, and agricultural drought occurrences.	Climate data of the basin	River basin report, CWC, Water year book	Defined as the ratio of the potential evaporation and rainfall
3	**Rainfall variability**: increases the incidence of drought.	Historical data of annual rainfall in different parts of the basin	River basin report, CWC, Water year book	It is estimated by taking the coefficient of variation in annual rainfall for a time series
4	**Annual renewable water resources (ARWR)**: the ARWR has a direct impact on the water scarcity for irrigation, domestic uses and environmental water scarcity in the basin. Higher the ARWR, lower will be the scarcity of water for irrigation and domestic uses and environmental water scarcity.	Renewable water resources in different years	CWC + CGWB + SWAT model outputs from INRM Consultants	ARWR is estimated by taking the sum of the mean annual runoff and the mean annual groundwater recharge
5	**Magnitude and Frequency of Floods: t**he magnitude and frequency of occurrence of floods have a direct implications for ecology and economy	Frequency of occurrence of a flood of certain magnitude that has the capacity to cause ecological damages	Flood frequency analysis by the researchers	From the time series data on flood discharge in different years, and the available records of the ecological damages caused by floods, we will fix a 'threshold discharge' beyond which the flows is expected to cause ecological and economic damages. From the flood frequency analysis (using rainfall and catchment parameters), we will derive the frequency of occurrence of floods of the designated magnitude/

Table A4. 2: Parameters Influencing the Exposure To The Hazard, Analytical Procedure For Their Estimation, Data Requirements And The Sources From Which They Can Be Obtained

No.	Exposure (b)	Data required	Source from which it can be obtained	Analytical procedure to estimate the values
1	**Impact on ecology**: change in ecological functions and associated economic activities that the river flow supports.	River ecology[1]	Report of ecological studies of Ramganga river basin	It is indicated by the changes in the population of fish and other aquatic animals, and the size of the outputs from the economic activities that are dependent on the river (fishing, navigation and boating)
2	**Irrigation water scarcity**: gap between irrigation water requirement and water availability for irrigation (irrigation potential)	Irrigation potential of sources in the basin and potential evapotranspiration (PET) v/s rainfall data	Own analysis based on data from various sources, viz., the SWRDs, CGWB, India-WRIS	Irrigation potential is estimated by taking the ratio of the total volume of water available from various sources for irrigation and the volume of water required to irrigate one ha of land; the total land area requiring irrigation is worked out by considering the total arable land where the potential evapotranspiration (PET) exceeds the effective rainfall and also considering the likely future expansion in irrigated area
3	**Drought Proofing Capacity of reservoirs**: provision of buffer storage of surface water in reservoirs per capita.	Renewable water resources in different years Reservoir storage details	River basin report, CWC, Water year book	Buffer storage of water is estimated by the total live storage of water in the surface reservoirs divided by the population
4	**Drought Proofing Capacity of groundwater**: Stock of good quality groundwater per capita—reduces the exposure of agricultural systems and drinking water supply systems to shocks from droughts.	Groundwater data from CGWB	India-WRIS, NCIWRDP report (1999)	This is estimated by taking the ratio of the total static groundwater available within the unit (considered for analysis) by the population of the area
5	**Proportion of people who are living in low-lying (flood-prone)**	Proportion of low-lying area in the sub-basins; average population density of the sub-basins	Report of the State Disaster Management Authority	This is estimated by taking the ratio of the total area that is 'designated as 'low-lying' by the SDMA and the total geographical area of the sub-catchment
6	**Susceptibility of groundwater to pollution caused by floods:** higher the proportion of the area where groundwater is shallow, higher the exposure of the drinking water sources based on groundwater to biological contamination	Proportion of the area in the sub-basin where the groundwater table is available at a very low depth, say, less than 10 m.	Ground Water Atlas for districts falling in the sub-catchments, available from the Central Ground Water Board	This can be estimated by dividing the total area of the sub-catchment under shallow groundwater condition by the total geographical area of the sub-catchment

[1] The data relating to river ecology will include the number of aquatic and riparian species (flora and fauna) that the river provides habitat for (source: based on Sponseller *et al.*, 2013: Thompson & Lake, 2010; Ward & Stanford, 1983; Webster, 2007); and the biological processes (nutrient recycling; breeding of aquatic animals) that the continuous flow of water supports (Barbarossa et al., 2020).

Table A4.3: Parameters Influencing the Vulnerability to Disruptions caused by Hydrological Alterations, analytical procedure for their estimation, data requirements and the sources from which they can be obtained

No.	Vulnerability (c)	Data required	Source from which it can be obtained	Analytical procedure to estimate the values
1	Proportion of people who are directly dependent on the river water (for the ecological functions and the economic activities that they support) for livelihoods	Socio-economic profile data + reports of ecological studies available for the basin & expert opinion	CWC basin report, published research papers and expert opinion	This can be estimated by the total number of people who are dependent on fishing from the river, navigation and recreational services for their livelihood divided by the total population
2	Proportion of people whose source of livelihoods is dependent on surface and groundwater, directly (agricultural communities, cattle rearing communities and fisher-folk)	Socio-economic profile of people in the basin + overall response of the crops to temperature stress	River basin report, CWC, Water year book for the basin	This is estimated by taking the ratio of the sum of the population of farmers (including, farm labourers), dairy farmers and fishing communities, and the total population in the geographical unit
3	Proportion of farm outputs dependent on surface water	Agricultural statistics	Census data	This is estimated by taking the ratio of the approx. value of agricultural outputs from surface water irrigated area and the total agricultural outputs in value terms (including that from rain-fed areas)
4	Proportion of population who depend on surface water as primary source of water for domestic use, but have alternate sources of potable water	Data on drinking water supply sources in the rural areas	Census data	This can be deduced from the data on population having different types of primary and secondary water sources for the respective districts
5	Proportion of people living in low-lying area who are poor	Data on population affected by floods and poor people affected by floods	State Disaster Management Authority and Census data	This is estimated by taking the ratio of the approximate number of poor people living in low lying area and the total population living in low-lying areas
6	Vulnerability of drinking water users to pollution due to floods: higher the proportion of people living in the shallow groundwater areas dependent on wells for domestic water supply, higher the vulnerability to pollution caused by floods	Proportion of people in the shallow groundwater areas of the sub-catchments who are dependent on wells for domestic water supply	Depth to groundwater levels obtained from India-WRIs, and Census data on population of the respective districts	This can be estimated by taking the proportion of the geographical area under shallow groundwater (as a fraction), and multiplying by the proportion of HHs or population in the sub-catchment who are dependent on GW for drinking purpose (as a fraction).

