IMPACT OF CHARTER IMPLEMENTATION
ON
ENVIRONMENTAL STATUS OF PULP & PAPER INDUSTRIES
IN GANGA RIVER BASIN
(IN STATES ALONG MAIN STEM OF RIVER GANGA)

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September, 2022

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ACKNOWLEDGEMENT

We thank the support and encouragement received from the Chairman and Member Secretary of Central Pollution Control Board during the preparation of this report.

We would like to thank the funding agencies National Mission for Clean Ganga (NMCG) under Pollution Inventorization, Assessment and Surveillance on River Ganga (PIAS) project and World Bank under Strengthening of Environmental Regulators (SER) project for their financial supports.

We are extremely grateful to monitoring teams from Central Pollution Control Board, Regional Directorates- North (Lucknow) and East (Kolkata), technical institutes like CPPRI, NEERI, IIT-BHU, IIT Kanpur, IIT Delhi, IIT Roorkee etc. who have participated in the study and carried-out field monitoring jointly with concerned State Pollution Control Boards/Pollution Control Committee.

We would like to thank Dr. Nitin Endlay, CPPRI, Saharanpur & Dr. (Prof.) Vivek Kumar, IIT-Delhi for giving time to review this report technically for better presentation and understanding.

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BASELINE DATA

Baseline year: 2011

Operational industries: 67 nos. in river Ganga main stem (as per record available at CPCB)

Production: 5965.96 MT/day

Freshwater Consumption: 306.30 MLD

Wastewater Discharge: 201.35 MLD

BOD Load: 76.51 TPD

Sl. No.	Type of Industry	Category	Freshwater consumption (kL/MT of product)	Wastewater Discharge (kL/MT)	BOD Load (kg BOD /MT)
1	Agro Based Pulp & Paper Mills producing bleached grades of chemical pulps, papers, paperboards & newsprint	B1	80	70	26.6
2	Agro Based Pulp & Paper Mills producing unbleached grades of papers and paperboards	B2	40	30	11.4
3	RCF and Market Pulp Based Paper Mills producing bleached grades of papers, paperboards & newsprint	C1	25	20	7.6
4	RCF and Market Pulp Based Paper Mills producing unbleached grades of papers and Paperboards	C2	20	15	5.7

1. INDIAN PAPER INDUSTRY

India is one of the fastest growing paper market in the world. The growing knowledge base coupled with synergistic contributions from flagship schemes of the government, namely, Sarva Shiksha Abhiyan, (SSA), Skill India, Beti Bachao Beti Padhao, Right to Education etc. has assured a robust demand for paper and paper board. Paper industry has three broad categories of products i.e. writing & printing paper, packaging grade paper (Kraft, duplex board and paper board) and newsprint. A brief profile of the Indian Paper industry is summarised in **Table 1.**

Table 1: Profile of Indian Paper Industry

Number of Paper Mills		**900**
Total Installed Capacity (Million Tonnes)		29.11
Operating Installed Capacity (Million Tonnes)		23.99
Production of Paper, Paper board and Newsprint (Million Tonnes)		21.36
Raw material	• **Wood** • **Agro residues** • **Waste Paper**	3.91 1.16 16.29
Per capita consumption (Kg)		15.63

Source: Census Survey of Indian Paper Industry

As indicated the Indian Paper industry use diverse raw materials such as wood (eucalyptus, poplar, veneer chips etc.), agro residues like bagasse, and wheat straw, recycled fibre/waste paper (indigenous/imported) and market pulp.

During Pre-Covid period i.e. 2010-2020, the Indian Paper Industry registered a substantial growth which resulted in a double fold increase in production from 10.99 million tonnes (2010) to 21.36 million tons (2020). Though it suffered setback during Covid lockdown but Post-Covid the strong demand of pharmaceutical sector, FMCG sector, online shopping and increased use of hygienic paper products have given fillip to packaging paper sector.

2. RIVER GANGA & PAPER INDUSTRIES IN GANGA RIVER BASIN

There are 14 major river basins in India with natural waters. Of these river basins, river Ganga sustains the largest population. One of the headstreams of river Ganga namely river Bhagirathi originates in the Himalayan ranges from the Gangotri glacier at 4,000 m above mean sea level. It

flows swiftly for 250 km in the mountains, descending steeply to an elevation of 288 m above mean sea level. In the Himalayan region, river Bhagirathi confluences with another head stream namely river Alaknanda at Devprayag, Uttarakhand to form river Ganga.

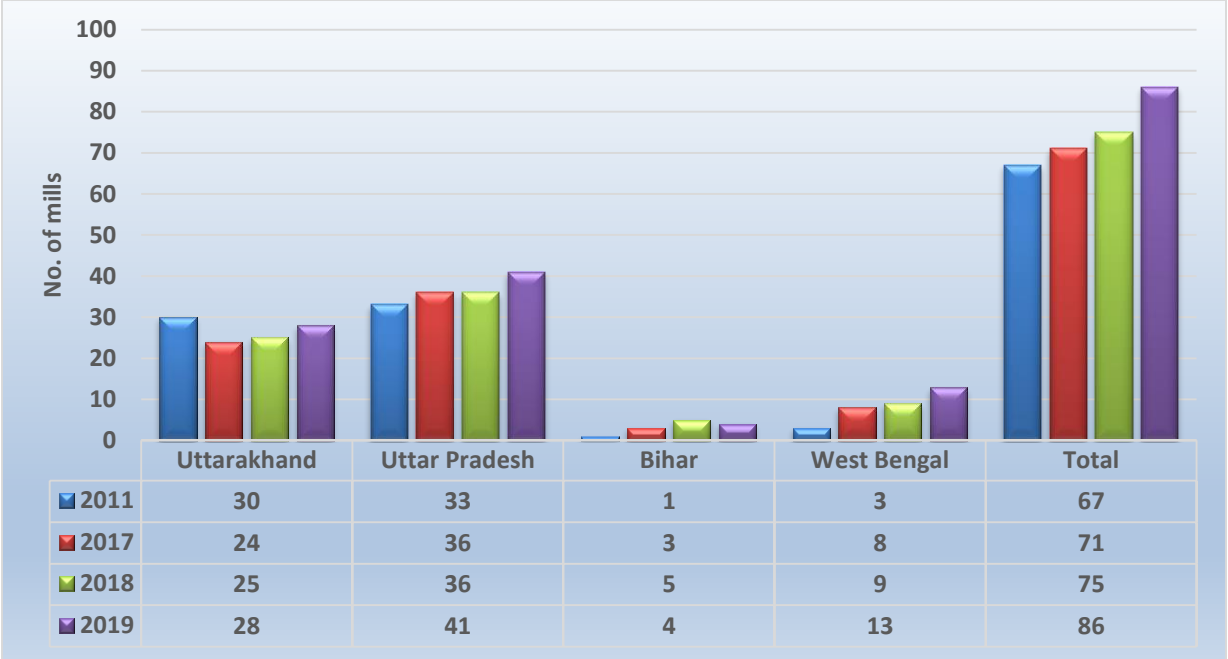
For thousands of years' river Ganga has been a cradle of human civilization and life line to millions of Indians who live along its course and depend upon it for domestic, irrigation and industrial uses. Though river Ganga is arguably the most sacred river in the world deeply revered by the people of India, ironically, due to rapid growth in population and industrialisation, urbanisation, over the years it became one of the most polluted river due to continuous discharge of untreated/partially treated sewage, industrial effluents from tanneries, distilleries, sugar industries, pulp and paper mills, disposal of discarded garbage, agricultural runoff and decrease in assimilating capacity of the river due to lean/less flow.

Due to geographical reasons, water availability and raw material availability there has been a significant growth in terms of number of mills and production of pulp and paper mills located in river Ganga in last one decade which is indicated in **Table 2** & **Fig 1.**

Table 2: Year Wise and State Wise Distribution of Number of Pulp & Paper Industries in River Ganga Basin

S. No.	Name of State	Total no. of units**			
		2011	2017	2018	2019
1.	Uttarakhand	30	34 (24)	31 (25)	28 (28)
2.	Uttar Pradesh	33	43 (36)	39 (36)	45 (41)
3.	Bihar	01	04 (03)	05 (05)	05 (04)
4.	West Bengal	03	09 (08)	10 (09)	15 (13)
Total		**67***	**90 (71)**	**85 (75)**	**93 (86)**

** In year 2011, all 67 industries were operational as per record available at CPCB,*
*** Numbers of operational unit is mentioned in parenthesis*
***Note:** Number of units are inventorized annually in association with concerned SPCBs/PCC*



	Uttarakhand	Uttar Pradesh	Bihar	West Bengal	Total
2011	30	33	1	3	67
2017	24	36	3	8	71
2018	25	36	5	9	75
2019	28	41	4	13	86

Figure 1: Total number of operational Pulp & Paper Mills in river Ganga basin

As such till last decade or so Pulp and Paper Mills in Ganga River basin were considered as one of the major contributors to pollution of water bodies (surface and sub-surface) in the Ganga River Basin.

3. CHARTER FOR WATER RECYCLING & POLLUTION PREVENTION IN PULP & PAPER INDUSTRIES LOCATED IN GANGA RIVER BASIN

Up to 2011, most of the mills in Ganga river basin were facing issues of compliance to consent norms and challenges to sustain/ensure continued operation. The major reasons for significant environmental impact of pulp and paper mills on river Ganga were use of obsolete technology and equipment, lack of process optimisation, intensive use of water and consequently high discharge, low performing and in adequate existing effluent treatment plants, discharge of black liquor due to absence of chemical recovery, lack of awareness and trained manpower for ETP monitoring, production etc. With declaration of Ganga as National River and constitution of **National Ganga River Basin Authority (NGRBA)** to ensure effective abatement of pollution and conservation of the river Ganga, the issue of minimizing the environmental impact of pulp

and paper mills in Ganga River Basin on river Ganga became a priority agenda before regulatory regime.

Considering the adverse impact on water bodies due to discharge of untreated/partially treated wastewater, in 2010 Central Pollution Control Board (CPCB) sponsored a study jointly with **IIT Kanpur, IIT Delhi, IIT Roorkee and Central Pulp and Paper Research Institute (CPPRI), Saharanpur on "Techno-economic feasibility for setting up of Common Chemical Recovery Plant & Common Effluent Treatment Plant for Pulp & Paper Industries operating under identified cluster in Uttar Pradesh & Uttarakhand".** The setting up CETP in these clusters was found to be unfeasible due to logistic reasons. Hence the report advocated for ETP upgradation by individual units. As for black liquor management, the report recommended installation of stand-alone or Common Chemical Recovery Plants (CRPs) by agro based units (even producing Kraft paper) as mandatory requirement for agro based paper mills in order to continue their manufacturing operations.

The follow up of the above study led to formulation of **Charter for Water Recycling & Pollution Prevention in Pulp and Paper Industries located in Ganga River Basin** by CPCB in consultation with leading technical institutes like **IIT Roorkee, IIT Kanpur, IIT Delhi and CPPRI** with an objective reduces the water and environmental foot print of pulp and paper mills in Ganga River basin as well as improve the overall river water quality of the receiving streams/tributaries as well as of river Ganga.

The major highlights of the Charter were bench marking and finalisation of targets for fresh water consumption & waste water discharge, revision of discharge norms for Chemical Pulp Mills (Wood & Agro- Bleached & Unbleached) and RCF based Mills (Bleached & Unbleached).

The implementation of Charter through systematic and time bound action plan and adoption of effective monitoring protocol led to significant technological and ETP upgradation in these paper mills , catalysed adoption of cleaner production initiatives/strategies/technologies leading to process optimisation, resource conservation, water conservation, reduction in energy consumption , reduction in specific fresh water consumption and waste water discharge leading to improve overall environmental status and sustainability.