Table A4. 4: Defining Quantitative Criteria for Assigning Values for Different Influencing Variables

S. No	Risk Assessment Variables	Quantitative criteria for Assessing the Variables		
		(a) Hazards		
	Variable	Highly prone to hazard	Moderately prone	Least prone to hazard
1	Extent of flow alteration	If flow alteration > 90% of mean runoff of monsoon season and > 50% of the non-monsoon (lean season) flows in a semi-arid area, or > 50% of mean runoff of monsoon and > 25% of the mean runoff of lean season in sub- humid area	Flow alteration between 90% and 50% of the runoff of the monsoon season and between 50% & 25% of the runoff of the lean season in semi-arid area, or between 50% and 25% of the mean monsoon runoff and between 25%-10% of the lean season flow in sub-humid area	Flow alteration <50% of the monsoon runoff and < 25% of the lean season runoff in a semi-arid area or < 25% of the monsoon runoff and < 10% of the lean season runoff in sub-humid area
2	Aridity	Arid to Hyper-arid	Semi-arid	Humid-sub- humid
3	Rainfall variability (coefficient of variation, %)	CV more than 40%	CV in the range of 17-40%	CV less than 17%
4	Annual renewable water resources (m^3/capita)	<1000m^3/capita/year	Between 1000 and 1700 m^3/capita/year	1700 m^3/capita/year
5	Magnitude and frequency of floods: frequency of occurrence of flood of a designated magnitude	Periodicity > once in 10 years	Periodicity between once in 10 years to once in 20 years	Periodicity between once in 20 years and once in 50 years
		(b) Exposure		
		High exposure	Moderate exposure	Low exposure
1	Impact on Ecology: Extent of impact of flow alterations on the ecological and economic activities that the river supports	Both ecological and economic functions are severely affected	Ecological and economic functions are moderately affected	Economic and ecological functions are not affected
2	Irrigation water scarcity: irrigation potential of the existing sources/ total land area requiring irrigation #	Irrigation potential of existing sources in ha/total arable land in ha < 0.5	Irrigation potential of existing sources/total arable land = 0.5 to 1.0	Irrigation potential of existing sources/total arable land> 1
3	Drought Proofing Capacity of Reservoirs: Provision of buffer storage of water in reservoirs (m3/capita/year)	Provision of buffer storage in a reservoir less than 10 m^3/capita/year	Provision of buffer storage in a reservoir is 11 to 36 m^3/capita/year	Provision of buffer storage in a reservoir is > 36 m^3/capita/year
4	Drought Proofing Capacity of Groundwater: Groundwater stock reduces the exposure of agricultural systems and drinking water supply systems to shocks from droughts (m^3/capita)	Groundwater stock per capita/annum < 200 m^3	Groundwater stock per capita/annum, 200-500 m^3	Groundwater stock per capita > 500 m^3
5	Proportion of people living in low-lying areas	Proportion > 50%	Proportion =50% to 25%	Proportion < 25%
6	Susceptibility of groundwater to pollution caused by floods: Proportion of the area in the sub-basin where the groundwater table is available within 10 m depth	Proportion > 50%	Proportion =50% to 25%	Proportion < 25%
		(c) Vulnerability		
		High vulnerability	Moderate vulnerability	Low vulnerability

S. No	Risk Assessment Variables	Quantitative criteria for Assessing the Variables		
1	Proportion of people dependent on the river (for the ecological functions and economic activities that they support) for livelihoods (%)	Proportion > 25%	Proportion, 25% to 10%	Proportion < 10%
2	Proportion of people whose source of livelihood is dependent on surface water and groundwater, directly (agricultural communities, cattle rearing communities and fisher folk (%)	Proportion >50%	Proportion = 50 % to 20%	Proportion < 20%
3	Proportion of farm outputs dependent on surface water	Proportion> 30%	Proportion – 30 to 10%	Proportion < 10%
4	Proportion of population who depend on surface water as primary source of water for domestic use, but have alternate sources of potable water	Less than 25% of those dependent on surfacewater have alternate source	50-25% of those dependent on surfacewater have alternate sources	More than 50% of those dependent on surfacewater have alternate sources
5	Proportion of people living in low-lying area who are poor	Proportion> 50%	Proportion = 50 to 20%	Proportion < 20%
6	Vulnerability of drinking water users to pollution due to floods: higher the proportion of people living in the shallow groundwater areas dependent on wells for domestic water supply, higher the vulnerability to pollution caused by floods	Proportion >50%	Proportion = 50 % to 20%	Proportion < 20%

Table A4 5: Variables for basin risk assessment, method of estimation and data sources

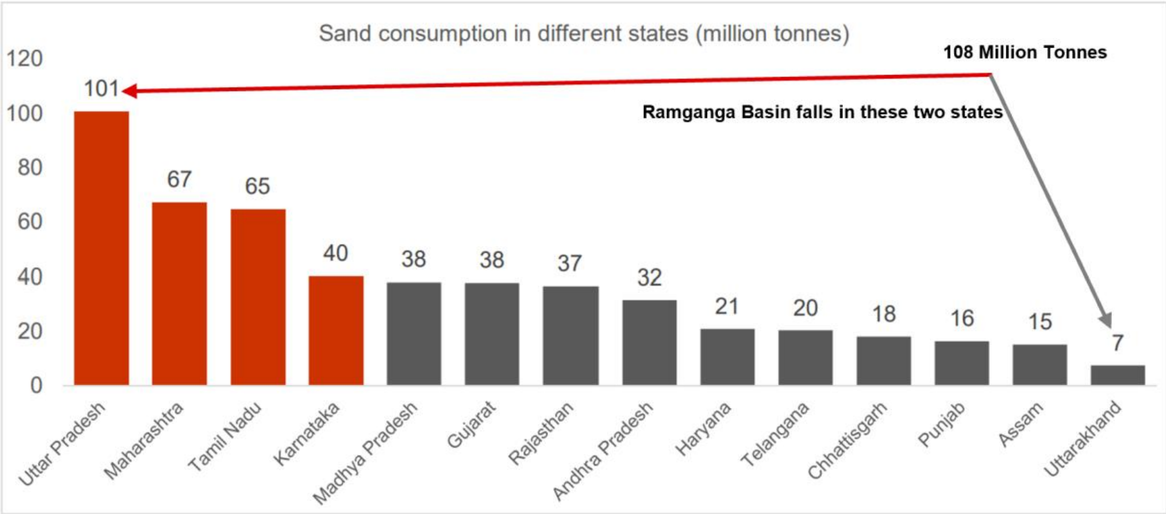
S. No	Variables	Method of estimation	Data sources	Remarks
		Hazard		
1	Extent of flow alteration	Comparison of the mean stream flows under the current condition with that under natural/pristine conditions for monsoon and non-monsoon seasons at the drainage outlets of different sub-catchments	Outputs from SWAT model of the stream flows for pristine and present conditions at the drainage outlets of different sub-catchments, set up by INRM Consultants	
2	Aridity	Secondary data source	Mapsofindia.com	