3.1. Categorization of Pulp & Paper Mills

As the pulp and paper mills operating in river Ganga basin used diverse raw materials to manufacture various grades of paper the mills were categorized based on the type of raw material used and paper produced by them (**Table 3)**, so that action plans for each individual category of paper mills can be prepared**.**

Table 3: Categorization of Pulp and Paper Industries as per Charter

Sl. No.	Type of Industry	Category
1	Wood Based Pulp & Paper Mills producing bleached grades of chemical pulps, papers, paperboards & newsprint	A1
2	Wood Based Pulp & Paper Mills producing unbleached grades of chemical pulps, papers and paperboards	A2
3	Agro Based Pulp & Paper Mills producing bleached grades of chemical pulps, papers, paperboards & newsprint	B1
4	Agro Based Pulp & Paper Mills producing unbleached grades of papers and paperboards	B2
5	RCF and Market Pulp Based Paper Mills producing bleached grades of papers, paperboards & newsprint	C1
6	RCF and Market Pulp Based Paper Mills producing unbleached grades of papers and Paperboards	C2
7	RCF and Market Pulp Based Specialty Paper Mills	D

As per the criteria of categorization suggested in charter, all pulp and paper industries have been categorized and state wise distribution of these industries is shown in **Table 4.** Spatial and temporal variation of number of operational industries among these 7 categories is shown in **Figure 2, 3, 4, 5 and 6 respectively.**

Table 4: State wise and Category Wise Distribution of No. of Operational Pulp and Paper Mills in River Ganga Basin

UTTARAKHAND								
	Total Operational units	**A1**	**A2**	**B1**	**B2**	**C1**	**C2**	**D**
2017	24	1	0	3	2	5	12	1
2018	25	1	0	3	2	6	12	1
2019	28	1	0	3	2	6	15	1
UTTAR PRADESH								
	Total Operational units	**A1**	**A2**	**B1**	**B2**	**C1**	**C2**	**D**
2017	36	0	0	2	1	11	22	0
2018	36	0	0	2	1	12	21	0
2019	41	0	0	3	2	12	24	0
BIHAR								
	Total Operational units	**A1**	**A2**	**B1**	**B2**	**C1**	**C2**	**D**
2017	3	0	0	0	0	0	3	0
2018	5	0	0	0	0	0	5	0
2019	4	0	0	0	0	0	4	0
WEST BENGAL								
	Total Operational units	**A1**	**A2**	**B1**	**B2**	**C1**	**C2**	**D**
2017	8	0	0	0	0	2	5	1
2018	9	0	0	0	0	2	6	1
2019	13	0	0	0	0	2	10	1

Note: There was no procedure for categorization in year 2011 so year 2011 is not included in above table.

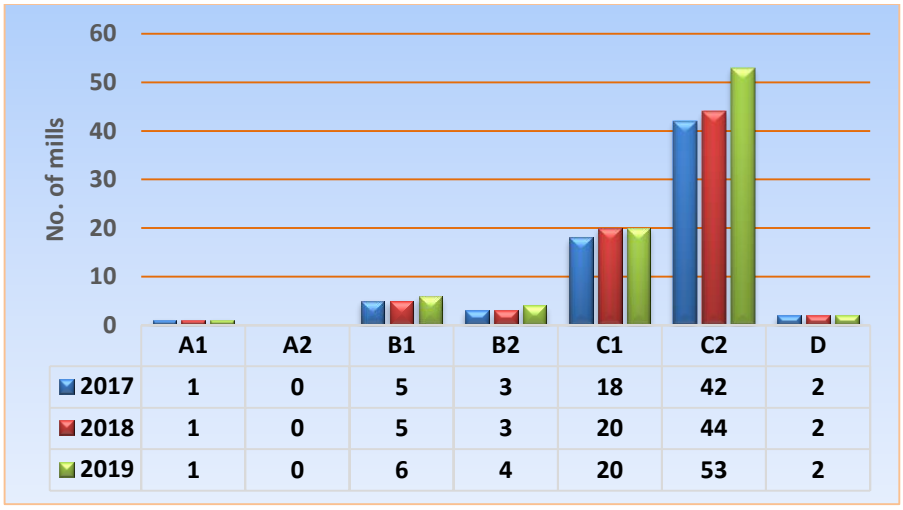
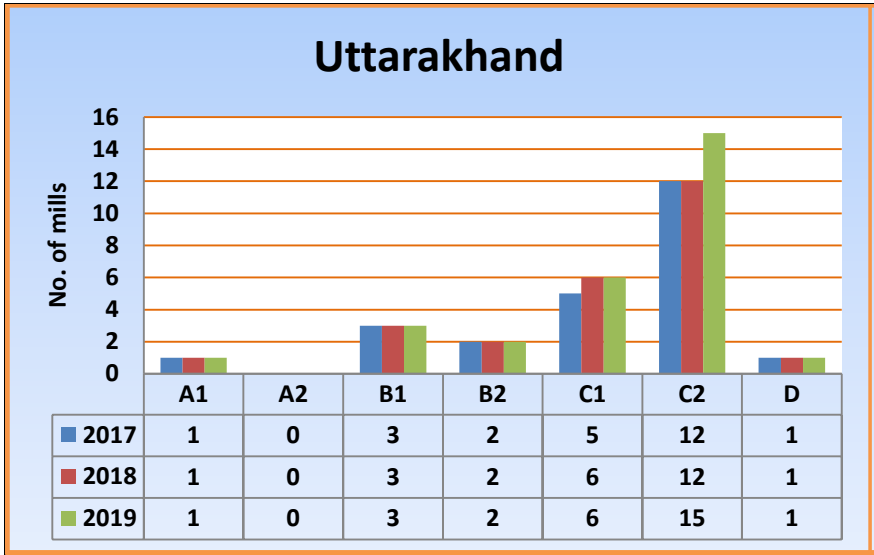
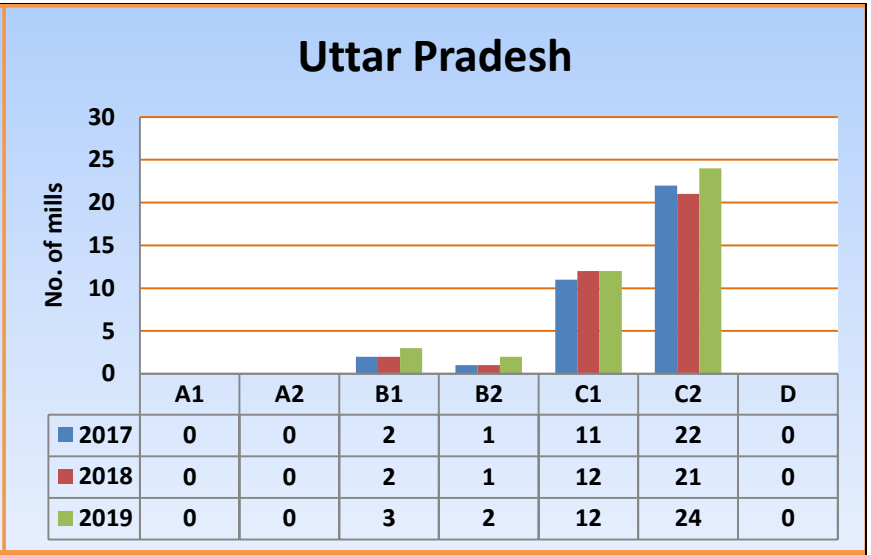


Figure 2: Category Wise Distribution of Operational Pulp & Paper Mills in River Ganga Basin



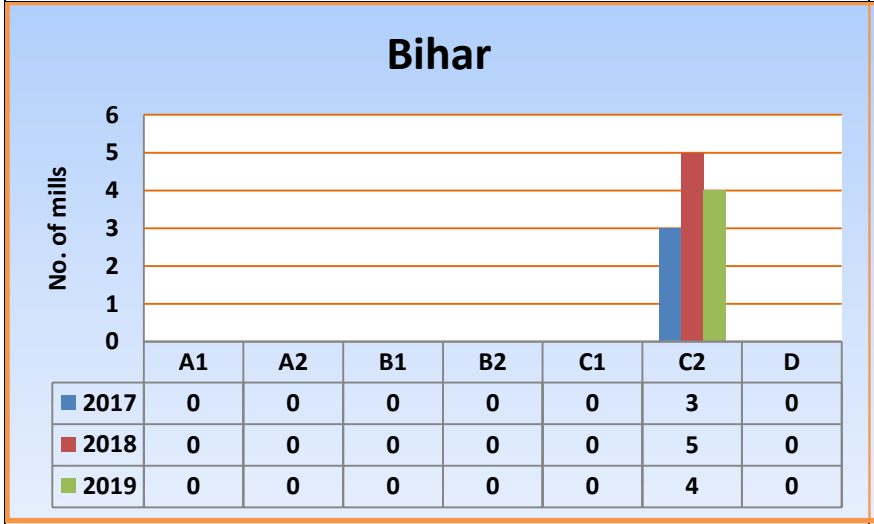
	A1	A2	B1	B2	C1	C2	D
2017	1	0	3	2	5	12	1
2018	1	0	3	2	6	12	1
2019	1	0	3	2	6	15	1

Figure 3: Category wise distribution of operational paper mills in Uttarakhand



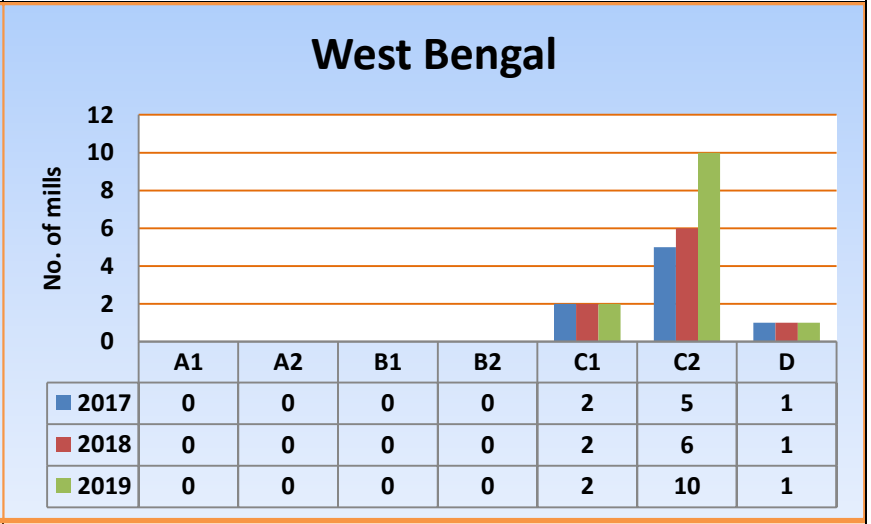
	A1	A2	B1	B2	C1	C2	D
2017	0	0	2	1	11	22	0
2018	0	0	2	1	12	21	0
2019	0	0	3	2	12	24	0

Figure 4: Category wise distribution of operational paper mills in Uttar Pradesh



	A1	A2	B1	B2	C1	C2	D
2017	0	0	0	0	0	3	0
2018	0	0	0	0	0	5	0
2019	0	0	0	0	0	4	0

Figure 5: Category wise distribution of operational paper mills in Bihar



	A1	A2	B1	B2	C1	C2	D
2017	0	0	0	0	2	5	1
2018	0	0	0	0	2	6	1
2019	0	0	0	0	2	10	1

Figure 6: Category wise distribution of operational paper mills in West Bengal

3.2. Salient Features of Charter

Following are the salient features of the Charter:

a. Benchmarks for specific fresh water requirement and specific effluent discharge **(Table 5).**

Table 5: Targets for Fresh Water Consumption and Effluent discharge as per Charter

Sl. No.	Category	Benchmarking for Fresh water consumption (kL/MT of product)	Benchmarking for effluent discharge (kL/MT of product)
1.	A1	50	40
2.	A2	25	20
3.	B1	50	40
4.	B2	25	20
5.	C1	15	10
6.	C2	10	6
7.	D	50	40

b. Proposed strategies for Charter Implementation:

- Reduction in water consumption through process improvements and implementation of recycle and reuse practices.
- Quantum improvement on the individual ETP by augmentation/ up-gradation and adding tertiary treatment units to produce industry grade water for use within the industry.
- Strict metering of the water use and wastewater generation.
- Extensive and regular monitoring protocol to be followed by regulatory authorities.
- Third party involvement for planning, assessment & monitoring.
- Local paper mill associations to play pivotal role in facilitating the individual pulp & paper mills.

c. Treated effluent quality norms **(Table 6).**

d. Proposed strategies for reducing fresh water consumption.

e. Recommended best practices for process upgradation.

f. Action plan for implementation of technological & process improvements.

Table 6: Targeted treated effluent quality norms as per charter

Parameters	Existing standards		Standards as per charter	
	Large Pulp & Paper Mills (Capacity above 24000 MT/Annum)	Small Pulp & Paper Mills (Capacity up to 24000 MT/Annum)	Integrated pulp & paper mills manufacturing chemical pulp	RCF and Market based pulp & paper mills
pH	7.0-8.5	5.5-9.0	6.5 - 8.5	6.5 - 8.5
TSS, mg/L	50	50	30	30
BOD, mg/L	30	30 (discharge into inland surface water) 100 (discharge on land)	20	20
COD, mg/L	250	-	200	150
TDS, mg/L	-	-	1800	1600
Colour, PCU	-	-	250	150
AO_x	1 kg/tonne of paper produced	2 kg/tonne of paper produced	8 mg/L	-
SAR	-	26 (discharge on land)	10	8

g. Action plan for implementation of water conservation & water recycling.

h. Recommended minimum requirements (tertiary treatment) for ETP upgradation.

i. Action plan for assessment, augmentation and upgradation of ETPs.

j. Action plan for monitoring & surveillance of environmental compliance

k. List of logbooks which were made mandatory to maintain:

- Fresh water consumption
- Waste water discharge
- Energy consumption in ETP
- Chemical consumption in ETP
- Waste water analysis

l. Colour coding of fresh water, backwater, treated effluent, return sludge and recycled water pipelines for proper identification.

m. Training of ETP personnel on basic & fundamentals of ETP operation.

n. Establishment of mandatory ETP monitoring lab and Environment Management Cell (EMC).