3	Rainfall variability (Coefficient of variation, %))	Secondary data source and analysis of data	India WRIS	
4	Annual renewable water resources (m3/capita)	Adding up the annual runoff and groundwater recharge and dividing it by the population	SWAT model outputs from INRM for runoff + CGWB data for annual groundwater recharge	
5	Magnitude and frequency of floods: frequency of occurrence of flood of a designated magnitude	Statistical analysis of max. annual discharge of the main stream of the catchment for several years to determine the return periods for designated flood discharge (Gumbel distribution)	India-WRIS	
		Exposure		
1	Impact on Ecology: Extent of impact of flow alterations on the ecological and economic activities that the river supports	Using expert judgement	Expert judgement	-
2	Irrigation water scarcity: irrigation potential of the existing sources/ total land area requiring irrigation #	Irrigation potential of the available water sources in each sub-catchment in terms of area that can be irrigated / area that require irrigation	India-WRIS and district wise agricultural Contingency plan	Irrigation efficiency is assumed to be 60%
3	Drought-proofing Capacity of Reservoirs (m^3/ capita/year)	Total surface reservoir storage in each sub-catchment divided by the population	CWC basin report, 2012-13	Basin wise data is used for the analysis
4	Drought-proofing Capacity of Groundwater (m^3/capita): Groundwater stock reduces the exposure of agricultural systems and drinking water supply	Total dynamic groundwater resources in each sub-catchment divided by the population	CGWB annual report on dynamic groundwater resources of India	

	systems to shocks from droughts		
5	Proportion of people living in low-lying areas	GIS mapping using DEM	CWC data +DEM of the basin
6	Susceptibility of groundwater to pollution caused by floods: Proportion of the area in the sub-basin where the groundwater table is available within 10 m depth	GIS mapping of depth to groundwater levels	India-WRIS
	Vulnerability		
1	Proportion of people dependent on river water (ecological services and goods) for livelihoods (%)	Analysis of secondary data source	Handbook on fisheries statistics, 2020
2	Proportion of people whose source of livelihood is dependent on surface water and groundwater, directly (agricultural communities, cattle rearing communities and fisher folk (%)	Analysis of secondary data	Census data, 2011
3	Proportion of farm outputs dependent on surface irrigation (%)	Analysis of secondary data	Socioeconomic survey reports of the two states
4	Proportion of population who depend on surface water as primary source of water for domestic use, but have alternate sources of potable water	Analysis of secondary data	Census data, 2011 + MIS on drinking water supply for the two states
5	Proportion of people living in low-lying area who are poor	Superimposing DEM and poverty data on a spatial platform	Census data + CWC data +DEM

6	Vulnerability of drinking water users to pollution due to floods: higher the proportion of people living in the shallow groundwater areas dependent on wells for domestic water supply, higher the vulnerability to pollution caused by floods	Superimposing of the GIS map of depth to groundwater levels and the Census data on access to different types of different water sources	Census data + India WRIS data