3.3. Major Regulatory Steps Taken for Charter Implementation

a. Directions were issued in Feb 2015 to SPCBs for implementation of the Charter.

b. SPCBs issued directions to Pulp & Paper industries.

c. Organized 5 meetings at State and Regional levels.

d. All Pulp & Paper mills prepared & implemented individual action plans.

e. Enforcement of zero black liquor discharge through dismantling of 100 chemical pulping digesters from 33 pulp & paper mills & commissioning of 7 Chemical Recovery Plants catering 10 agro based pulp & paper mills.

4. PRODUCTION OF PULP AND PAPER

4.1. Pulping processes

The use of bagasse, agricultural residues like wheat straw, grasses and waste paper is majorly used for manufacturing of pulp in river Ganga basin. The following processes are commonly used for pulping of woody and non woody raw materials:

a. Ground wood process

b. Kraft or Sulphate process

c. Sulphite process

d. Soda process

e. Neutral sulphite semi-chemical pulping process

However, the charter suggests only sulphate pulping and soda pulping processes as these are the most suitable process for pulping of Bagasse and other agro residues. Both processes are described below:

4.1.1. Kraft or Sulphate process

In this process the raw material, such as wood/bamboo, is cut into small pieces and digested with a solution containing sodium hydroxide and sodium sulphate. The binding material in the wood, lignin and other compounds are dissolved in the cooking liquor at the temperature and pressure conditions of digester. The spent liquor, called black liquor is concentrated in evaporators and burnt in a furnace for the recovery of chemicals which are reused in the process. The heat generated during combustion is recovered in form of steam. The molten residue of inorganic chemicals is dissolved in water to produce green liquor. The green liquor is reacted with lime to convert sodium carbonate to sodium hydroxide. The calcium carbonate is calcined in a rotary kiln for use in the earlier step. The Kraft process has been widely used in India and gives good quality pulp. In case of agro residues in place of chipping, washing of raw material is done before pulping.

4.1.2. Soda process

Digestion of the prepared raw material here is done in cooking liquor consisting mainly of NaOH at a pressure of 4-5 kg/cm^2 maintained with steam. Raw materials such as rice straw, wheat straw, waste paper or rags are brought into contact with about 15% of their weight of NaOH. The materials mentioned here have potential of replacing bamboo resources as these are depleting rapidly. At the 3-4hr of operation, the pulp blown to tanks after release of pressure is washed on screens. The spent liquor is quite dilute and contains substantial quantities of non-cellulosic material in the case of grasses and straws.

4.2. Recent Paper Production Trend in Different Categories

In recent years' production of pulp and paper has increased significantly in river Ganga basin. State wise distribution of production is shown in **Table 7.**

Spatial and temporal variation of production among these 7 categories is shown in **Figure 7, 8, 9, 10, 11 and 12** sequentially. Major growth in production has been observed in C1, C2 and D category.

Table 7: Category Wise Production (in MT/day) for Year 2017, 2018 and 2019

UTTARAKHAND							
Year	Category						
	A1	A2	B1	B2	C1	C2	D
2017	493.15	0	696	145	708	1288.3	41
2018	493	0	700	145	940	1910	100
2019	437	0	728	143	874	2061.6	200
UTTAR PRADESH							
Year	A1	A2	B1	B2	C1	C2	D
2017	0	0	251.7	100	988.76	2593.1	0
2018	0	0	245	100	1336	3382.5	0
2019	0	0	380	150	1267.3	3657.53	0
BIHAR							
Year	A1	A2	B1	B2	C1	C2	D
2017	0	0	0	0	0	129.17	0
2018	0	0	0	0	0	189	0
2019	0	0	0	0	0	148	0
WEST BENGAL							
Year	A1	A2	B1	B2	C1	C2	D
2017	0	0	0	0	44	539	93
2018	0	0	0	0	92	743	83
2019	0	0	0	0	73.5	1220.54	99

Note: There was no procedure for categorization in year 2011, so year 2011 is not included in above table. Only Uttarakhand is falling under A1 category.

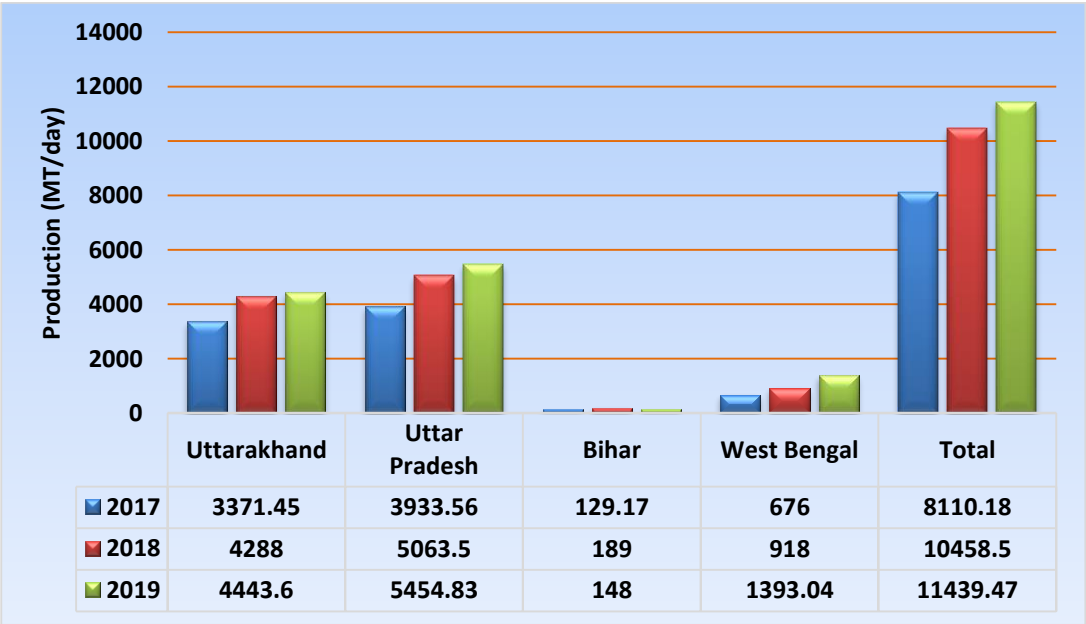
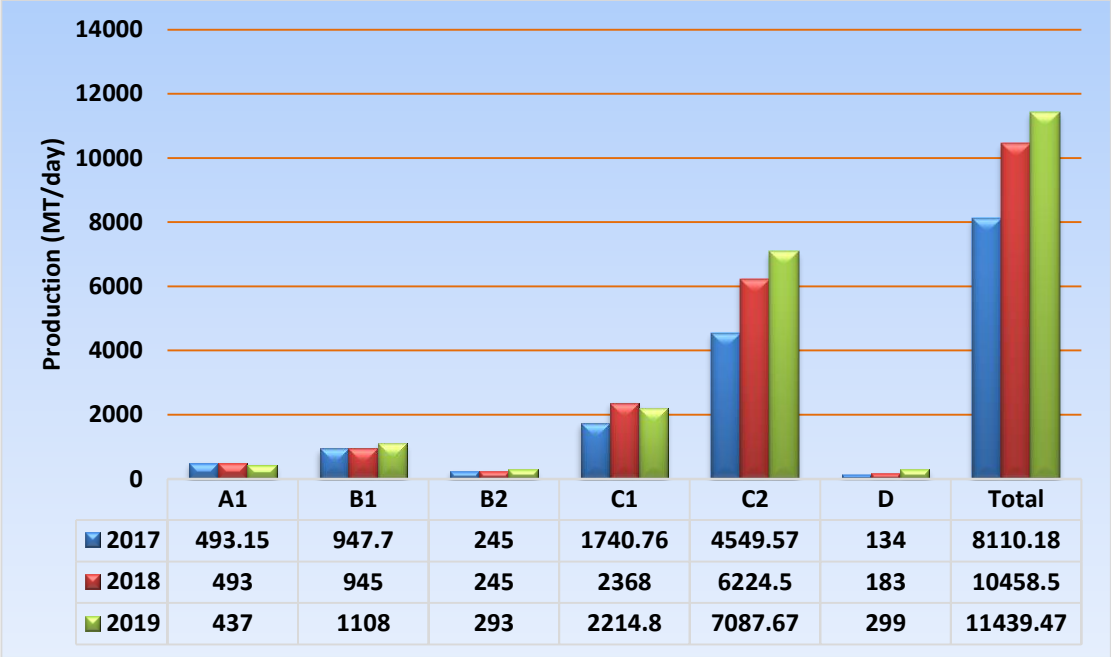
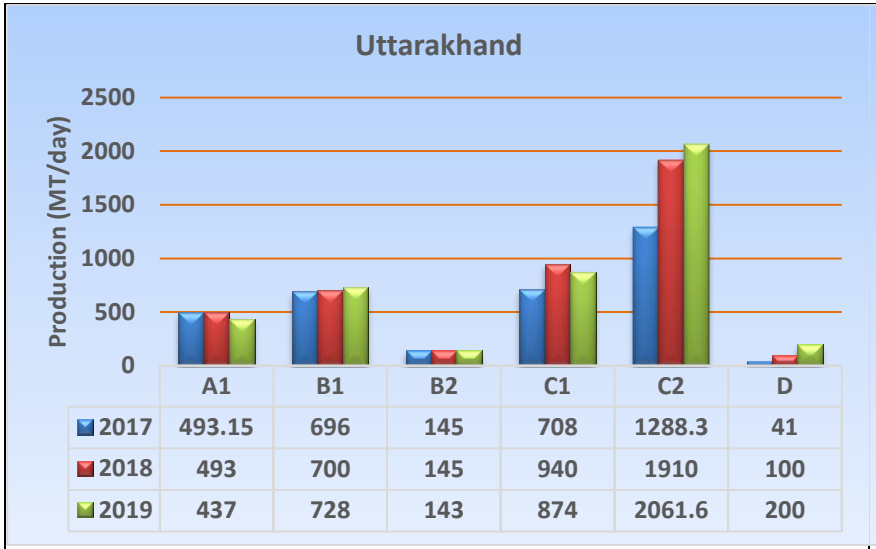


Figure 7: State Wise Distribution of Paper Production in Recent Years



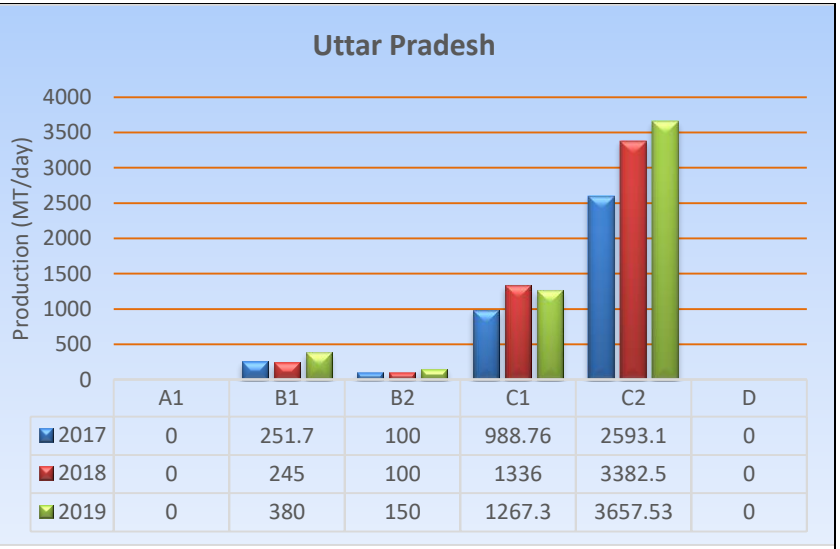
	A1	B1	B2	C1	C2	D	Total
2017	493.15	947.7	245	1740.76	4549.57	134	8110.18
2018	493	945	245	2368	6224.5	183	10458.5
2019	437	1108	293	2214.8	7087.67	299	11439.47