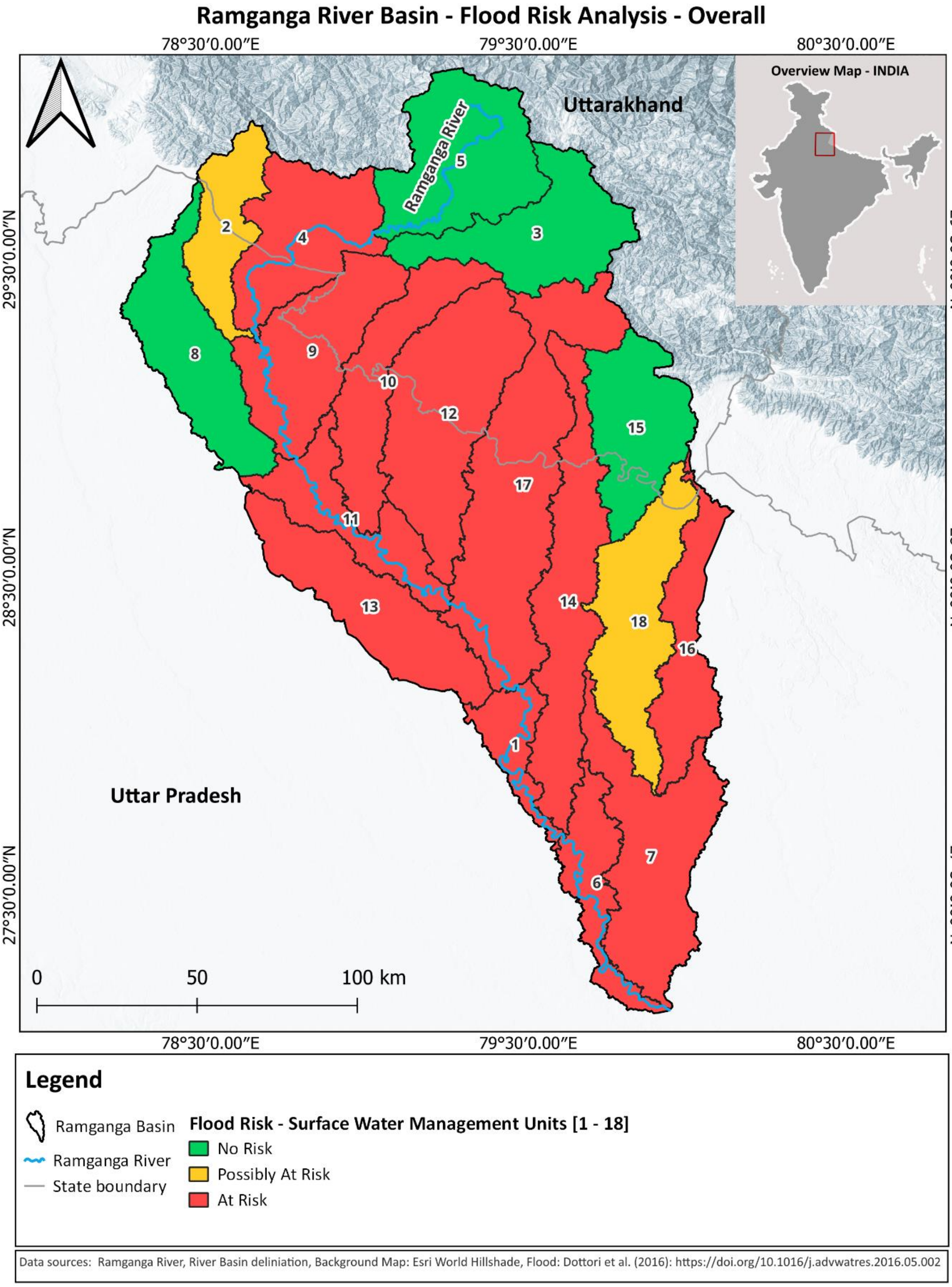
ANNEXURE A5: KWMI 5- ADDITIONAL INFORMATION ON METHODOLOGY, RESULTS AND DATA



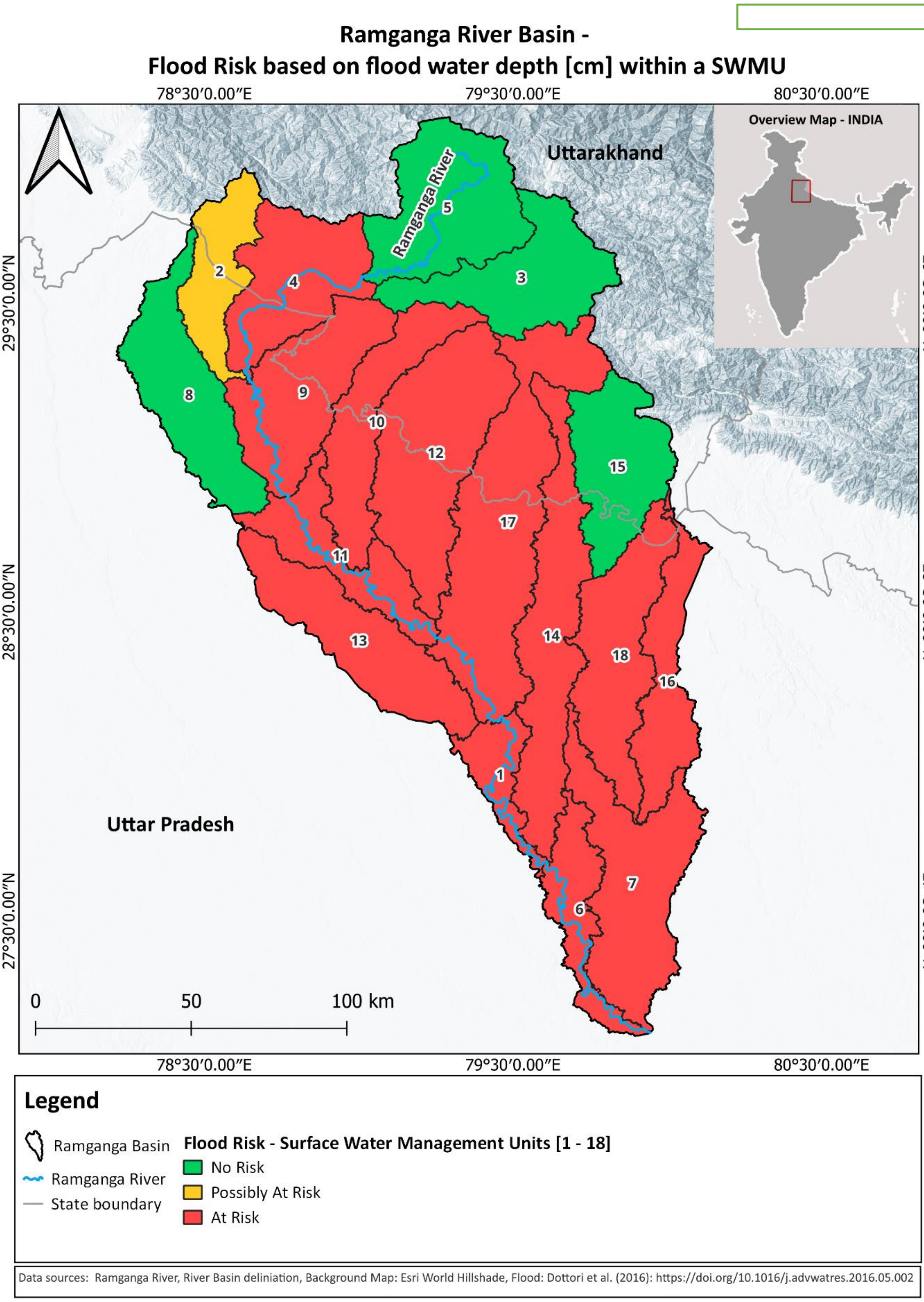
Source: RBI, Analysis

Sand consumptions in different states in year 2017 (Source: Sand Mining Framework, 2018)

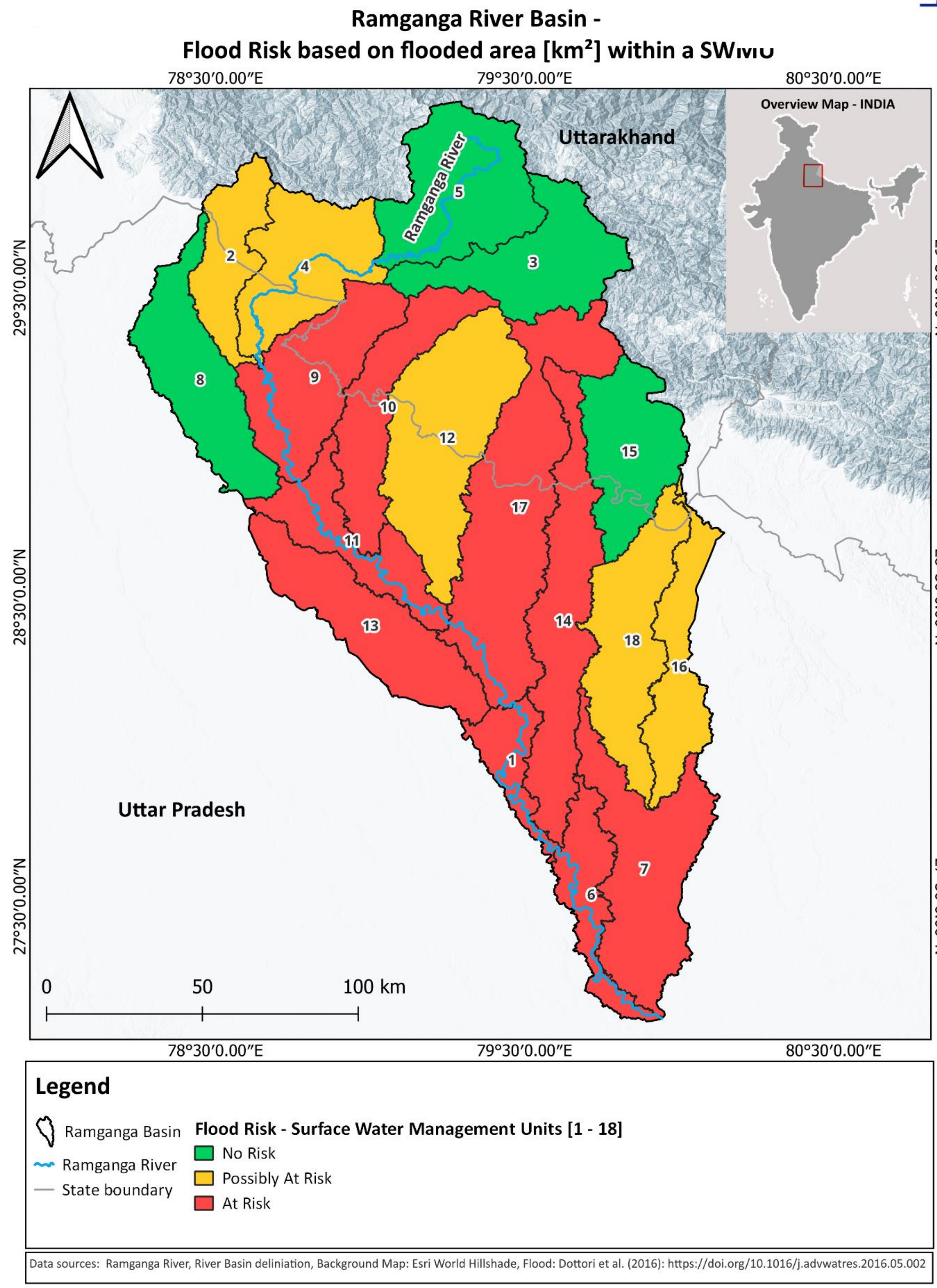
Figure A5. 1: Sand consumption in Indian states in 2017