Figure 8: Category Wise Distribution of Paper Production in Recent Years



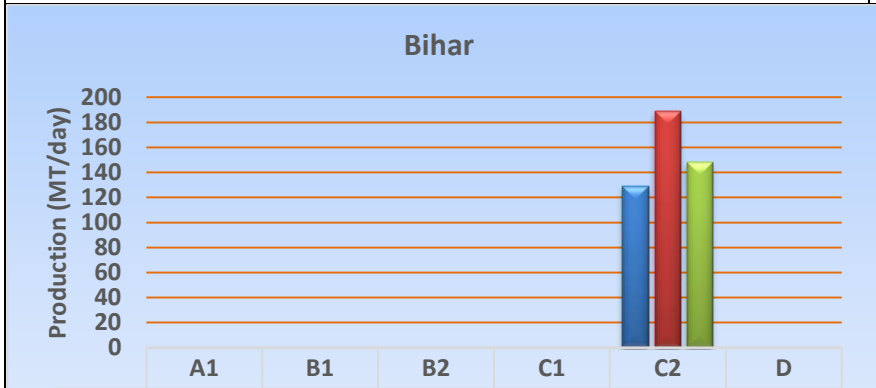
	A1	B1	B2	C1	C2	D
2017	493.15	696	145	708	1288.3	41
2018	493	700	145	940	1910	100
2019	437	728	143	874	2061.6	200

Figure 9: Category Wise Distribution of Production in Uttarakhand



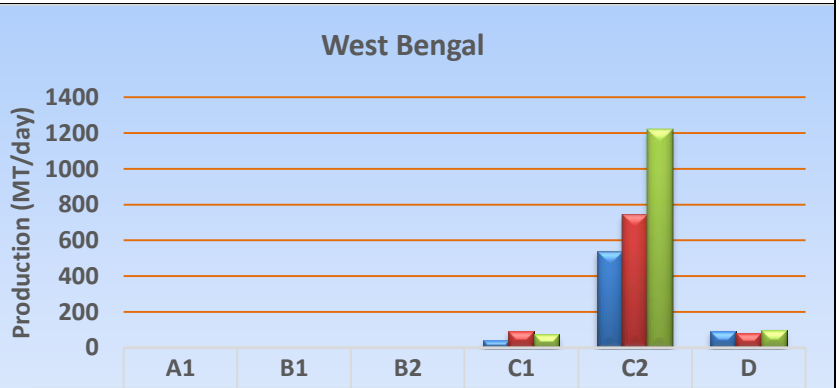
	A1	B1	B2	C1	C2	D
2017	0	251.7	100	988.76	2593.1	0
2018	0	245	100	1336	3382.5	0
2019	0	380	150	1267.3	3657.53	0

Figure 10: Category Wise Distribution of Production in Uttar Pradesh



	A1	B1	B2	C1	C2	D
2017	0	0	0	0	129.17	0
2018	0	0	0	0	189	0
2019	0	0	0	0	148	0

Figure 11: Category Wise Distribution of Production in Bihar



	A1	B1	B2	C1	C2	D
2017	0	0	0	44	539	93
2018	0	0	0	92	743	83
2019	0	0	0	73.5	1220.54	99

Figure 12: Category Wise Distribution of Production in West Bengal

5. MANAGEMENT OF TRADE EFFLUENT

5.1. Black Liquor Management in Wood/Agro based Units

Before Charter, discharge of untreated / partially treated black liquor by agro residues based pulp and paper mills along with treated effluent was a major contributor to pollution load discharged into river Ganga. Besides pollution load it also resulted in loss of valuable chemicals as well as contributed to high colour in the effluent / receiving stream.

Thus under the charter installation and operation of Chemical Recovery Processes (CRPs) **(Fig 13)** by the Pulp & Paper mills manufacturing chemical pulp from wood/agro residues was made mandatory for black liquor management. As a result, while some of the agro based paper mills went for capacity expansion to make installation and operation of chemical recovery system techno- economically feasible and viable while the other low capacity agro based paper mills switched over to RCF after dismantling of digester.

Further a **Protocol for Operating Chemical Recovery Plants (CRPs) (Individual/ Common)** was also prepared under the Charter to ensure regular chemical recovery operation **which** is as under:

Protocol for Chemical Recovery Operation

a. Flow measurement of Weak Black Liquor (WBL), Strong Black Liquor (SBL), Measurement of Heavy Black Liquor (HBL) by installing Mass Flow meter (Recording of daily, to-date monthly and to-date yearly flow of WBL, SBL and HBL).

b. All these Flow measurement devices shall be connected to PLC based logic or DCS with required password.

c. Recording of daily, to-date monthly and to-date yearly production of Soda Ash (in MT).

d. Separate steam mass flow meter in CRP should be installed.

e. Consumption of steam in evaporators in MT/Day (Recording daily, to-date monthly and to-date yearly steam consumption in MT).

f. Recording of Steam Economy of evaporators (on daily, to-date monthly and to-date yearly basis).

g. Consumption of power in the total CRP in Units/Day (Recording daily, to-date monthly and to-date yearly power).

h. Separate power meter (with totalizer) connected to PLC based logic or DCS with required password for the CRP should be installed.

i. Caustic (lye or soda) consumption figures should be noted on daily basis.

j. Agro-based Kraft paper mill should keep the record of caustic consumption in cooking (digester).

k. Agro-based writing-printing paper mill should keep record of caustic consumption in cooking and alkali extraction separately.

l. The mills should give the declaration of total caustic purchased and total Soda Ash produced in a month.

m. All the input raw materials utility (like steam, power, chemicals etc) effluent flow and pulp production data in Pulp Mill shall be recorded on daily / monthly / yearly basis.

n. Pulp Mills effluent flow drain should be separate and flow should be measured and recorded.

o. For Common CRP (CCRP), the black liquor has to be transported only through pipelines. Any other mode of transportation, like tankers, shall not be permitted.

p. All the Pulp Mill effluents shall be separate and cameras should be installed at the discharge points and there should be no permission to run digesters for pulping by Paper Mills without having CRP facility or membership of a common CRP.

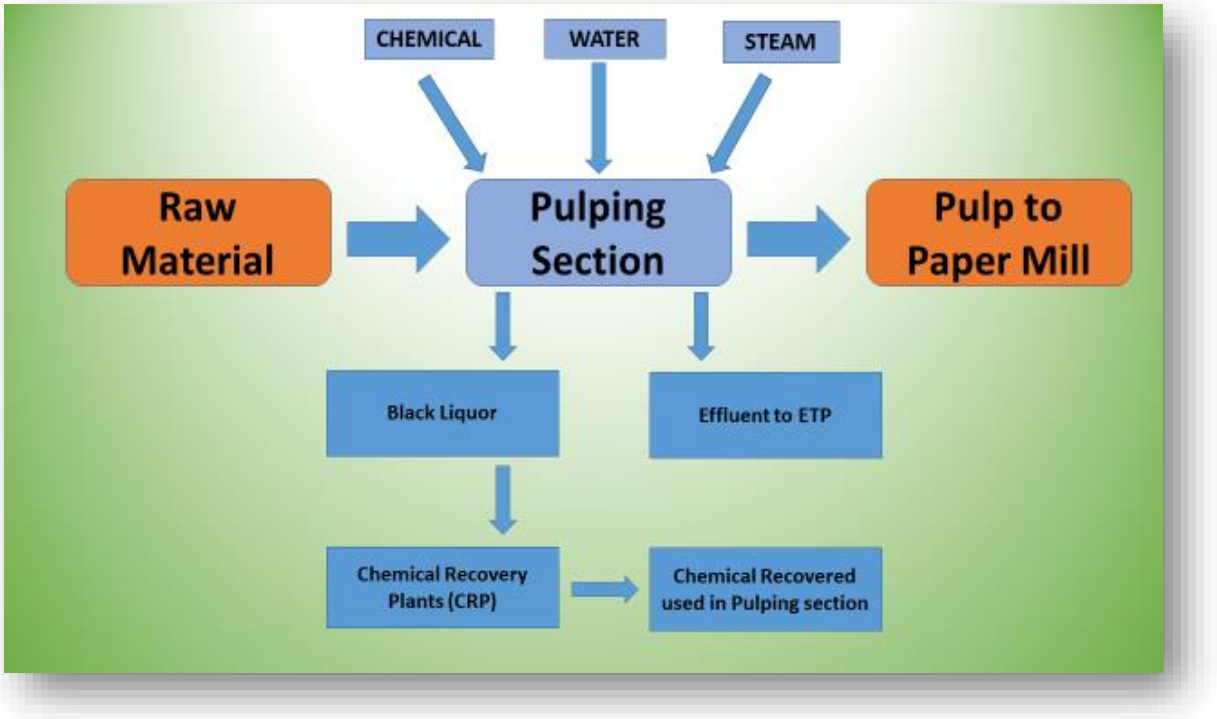


Figure 13: Black Liquor Management in Wood/Agro Based Pulp and Paper Mills in river Ganga Basin

5.2. ETP Upgradation

5.2.1. Installation of Fibre recovery Systems

The loss of fibres with mill were identified as a major cause of organic pollution load from pulp and paper mills of the cluster. In addition, it resulted in loss of valuable resource. Emphasis on installation of efficient Fiber Recovery systems like **Dissolved Air Floatation (DAF), Sedicell, Krofta, Poly Disc Filter etc. (Fig 14)** under charter helped in increased recovery of fibres leading to resource conservation and consequently reduction in pollution load going to ETP as well as facilitated reuse / recycling of the back water into the process leading to water conservation and reduction in fresh water consumption.

Figure 14: Fibre Recovery Units Installed by Pulp and Paper Industries in River Ganga Basin

5.2.2. ETP Upgradation as per Charter

The charter made it mandatory to have adequate ETP with following Units as indicated in **Fig 15** and discussed as under:

a. **Equalization Tank -** for mitigating the fluctuation in pollution load due to change in raw material furnish and product quality. Provision for air supply was also recommended to ensure thorough mixing and avoid settling of suspended solids.

b. **Primary Clarifier** to facilitate removal of suspended solids. It was recommended to upgrade the primary clarifier so that atleast**4-5 hrs retention** time along with **surface overflow rate of < 20 m^3 / m^2 / day** is achieved for satisfactory removal of suspended solids. It was recommended that the suspended solids level in primary clarifier overflow should be < 200 mg/l.

c. In Aeration **tank**, emphasis on providing adequate aeration with respect to inlet BOD load was made. Due to inherent issues of dead zone formation as well as irregular operation of surface aerators to save energy cost by the mills, installation of diffused aeration was given priority which had benefits of improved air to substrate contact leading to improved

reduction in pollution load. Maintaining MLSS level of 2000 – 2500 mg/l was made mandatory

d. Like Primary Clarifier, **Secondary Clarifier** was also required to be upgraded to provide at least **5-6 hrs retention** time to prevent washout of biological biomass along with **surface overflow rate of < 20 m^3/m^2/day.**

e. Tertiary Treatment involving Coagulation & Flocculation and/ or micro filtration, dual media filter, activated carbon filter, pressure sand filter etc. were made mandatory to further polish the treated effluent quality.

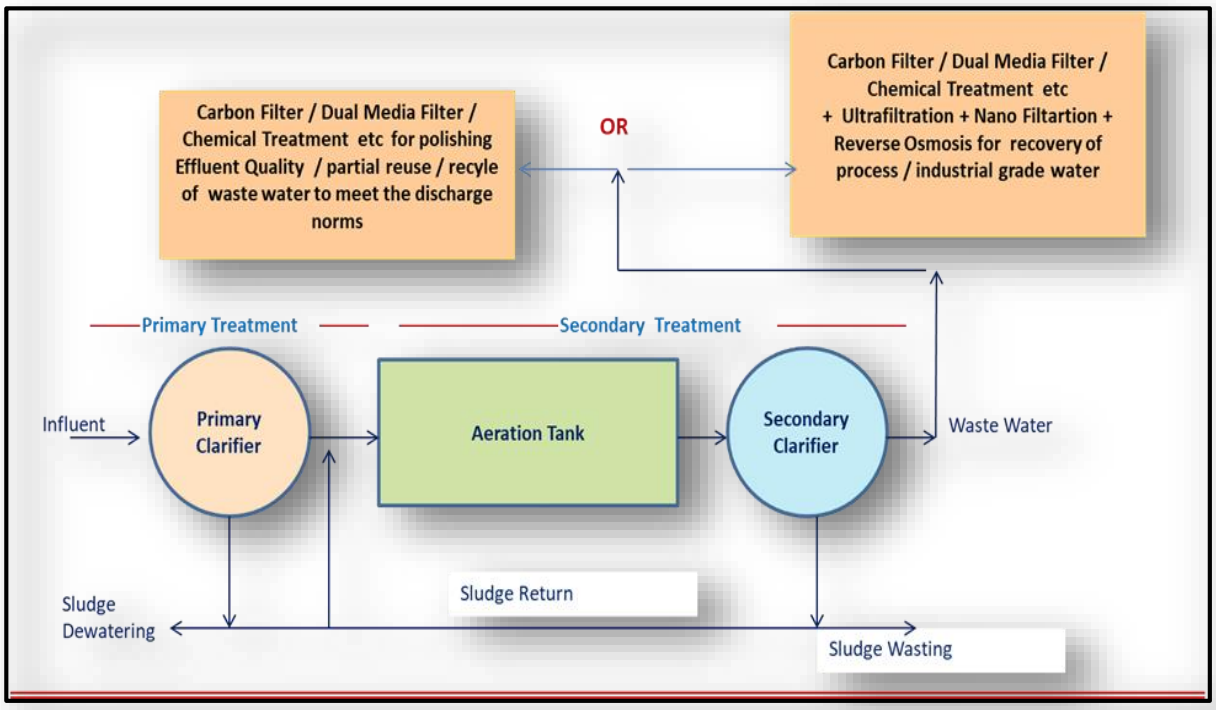


Figure 15: Effluent Treatment Plant along with Tertiary Treatment

6. COMPLIANCE VERIFICATION BY CPCB AND THIRD PARTY

Earlier, CPCB used to carry out inspection of Grossly Polluting Industries (GPIs) on annual basis. However due to workforce constraint, only 30-40% of GPIs were able to be inspected annually. Principal Secretary to Hon'ble Prime Minister directed CPCB to update inventory of Grossly

Polluting Industries (GPIs) every year and ensure that 100% inspection of GPIs is carried out annually through third party involving reputed technical institutes.