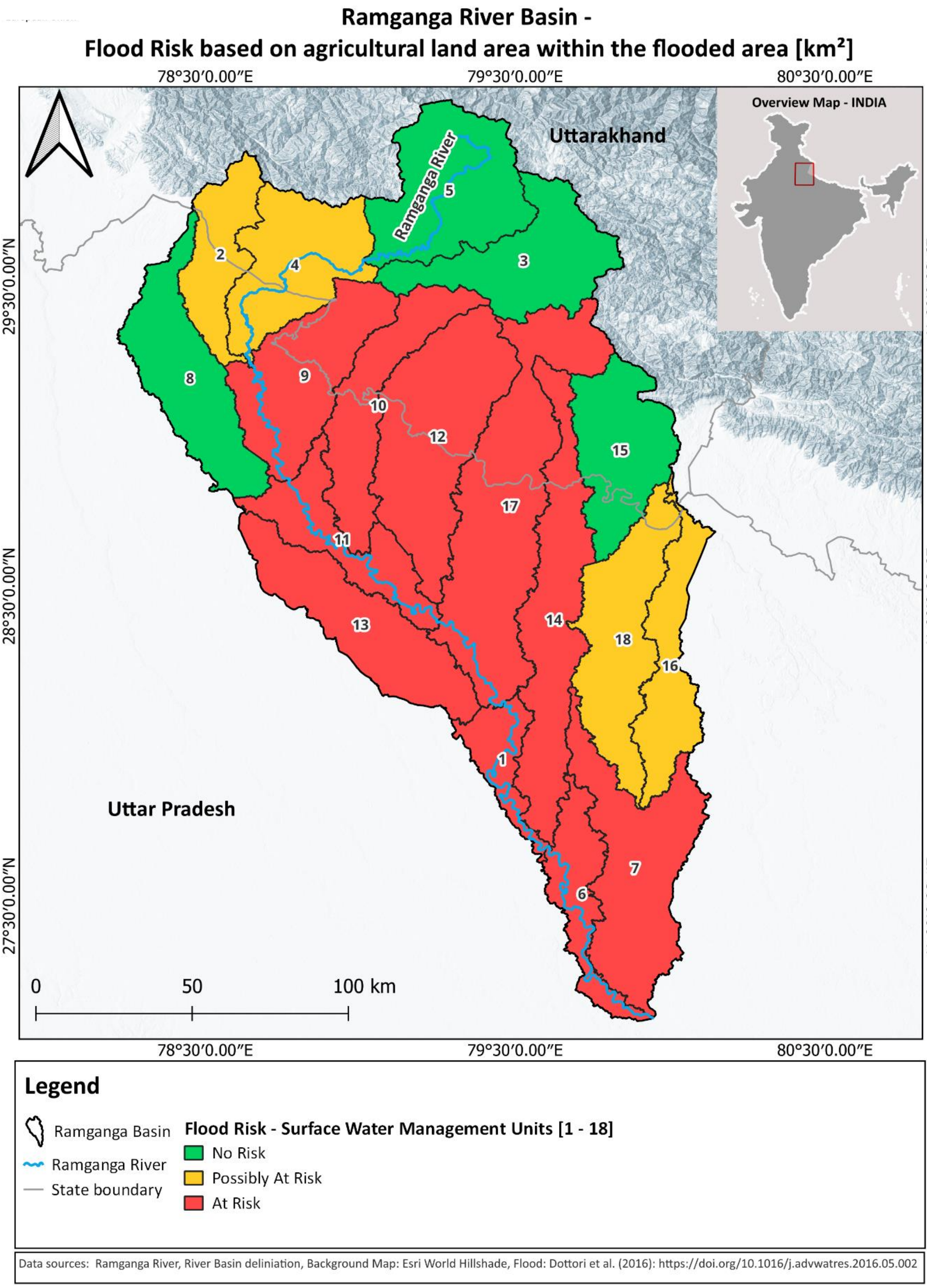
Map A5. 1: Final flood risk assessment based on all selected criteria



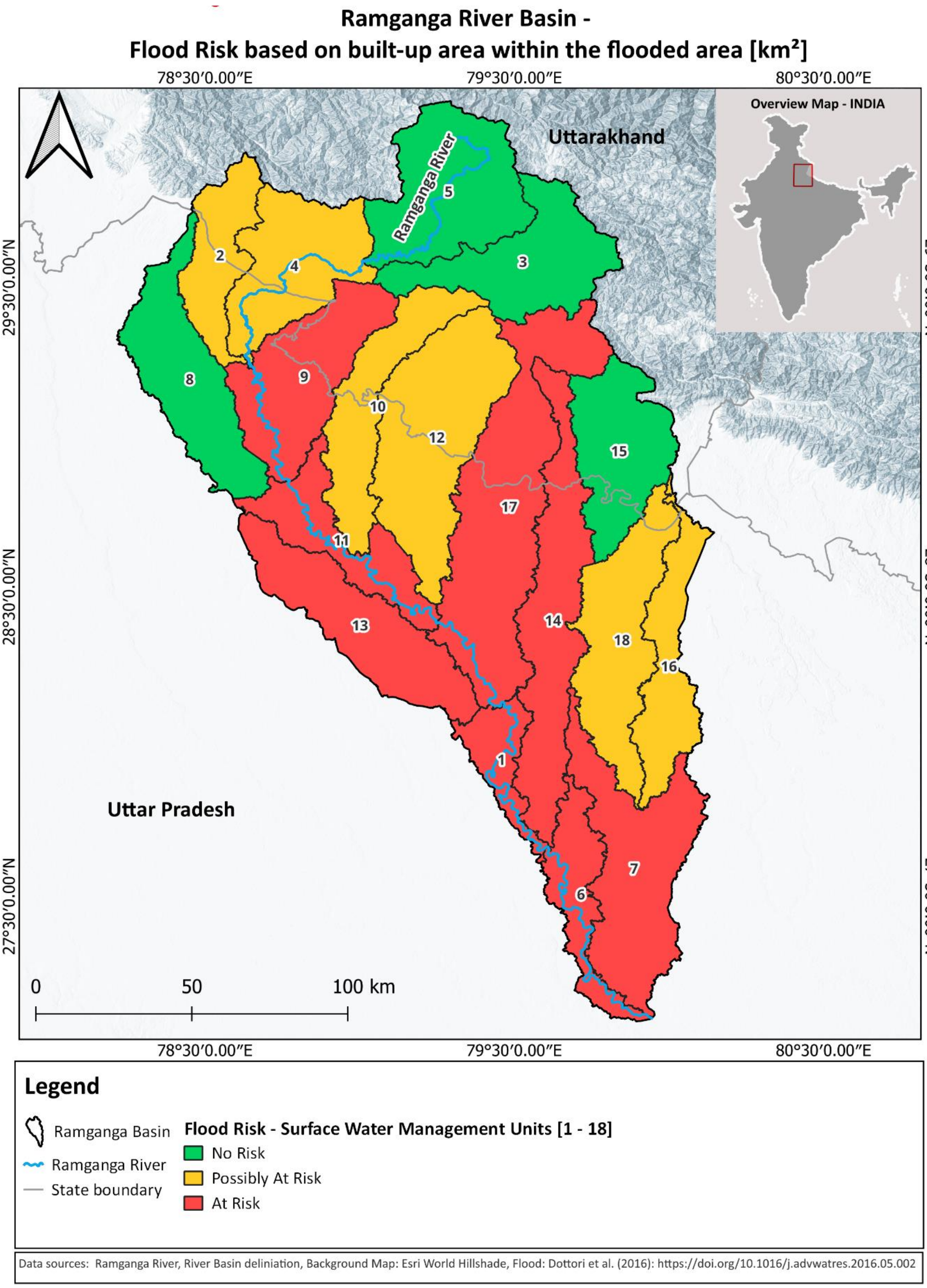
Map A5. 2: Flood risk assessment based on flood water depth within the SWMUs