Thus since 2017 onwards, CPCB has been assigning the task of GPIs inspection to Third party technical institutions with an ultimate objective of verifying compliance status, assessing freshwater consumption, wastewater generation and wastewater discharged (quality and quantity) by Pulp & Paper units (considered as GPIs) operating in the states of Uttarakhand, Uttar Pradesh, Bihar and West Bengal, and having discharge into drains, tributaries leading to river Ganga.

A detailed inspection format **(Annexure-1)** was developed by CPCB in consultation with the expert institutions and was provided to the Third party technical institutions for collection of necessary information.

6.1. Criteria for Allotment of Units to the Third Party

Following points were considered before allotment of units to third party technical institutions for inspection:

a. Field of expertise of institute

b. Distance of institute from unit

c. Financial proposal submitted by institute for carrying out inspections

Accordingly, following institutes were recognised as third party and units were allotted as shown in **Figure 16 &17.**

a. Aligarh Muslim University (AMU)

b. Central Pulp & Paper Research Institute (CPPRI)

c. Indian Institute of Technology Delhi (IIT-D)

d. Indian Institute of Technology Kharagpur (IIT-Kh)

e. Indian Institute of Technology Roorkee (IITR)

f. Jadhavpur University, Kolkata

g. Indian Institute of Technology Banaras Hindu University (IIT BHU)

h. Motilal Nehru National Institute of Technology, Allahabad (MNNIT)

i. National Institute of Technology Patna (NIT-Patna)

j. Pollution Control Research Institute –Bharat Heavy Electronics Ltd. (PCRI-BHEL)

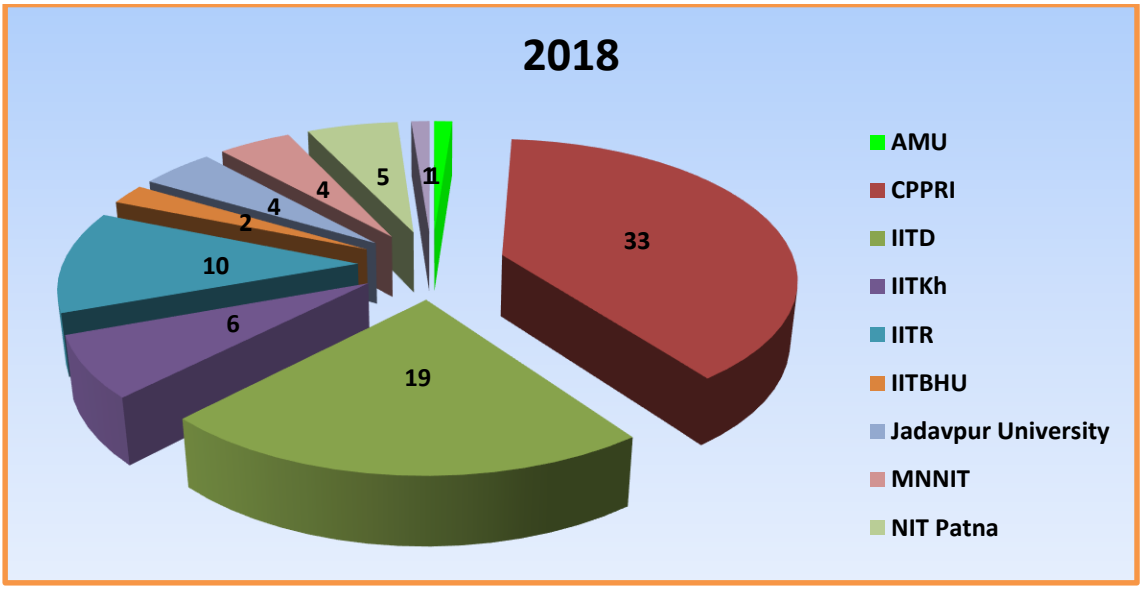


Figure 16: Distribution of Pulp and Paper Industries for Inspection among Technical Institutes in the Year 2018

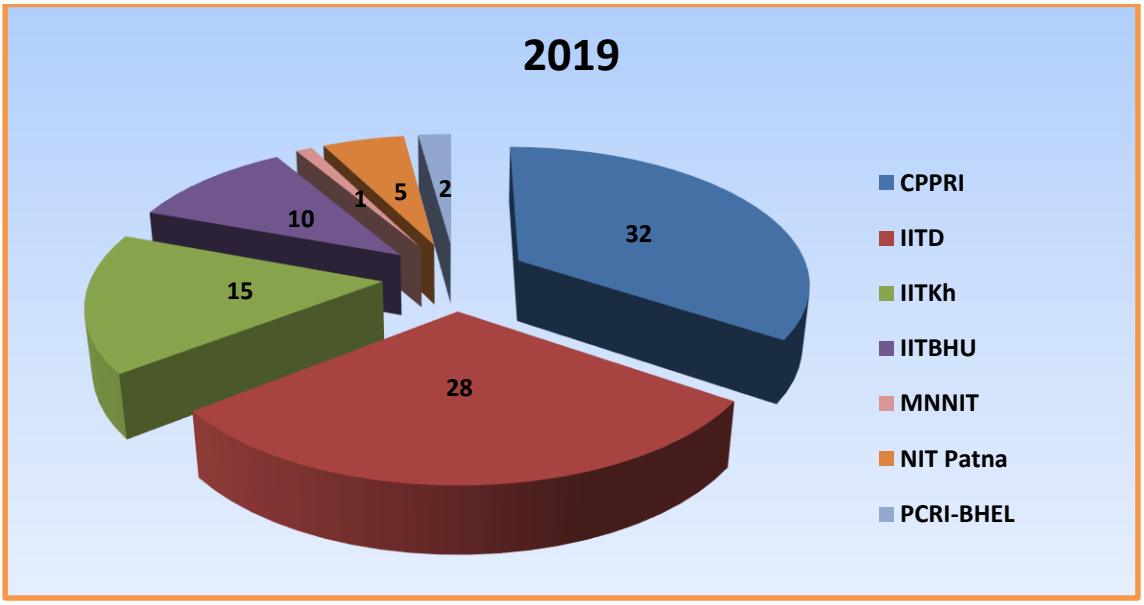


Figure 17: Distribution of Pulp and Paper Industries for Inspection among Technical Institutes in the Year 2019

6.2. Compliance Status

Compliance of the pulp and paper mills was decided on the basis of the level of major pollution parameters in final discharge with respect to consent parameters. By-pass, if any was considered as non-compliance. GPIs are considered non-complying due to various reasons such as exceedance in discharge norms of treated effluent, validity of consent to operate, operational status of pollution control devices etc. State wise overall compliance status of Pulp & Paper Mills in Ganga River Basin for year 2017, 2018 and 2019 is shown in **Table 8-10**, respectively and indicated in **Fig 18**.

Table 8: Compliance Status of Pulp & Paper Mills in Ganga River Basin – Year 2017

S. No.	State	Total	Operational	Complying	Non-Complying	Percentage compliance
1.	**Uttarakhand**	34	24	18	06	75
2.	**Uttar Pradesh**	43	36	20	16	55.5
3.	**Bihar**	04	03	00	03	0
4.	**West Bengal**	09	08	03	05	37.5
	Total	**90**	71	**41**	**30**	57.7

Table 9: Compliance Status of Pulp & Paper Mills in Ganga River Basin – Year 2018

S. No.	State	Total	Operational	Complying	Non-Complying	Percentage compliance
1.	**Uttarakhand**	31	25	25	0	100
2.	**Uttar Pradesh**	39	36	34	02	94.4
3.	**Bihar**	05	05	05	0	100
4.	**West Bengal**	10	09	07	02	77.8
	Total	**85**	**75**	**71**	**04**	94.7

Table 10: Compliance Status of Pulp & Paper Mills in Ganga River Basin – Year 2019

S. No.	State	Total	Operational	Complying	Non-Complying	Percentage compliance
1.	**Uttarakhand**	28	28	27	01	96.43
2.	**Uttar Pradesh**	45	41	32	09	78.05
3.	**Bihar**	05	04	04	00	100
4.	**West Bengal**	15	13	12	01	92.31
	Total	**93**	**86**	**75**	**11**	**87.21**

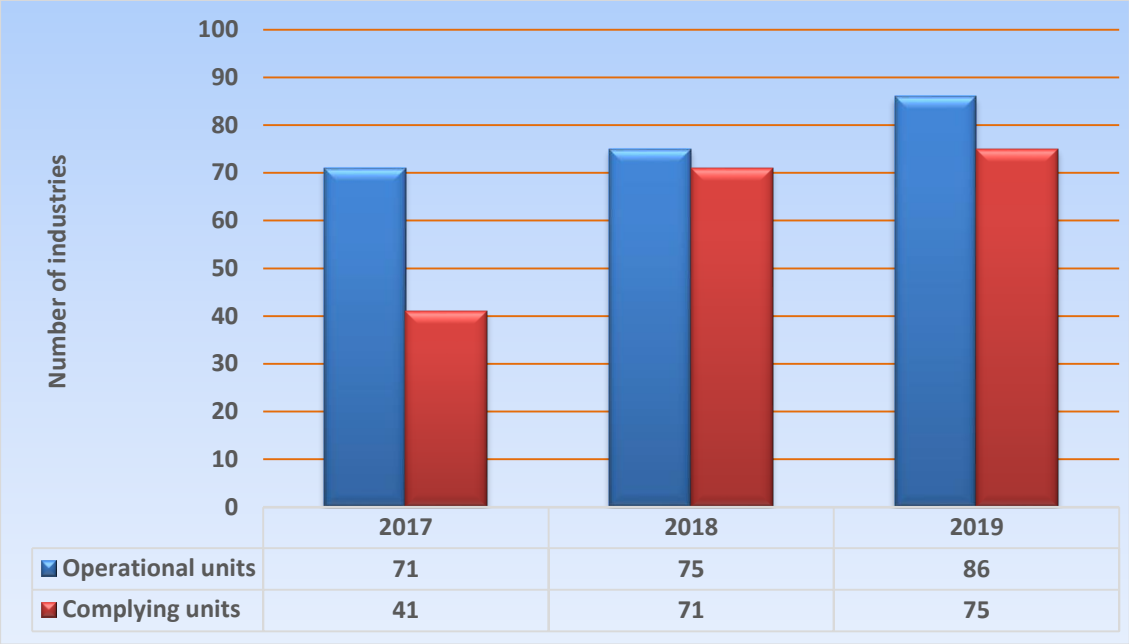


Figure 18: Year Wise Compliance Status of Pulp and Paper Mills in river Ganga basin

As indicated above there has been significant improvement in compliance status of Pulp & Paper Mills in River Ganga Basin.

7. TECHNOLOGY UPGRADATION, PROCESS OPTIMIZATION AND ETP PERFORMANCE EFFICIENCY

Due to implementation of charter, industries made upgradation in various stages of production process and ETP. Some of the steps taken by industries to achieve better environmental performance are mentioned below:

a. Installation of Chemical Recovery Plant (CRP) in agro based Pulp and Paper Mill for Black Liquor management.

b. Adoption of Oxygen Delignification and Chlorine Dioxide (ECF) bleaching by few agro based mills in Kashipur Cluster.

c. Upgradation of existing ETP including installation of aerators (diffused/surface) and development of required MLSS level.

d. Installation of tertiary treatment system for increased reuse/recycle of treated effluent.

e. Installation of flow meter at water intake / borewell, wastewater generation, treated effluent and recycle line.

f. Mandatory installation of Chemical recovery system in agro residues based paper mills

g. Closed loop fiber recovery and backwater system through incorporation of Poly disc filters or DAF (Dissolved Air Floatation) Units.

h. Setting up of Environmental Management Cell (EMC) by individual mills to effectively monitor the environmental compliance.

i. Replacement of paper machine shower nozzles with nozzles of specified diameter (0.6 – 0.8 mm) to reduce fresh water consumption.