Map A5. 3: Flood risk assessment based on the flooded area within the SWMUs

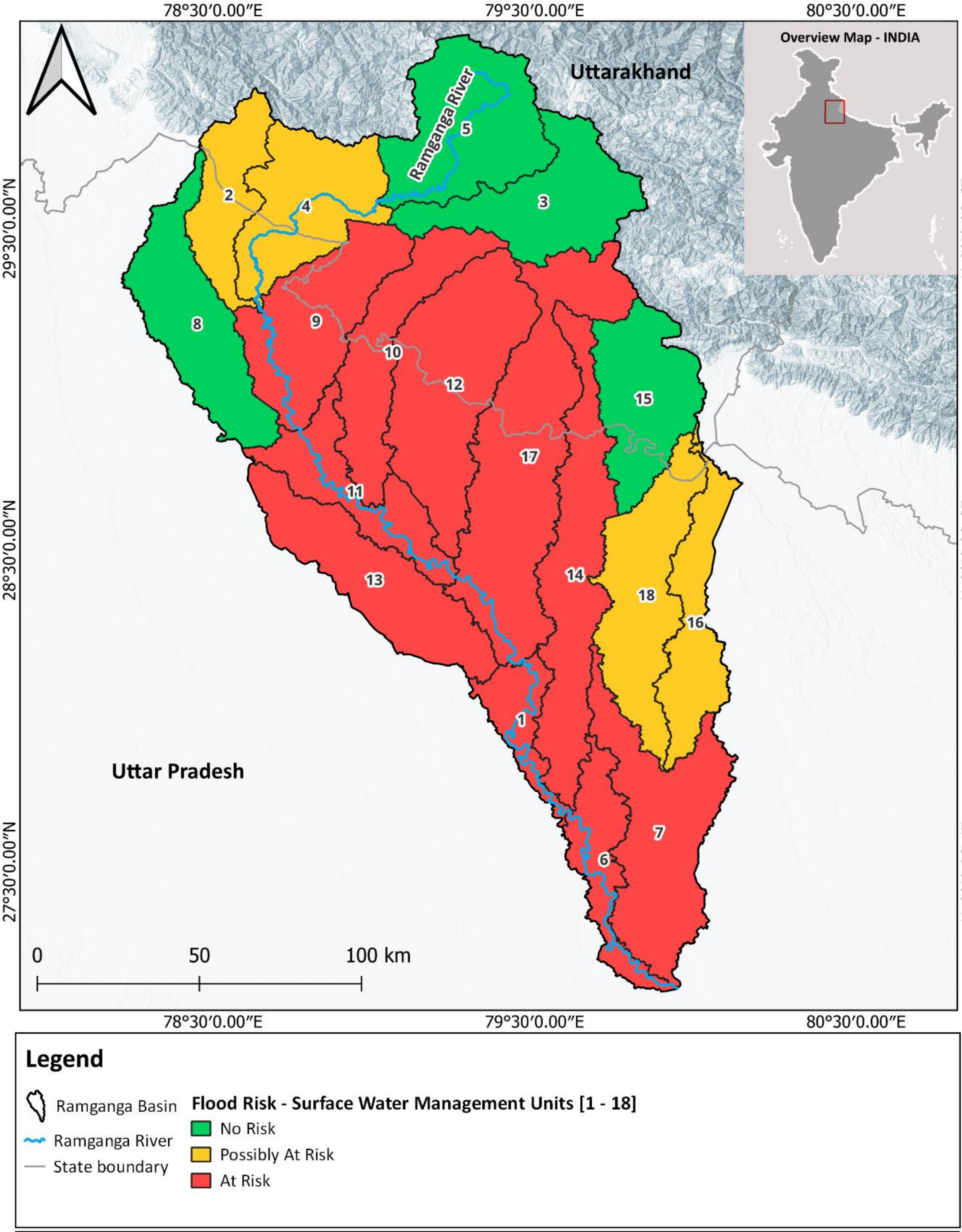


Map A5. 4: Map Flood risk assessment based on agricultural land affected within the flooded area



Map A5. 5: Flood risk assessment based on built-up area affected within the flooded area

Ramganga River Basin -
Flood Risk based on population affected within the flooded area [km²]