The impacts of Process Upgradation under Charter are also indicated in **Fig 19**:

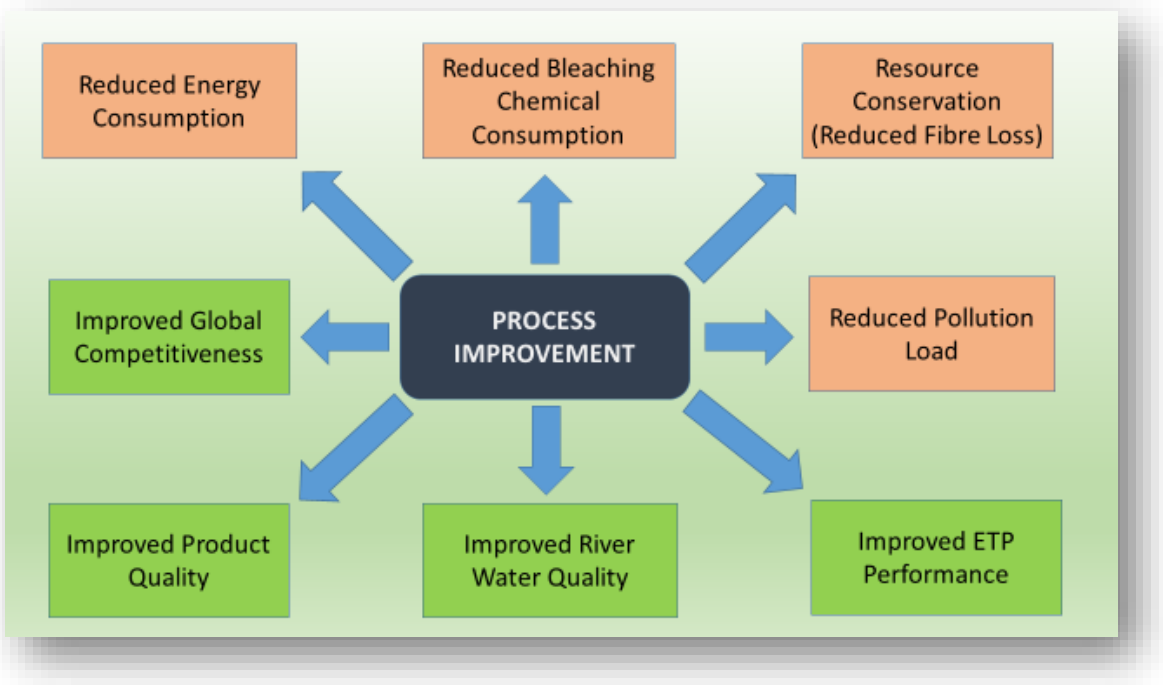


Figure 19: Benefits of Improvement/ Up-Gradation in Process and ETP

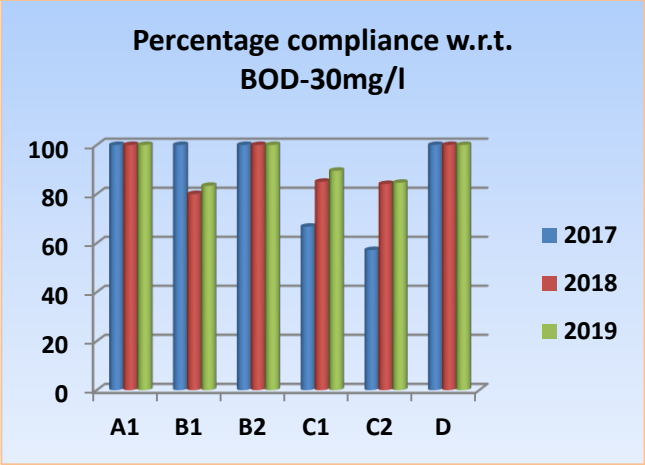
Industries willingly adopted Institution-Industry-Government Partnership Model for Technology management and Environmental Up-gradation as shown in Figure 19. – May be deleted

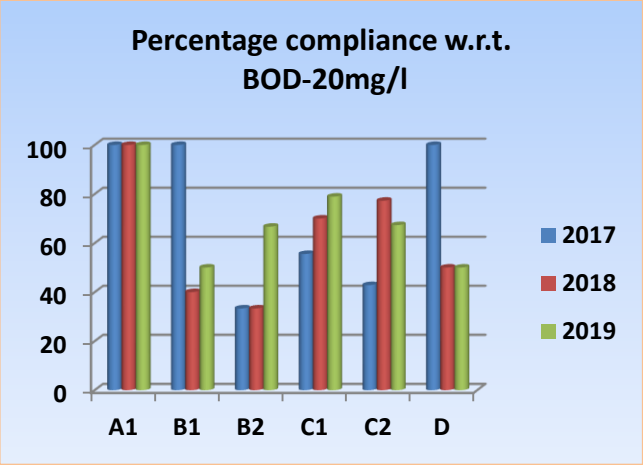
8. STRINGENT COMPLIANCE & TARGETS

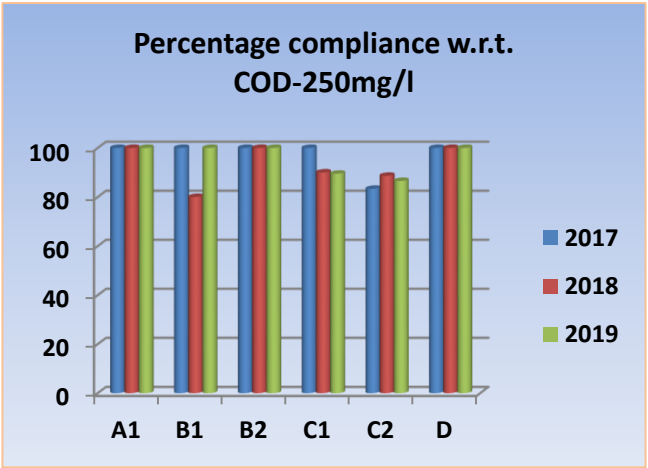
The treated effluent quality norms indicated in the Charter were very stringent compared to the general standards and the existing pulp and paper industry specific EPA rules for effluent discharge. The recent trends observed through inspections carried out in during 2017-2019 in context of compliance to national norms as well as charter norms is summarized in **Table 11**, and year wise compliance % is indicated in **Fig 20 and Fig 21.**

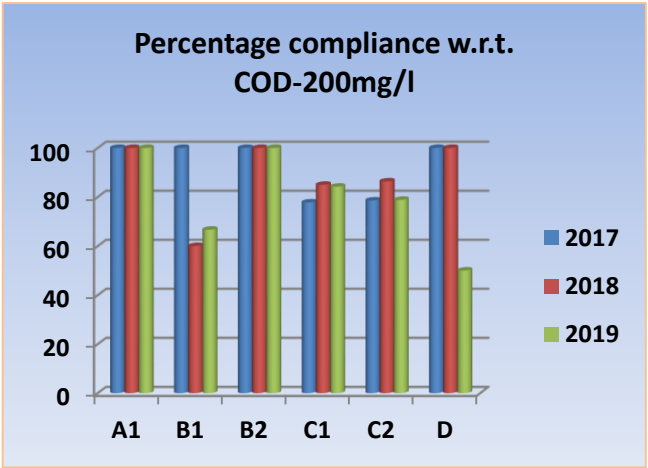
Table 11: Number of Industries Complying with National Standards and Charter Norms

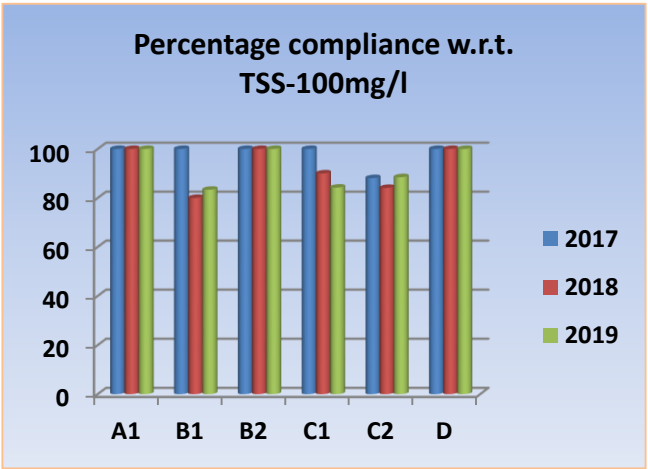
Number of industries complying with National norms and charter norms										
Category	**Year**	**Units Operational**	**National norms**			**Charter norms**				
			BOD	**COD**	**TSS**	**BOD**	**COD**	**TSS**	**Fresh water Consumption**	**Wastewater Discharge**
A1	2017	1	1	1	1	1	1	1	1	1
	2018	1	1	1	1	1	1	1	1	1
	2019	1	1	1	1	1	1	0	1	1
B1	2017	5	5	5	5	5	5	1	5	5
	2018	5	4	4	4	2	3	2	4	4
	2019	6	5	6	5	3	4	2	5	6
B2	2017	3	3	3	3	1	3	3	2	2
	2018	3	3	3	3	1	3	1	3	3
	2019	4	4	4	4	3	4	3	4	4
C1	2017	18	12	18	18	10	14	12	11	10
	2018	20	17	18	18	14	17	11	14	16
	2019	20	18	16	17	17	17	14	15	17
C2	2017	42	24	35	37	18	33	24	27	26
	2018	44	37	39	37	34	38	28	37	40
	2019	53	45	36	46	42	47	33	47	47
D	2017	2	2	2	2	2	2	1	1	1
	2018	2	2	2	2	1	2	1	2	1
	2019	2	2	2	2	1	1	1	2	1











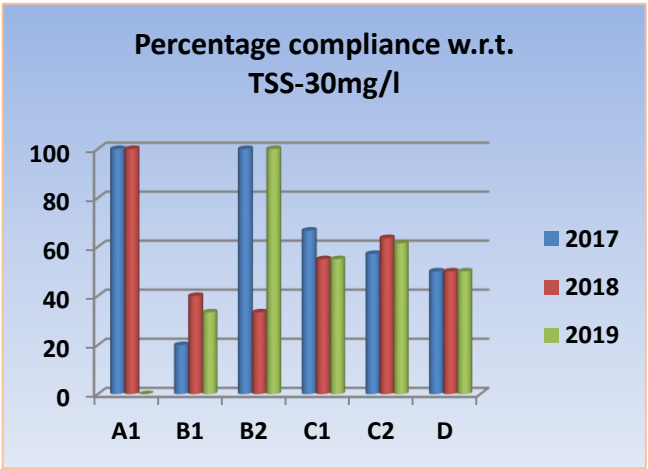
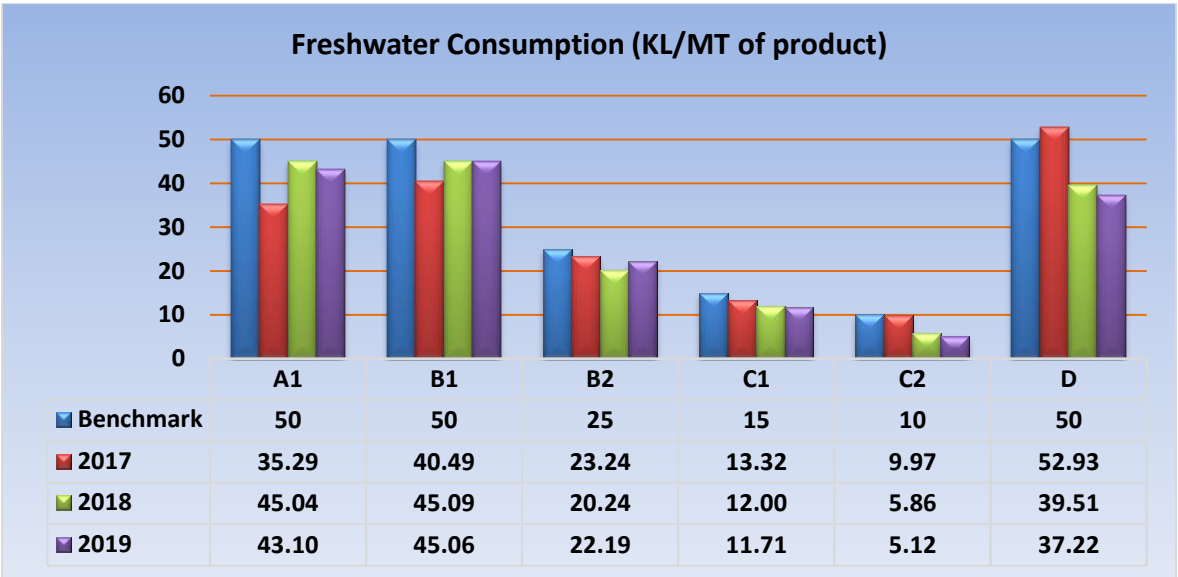


Figure 20: Percent of Mills Complying w.r.t National Discharge Norms

Figure 21: Percent of Mills Complying w.r.t Charter Discharge Norms

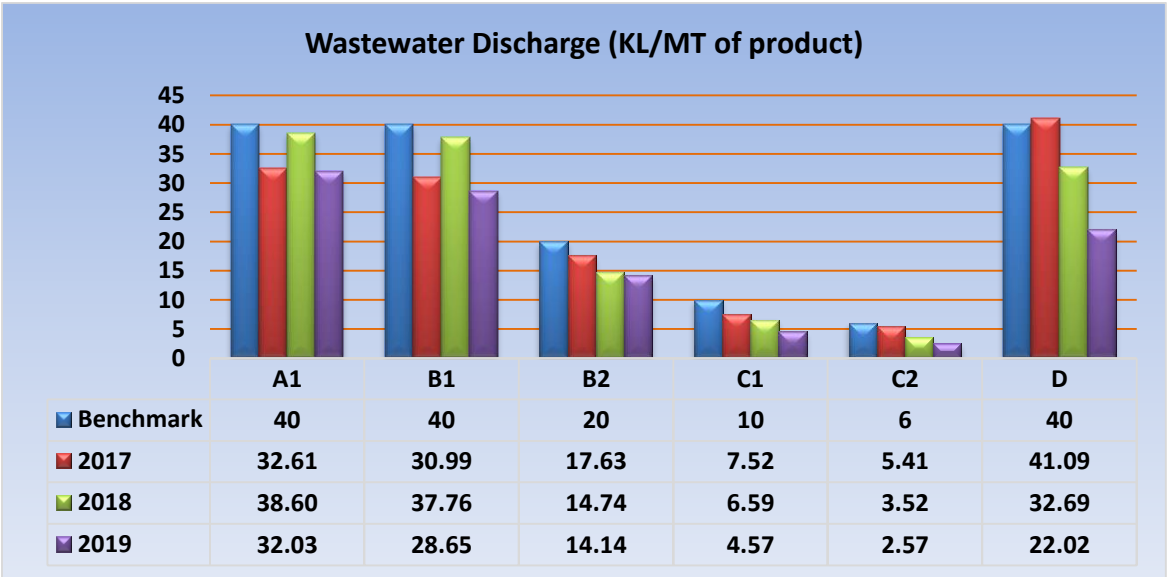
8.1. Trends in Fresh Water Consumption & Effluent Discharge

The process modification, technological upgradation, ETP upgradation, reuse/recycle of back water and treated effluent, process optimisation and other strategies adopted under Charter has resulted in significant reduction in fresh water consumption and consequently waste water discharge which is indicated in **Fig 22, 23 & 24.**



	A1	B1	B2	C1	C2	D
Benchmark	50	50	25	15	10	50
2017	35.29	40.49	23.24	13.32	9.97	52.93
2018	45.04	45.09	20.24	12.00	5.86	39.51
2019	43.10	45.06	22.19	11.71	5.12	37.22

Figure 22: Category-wise Specific Freshwater Consumption



	A1	B1	B2	C1	C2	D
Benchmark	40	40	20	10	6	40
2017	32.61	30.99	17.63	7.52	5.41	41.09
2018	38.60	37.76	14.74	6.59	3.52	32.69
2019	32.03	28.65	14.14	4.57	2.57	22.02

Figure 23: Category-wise Specific Wastewater Discharge

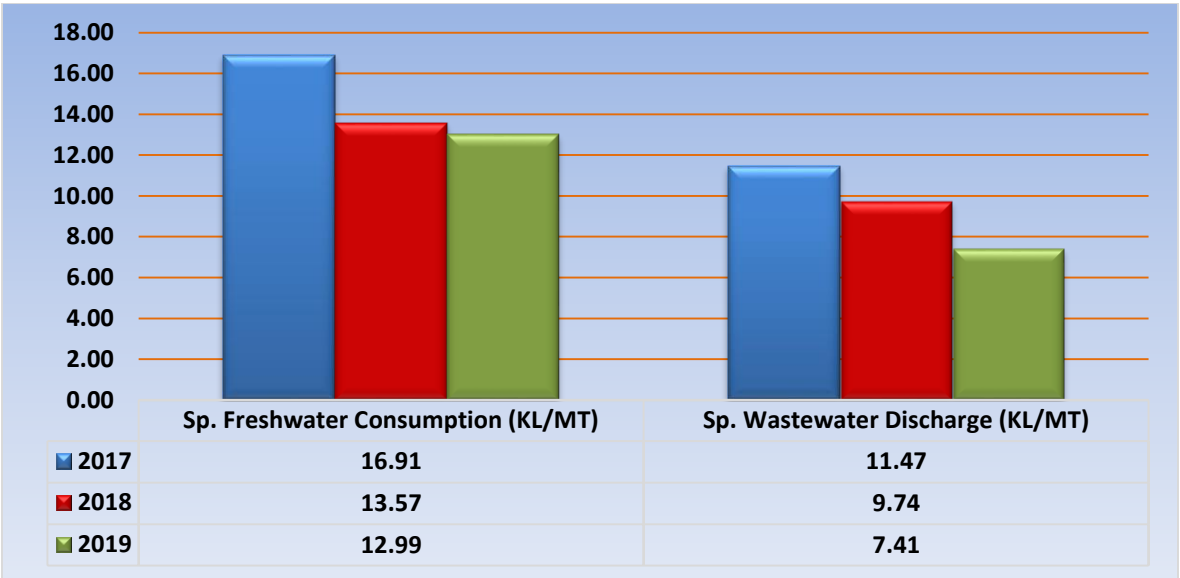


Figure 24: Year wise Comparison of overall specific freshwater consumption and specific wastewater discharge

8.2. Trends in Discharge of Pollution Load

The reduction in waste water discharge through optimisation of water consumption and reduction in waste water discharge as indicated above have contributed to reduction in discharge of pollution load as indicated in Fig 25, 26, 27& 28

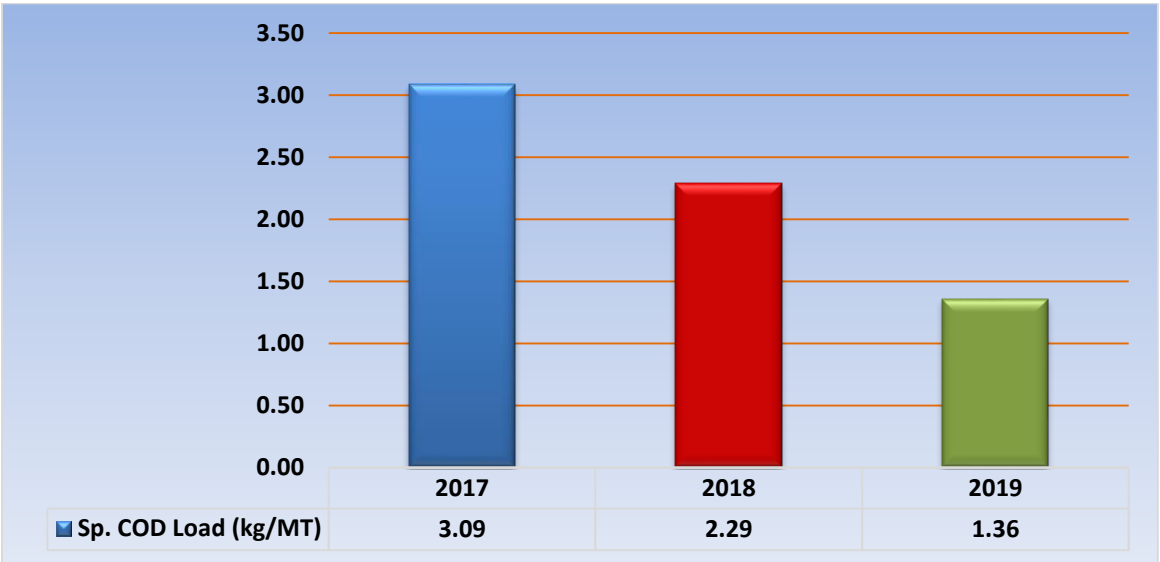


Figure 25: Year wise Discharge of COD Load by Pulp and Paper Mills in River Ganga Basin

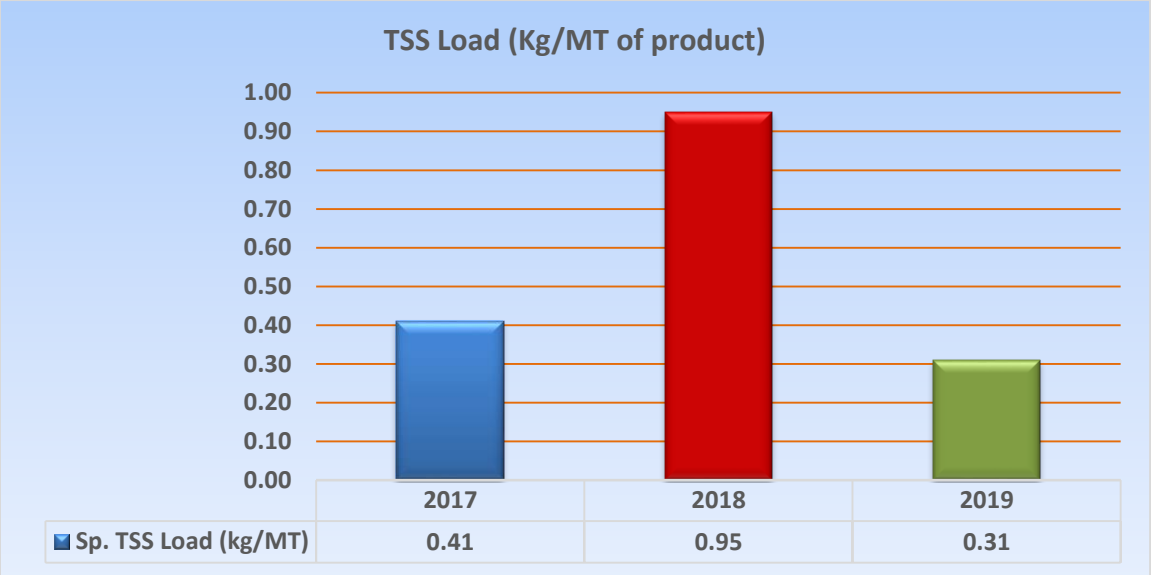


Figure 26: Year wise Discharge of TSS Load by Pulp and Paper Mills in River Ganga Basin

Note: In year 2018, few industries were highly non-performing w.r.t TSS values at ETP outlet and due to that TSS load has increased drastically, suitable actions were taken against these industries

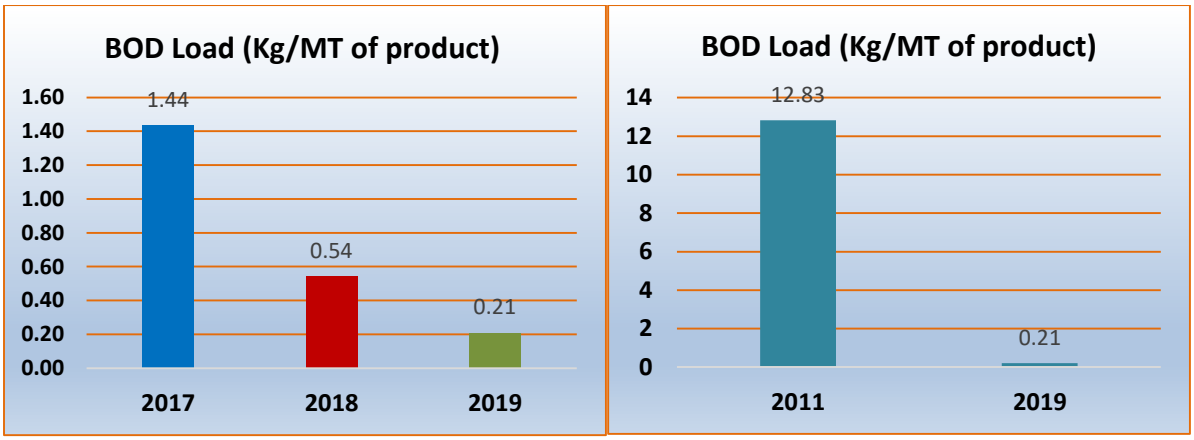


Figure 27: Year wise Discharge of BOD Load by Pulp and Paper Mills in River Ganga Basin

9. CONCLUSION

The useful takeaways of the Charter Implementation are summarised as under:

- Under the Charter the adoption of the Bare Minimum Technologies (BMT)/Best Practicable Technologies (BPT), emphasis on water recycling, water conservation, mandatory installation of flowmeters on borewells, ETP upgradation and modification through ETP adequacy assessment, installation of OCEMS at final discharge, Setting up of ETP monitoring Laboratory, training to manpower on analysis and ETP monitoring etc. have helped the various pulp and paper mills to meet the environmental challenges and ensure their sustainability as well as improve their competitiveness.
- Emphasis on water conservation, monitoring of daily fresh water consumption through installation of flow meters, reuse/recycling of back water and treated effluent, installation of fiber recovery units under Charter has resulted in significant reduction in specific fresh water consumption and consequently waste water discharge. For example, around 44%, 44.5%, 53 % and 74 % reduction was achieved by B1, B2, C1 and C2 category paper mills respectively in 2019 w.r.t 2011 base level.
- Similarly, by the year 2019 specific wastewater discharge also reduced significantly from 2011 level by around 59 %, 53 %, 77 % and 83 % in case of B1, B2, C1 and C2 category.
- The mandatory documentation of daily fresh water consumption, daily waste water discharge, daily energy consumption in ETP, daily Chemical consumption in ETP and analysis of pollution parameters has helped the mills in identification of areas to be tapped for further reducing the environmental impact.
- The Charter has created and awareness among the pulp and paper mills on need to reduce their water and environmental footprint through adoption of environmental friendly and energy efficient technologies
- The successful case studies under the Charter are now being replicated in other regions of the country also.