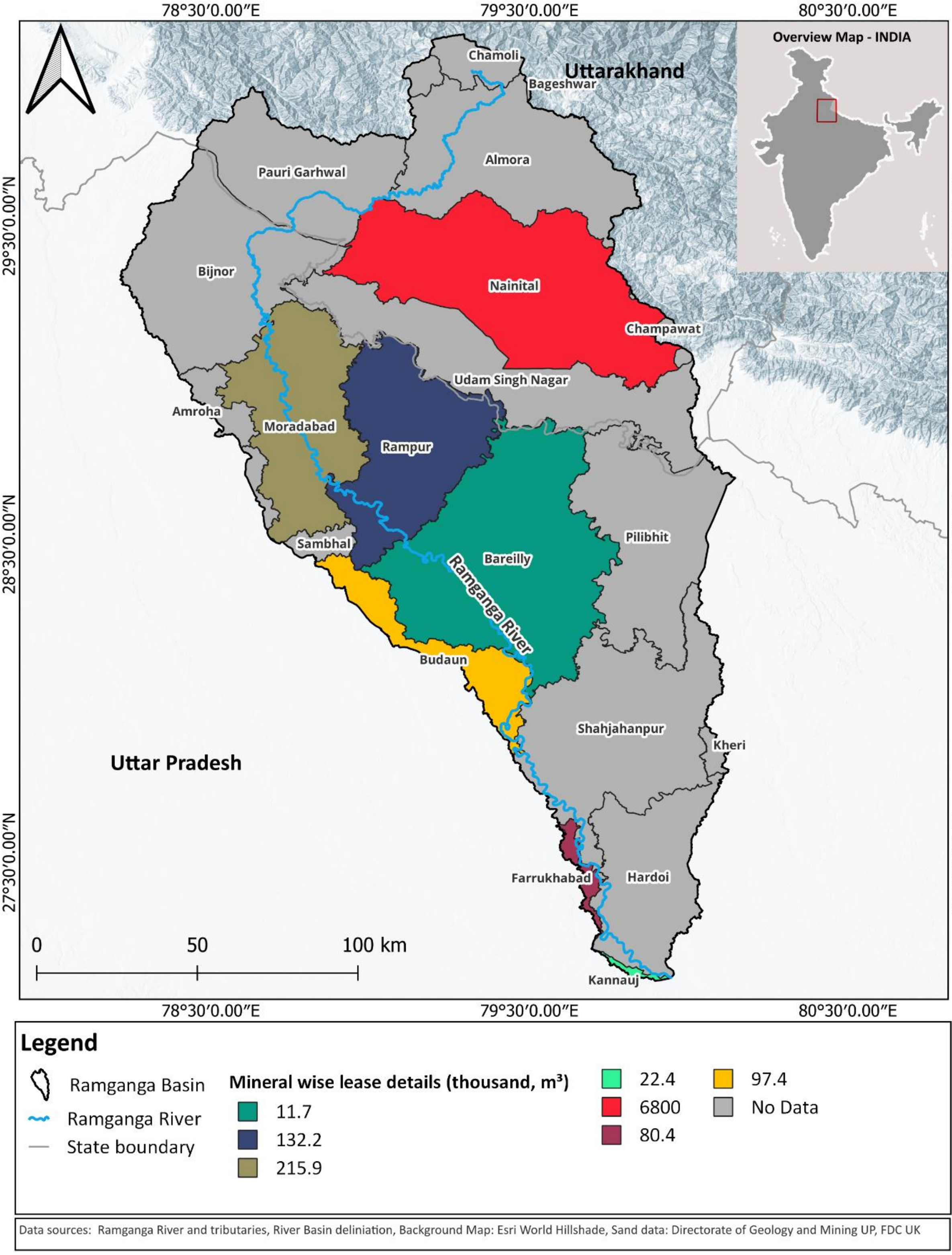


Data sources: Ramganga River, River Basin deliniation, Background Map: Esri World Hillshade, Flood: Dottori et al. (2016): https://doi.org/10.1016/j.advwatres.2016.05.002

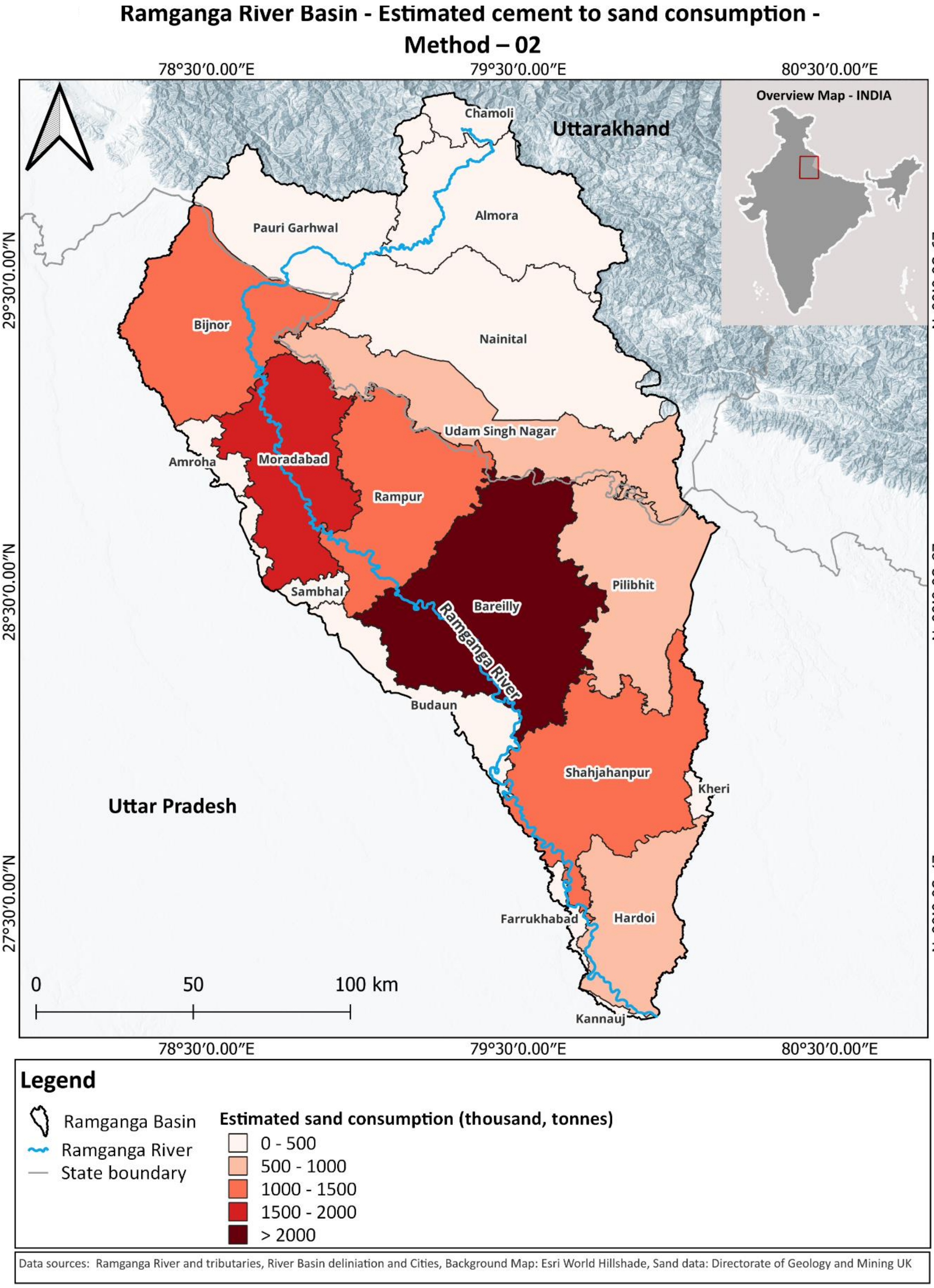
Map A5. 6: Flood risk assessment based on population affected within the flooded area

Co-funded by the European Union

Ramganga River Basin - Mineral-wise (sand) lease details – Method - 01

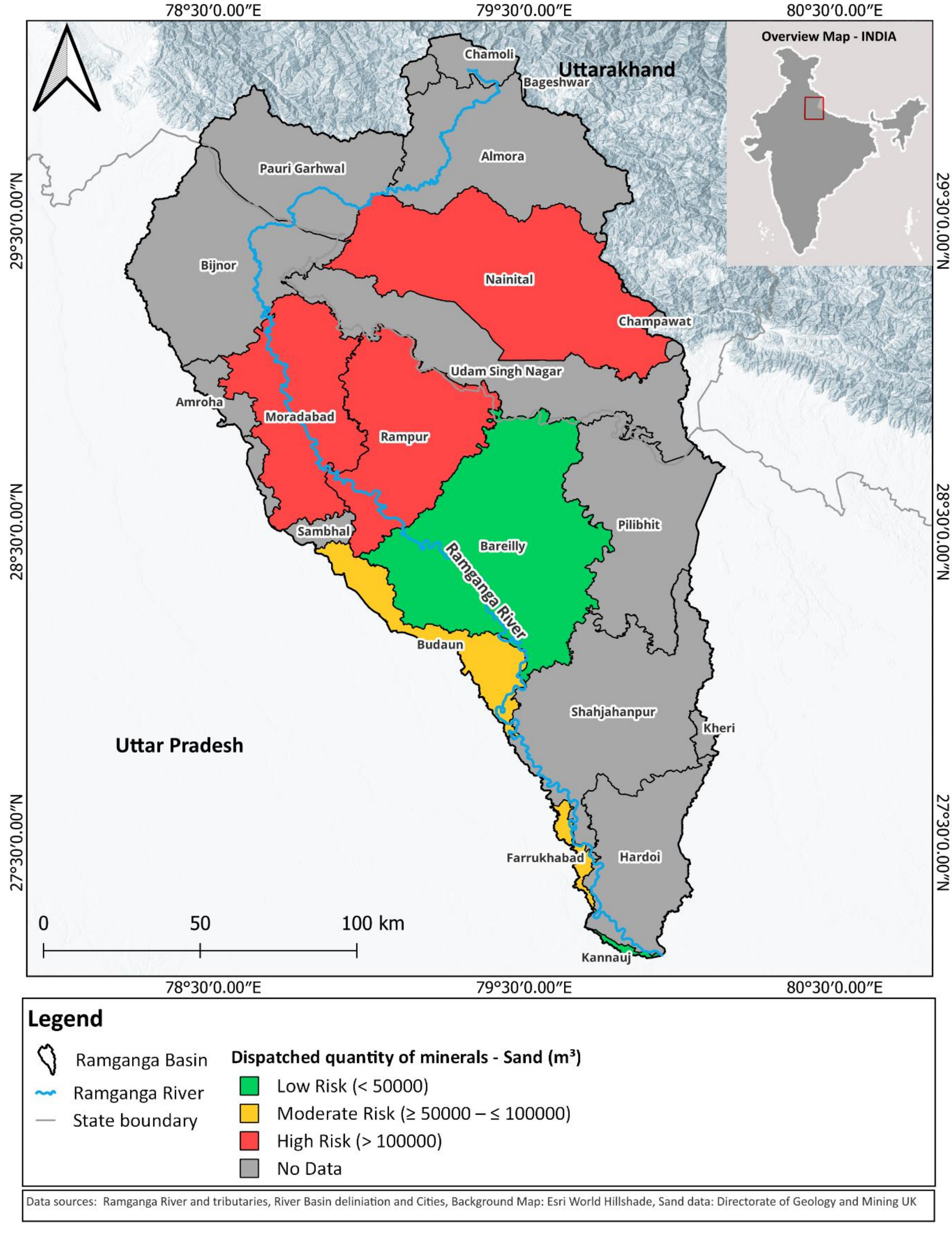


Map A5. 7: District map of mineral wise (sand) lease details – Method - 01

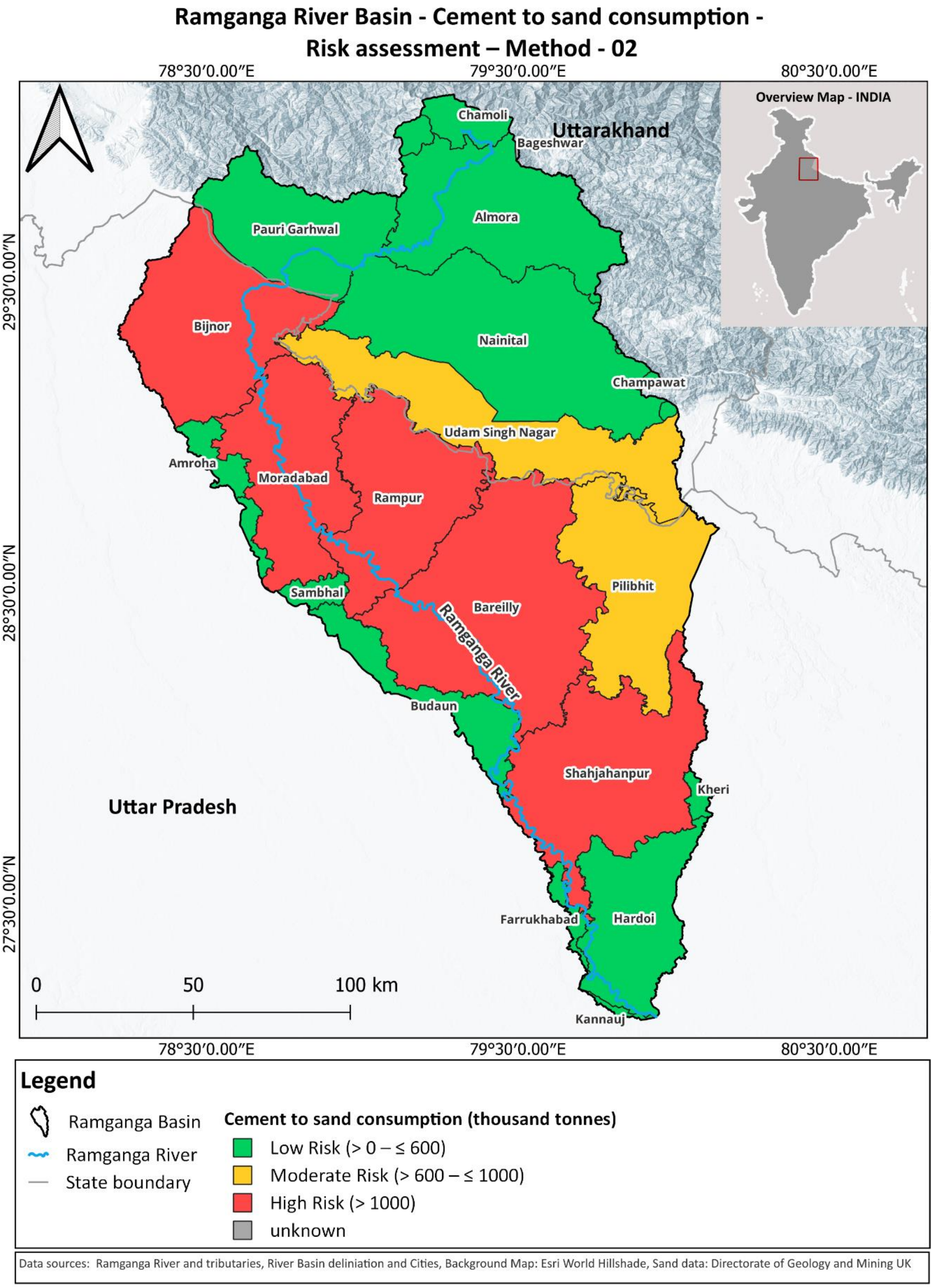


Map A5. 8: Estimated District-Wise Sand Consumption Values – Method - 02

Ramganga River Basin - Mineral-wise (sand) lease details – Risk assessment – Method - 01



Map A5. 9: Risk Assessment Based On Dispatched Quantities Of Minerals (Sand) – Method - 01



Map A5. 10: District-Wise Sand Consumption Risk Assessment – Method - 02