- Charter has indeed provided a road map to help the paper industry in becoming an environmentally friendly and sustainable industry rather than being considered as a grossly polluting industries
- In all the success of the Charter is result of synergetic efforts of the Paper Industry / Industry Association, Regulatory Authorities (Central & State Pollution Control Board), Technical Institutions (like IITs & CPPRI) and technology suppliers. **(Fig 28)**

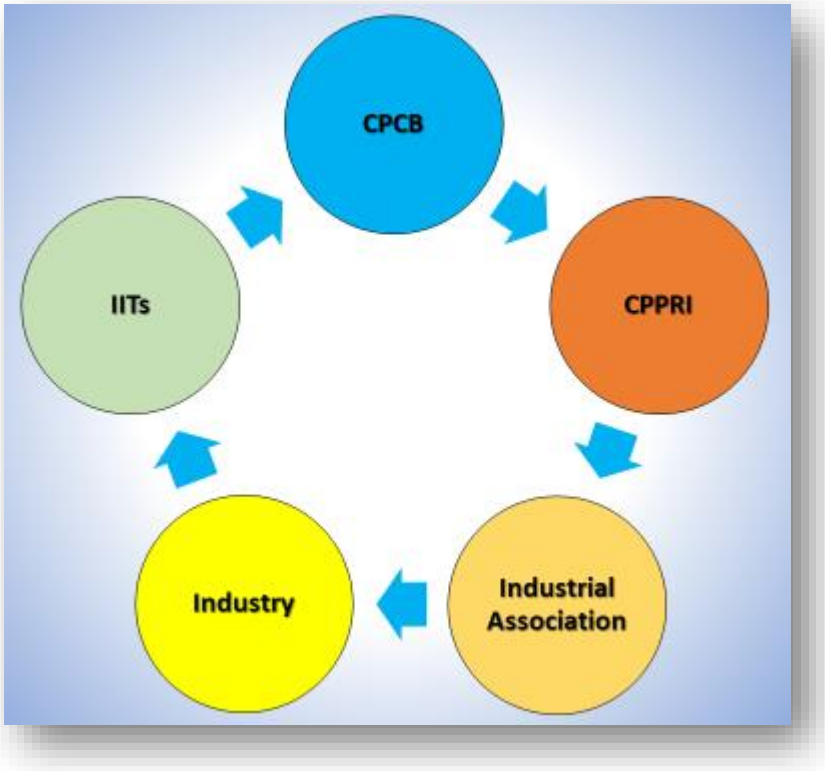


Figure 28: Major Stake Holders in Charter implementation

- The implementation of Charter has helped in upgradation of the status of Pulp & Paper mills in terms of process technology, practices and environmental performance, besides substantial reduction of fresh water consumption, wastewater generation and compliance with the prescribed environmental norms, to achieve desired level of environmental protection, and has contributed in meeting objectives of the National Mission for Clean Ganga to a significant extent from Paper Industry Perspective
- The Charter also suggested/identified **Bare Minimum Technologies** as an indication of the set of desired technologies or its appropriate alternatives required for implementation

by the Pulp & Paper industries operating in the Ganga River Basin States to achieve environmental sustainability.

- In all the Charter has proved to be a holistic approach in reducing the environmental footprint of pulp and paper mills in Ganga River Basin

10. RECOMMENDATION

- The success achieved through implementation of Charter Phase I & II in terms of reduction in fresh water consumption and waste water discharge and eventually the pollution load needs to be sustained on continued basis.
- As such there is a need for periodical review monitoring/inspections by Central & respective State Pollution Control Board or Third Party.
- The Charter should be a continued activity and should be revised/ updated at least after every five years.
- Efforts should be made to develop Low cost indigenous/Make in India tailor made eco-friendly technologies to reduce the environmental burden or production cost.
- Though the issue of color in the paper mill effluent (wood/agro) has been addressed to a certain extent under Charter, there is a need to develop/explore cost effective color removal technologies
- The Charter needs to be extended pan India now.

ABBREVIATIONS

AMU: Aligarh Muslim University

BMT: Bare Minimum Technology

BOD: Biochemical Oxygen Demand

COD: Chemical Oxygen Demand

CPCB: Central Pollution Control Board

CPPRI: Central Pulp & Paper Research Institute

CRP: Chemical Recovery Plant

ETP: Effluent Treatment Plant

IITBHU: Indian Institute of Technology Banaras Hindu University

IITD: Indian Institute of Technology Delhi

IITKh: Indian Institute of Technology Kharagpur

IITR: Indian Institute of Technology Roorkee

KLD: Kilo Litres per Day

MLD: Million Litres per Day

MNNIT: Motilal Nehru National Institute of Technology, Allahabad

NIT: National Institute of Technology

PCC: Pollution Control Committee

PCRI-BHEL: Pollution Control Research Institute –Bharat Heavy Electronics Ltd.

pH: Potential of Hydrogen

SPCB: State Pollution Control Board

TPD: Tonne per Day

TSS: Total Suspended Solids

ZLD: Zero Liquid Discharge

Annexure-I: Questionnaire format for Pulp & Paper industries

CENTRAL POLLUTION CONTROL BOARD
NGRBA Cell
INDUSTRY INSPECTION REPORT (PULP & PAPER)

Date of Inspection: _____

1.	Name of the industry & Complete Postal Address:			
2.	Spatial Co-ordinates (Latitude & longitude) in Decimal			
3.	Name of Contact person with designation Phone & Fax No/Email:			
4.	Year of commissioning			
5.	Category of Industry	Wood /Agro/Waste Paper based		
6.	Installed Capacity,(in TPD & TPA)			
7.	Production Capacity,(in TPD for last three months)			
8.	Specific Energy Consumption (last three years)	**Year 2019-2020 till date**	**Year 2018-19**	**Year 2017-18**
	For process			
	For ETP			
9.	Status of consents & Authorization (validity/applied)	a. Air Consent: b. Water Consent: c. HW Authorisation:		
10.	Status of ground water extraction permission (NOC of CGWA)	Yes/No/Fresh application/Applied for renewal		
11.	Source of Water: (with reading during visit)	No. of bore well: Water Meter Installed: (Y/N) Reading on the day of visit: ……in m^3/hr Totalizer value :……..in m^3 Logbook maintained: (Y/N)		
12.	**Product manufactured in TPD/TPM/TPA:**			
	S.No.		**Product manufactured in MTA**	

	Product (grade/type) & By Product manufactured	**2019-20 (Till date)**	**2017-18**	**2016-17**	
	01				
	02				
	03				

13. Raw material used / tonne of product

S.No.	**Raw Materials**	**Raw Material Consumption Per tonne of Product**		
		2019-20 (Till date)	**2018-19**	**2017-18**
01				
02				
03				

14. Process details (with Material Balance & Flow diagram):

15. **Water Consumption & Waste Water Generated:**

S.No.		**Water Consumption KLD**	**Water Consumption KL/MT of Paper produced**	**Wastewater Generated, KLD**	**Wastewater Discharge, KLD**
01	Process				
02	Domestic				
03	Others				

16. Effluent Treatment / ZLD Scheme for Industrial & Domestic:

In case of ZLD mention availability of flow meters (with flow rate and totalizer reading during visit) at all recirculation lines (Y/N):

Final Disposal: (Land/Water bodies with details):
Flow at inlet of ETP: M^3/Hr (at V notch at the time of inspection)
Flow at outlet of ETP: M^3/Hr (at V notch at the time of inspection)

Name of the drain in which effluent is being discharged:
Route of effluent reaching to River Ganga/tributary:

ETP unit	**Dimension**	**Retention time**	
1. Bar screen Chamber			
2. Equalization tank			
3. Primary Clarifier			
4. Aeration tank			
5. Secondary Clarifier			
6. Sand/multi grade filter			
7. Activated carbon filter			
8. Sludge drying bed			

Analysis results of samples collected by visiting team :

Parameters → / **Sampling location** ↓	**pH**	**TSS**	**TDS**	**BOD**	**COD**	**Colour & Others (Secto**

							r specific parameters)
	Inlet of ETP						
	Outlet of ETP						
	OCEMS	Installed – Yes / No			Connected – Yes / No		

17. **Groundwater Analysis Report-** Quality of Groundwater is compared with Bureau of Indian Standard (BIS) DRINKING WATER — SPECIFICATION (Second Revision)IS 10500: 2012.

Year of Dug	**Depth (meter)**	**Colour**	**pH**	**Total Alkalinity**	**Total Hardness**	**COD**	**TDS**	**Cl^-**	**F^-**	**NO_3**	**SO_4**
Permissible Limit		15	6.5-8.5	600	600		2000	1000	1.5	45	400

18. **Groundwater Analysis Report-** Quality of Groundwater is compared with Bureau of Indian Standard (BIS) DRINKING WATER — SPECIFICATION (Second Revision)IS 10500: 2012

Sample	Parameters (all values are in mg/l)													
	As	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Ni**	**Zn**	**Sb**	**Co**	**Se**	**V**
Permissible Limit	0.05	0.003	0.05	1.5	0.3	0.01	0.3	0.001	0.02	15			0.01	

19. **Recipient Drain's Analysis Report-** Quality of discharged effluent (for all parameters as notified under Environment (Protection) Rules, 1986

Sampling location	Parameters (all values are in mg/l except Colour & pH)								
	Colour	**pH**	**BOD**	**COD**	**TSS**	**TDS**	**Cl^-**	**NO_3**	**NH_3-N**
Up Stream									
Down Stream									
Status (Comply/ Non comply):									

20.	BOD Load (on the basis of inlet quality): BOD Load (on the basis of discharge quality):	
21.	Whether ETP units are adequate to achieve standards (Enclose details with dimensions)	Primary clarifier: Secondary clarifier: Aeration Tank: DMF:
22.	Staff engaged at ETP (in Nos.) ETP Manager : Chemist : Operator/Helper :	ETP Lab details: (give details of instruments available in lab of the unit with photographic evidence)
	Fuel Consumption	

23.	**S.No.**	**Type of Fuel**	**Fuel Consumption, MT or KL**		
			2018-19 (Till date)	**2017-18**	**2016-17**
	01	Coal			
	02	Furnace oil			
	03	Diesel			
	04	Others			

24.	**Stack Details and Source Emission Status**						
	S.No.	**Stack Attached To**	**Stack Ht (m)**	**Stack Dia (m)**	**PM (mg/Nm^3)**	**Opacity meter provided**	**Control equipment**
	01					Yes/ No	
	02					Yes/ No	

25.	**Hazardous Waste Status**					
	S.No	**HW Generated**	**Category**	**Authorised Quantity**	**Quantity Generated**	**Hw Disposal**
	01	Used Oil	5.1			
	02	Wastes containing oil	5.2			
	03	Others				

26.	Management of Solid waste (plastic, pins, glass etc.) Hazardous Wastes (Fly ash): Copy of agreement with recyclers /TSDF (also collect last 4 copies of Form 10):
27.	Installation Status of (1)OCEMS - (2)Web Camera (3)Flow meter : (Y/N) Connected with CPCB/SPCB Server : Y/N(With details)
28.	Action plan implementation status: (As per the sector specific format)
29.	By pass / unauthorised discharge? (Samples to be collected and analysed)
30.	Specific Observations:
31.	Photographs of ETP units, Bore wells flow meters, OCEMS, Inlet & outlet of ETP and others if required (by pass if any):
32.	Date of submission of report