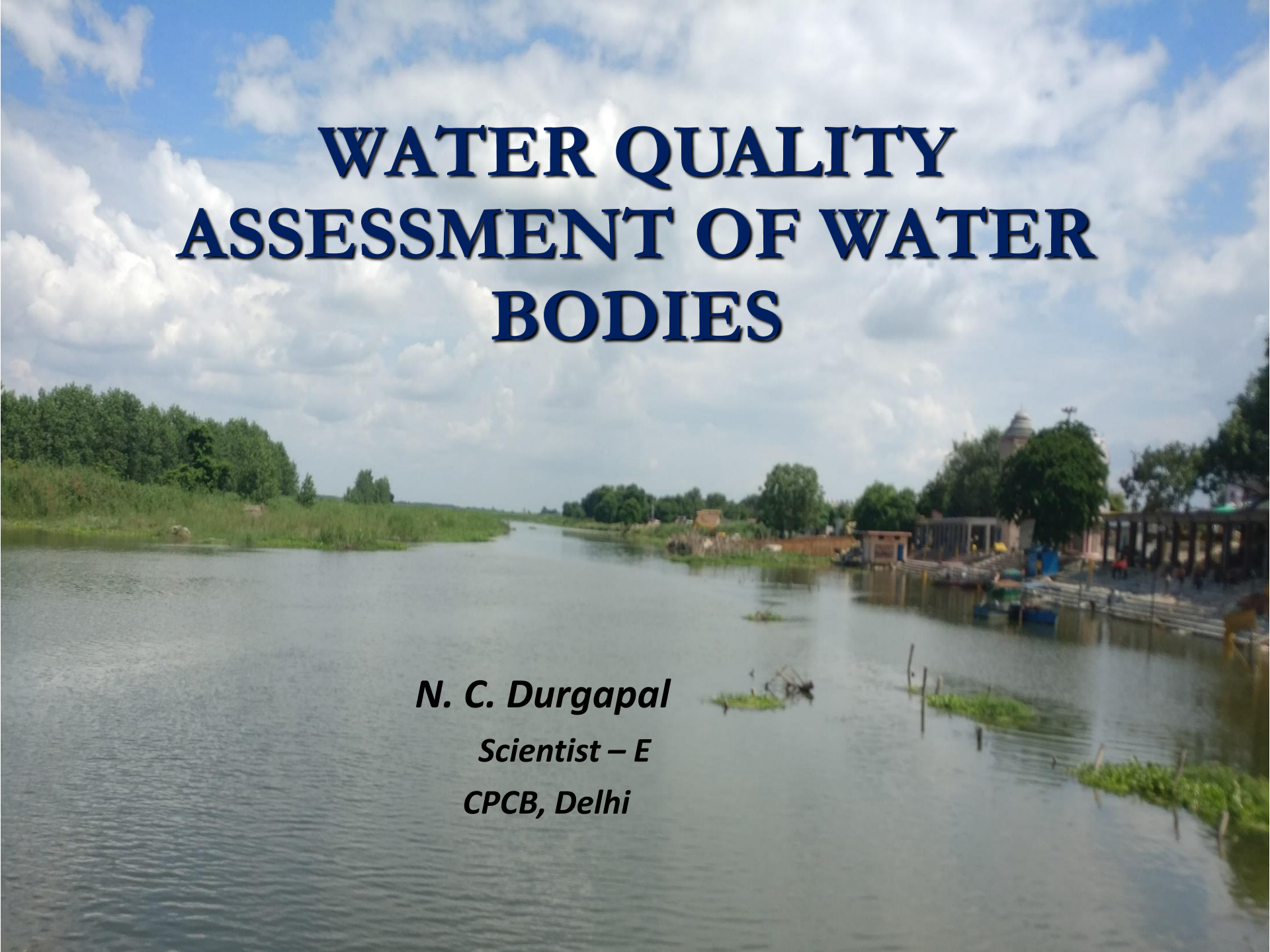

WATER QUALITY ASSESSMENT OF WATER BODIES

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PURPOSE OF ASSESSMENT

- To get information about the status and water quality trends of water bodies, both in terms of concentration and effects.
- To formulate/revision of water quality standards

- To ensure the compliance of prescribed standards.
- To have an idea about the suitability of water for various purposes.
- To compare the water quality with reference location/pristine water quality.
- To find out the impacts of waste water discharges into water bodies.
- To verify the effectiveness of various projects undertaken for water quality restoration.
- To have an idea about the non point sources of pollution.
- To get idea about the assimilation capacity of water bodies.

SITE SELECTION CRITERIA FOR ASSESSMENT

- All samples should be true representative of the sampled water body.
- Site where the water is well mixed
- Baseline station where water is available in natural and pristine state.
- The site should be upstream & downstream of urban center/ industries /tributaries.
- Abstraction site of water for various purposes
- Immediately D/s of an international/state boundary
- Easy accessibility under all conditions of weather.
- At the site where instream use of water is quite prominent along with upstream & downstream
- For lakes at the places of water inflows and outflows, central place and additional sites can be selected based on shape and size of lake.

FREQUENCY OF ASSESSMENT

- Depending upon the variation in water quality, sampling frequency may be half yearly, monthly, fortnightly etc.
- To measure the seasonal variation sample should be drawn on quarterly basis.
- At the site where the water quality depends on diurnal rhythmicity sample should be drawn for 24 hours with an interval of 2-3 hours.

TYPE OF SAMPLES FOR ASSESSMENT

Samples may be categorized into two classes:

- Grab sample: collected from the site where there is no significant fluctuations in water quality.

- Composite sample: it is a mixture of grab samples and of two types-
  - Time composite: where water quality changed frequently, samples collected from same location but at different time
  - Location composite: where the water is not well mixed, samples collected from different locations at same time.

COLLECTION & PRESERVATION OF SAMPLE FOR ASSESSMENT

- Use of proper containers for the collection of the samples on the basis of the parameters to be analyzed.
- Samples should be collected by taking precautions to avoid contamination especially in case microbiological samples .
- Contamination from bottom sediments should be avoided during sampling.
- Leave an air space except in case of volatile compounds to allow for thermal expansion during transportation and proper shaking of sample during analysis.
- Adopt appropriate sampling methodology/sampler to get representative samples.
- To maintain originality of the samples, preservation is essential. Prescribed preservation procedures for various parameters are to be adopted immediately after sample collection.

PARAMETERS USED FOR WATER QUALITY ASSESSMENT

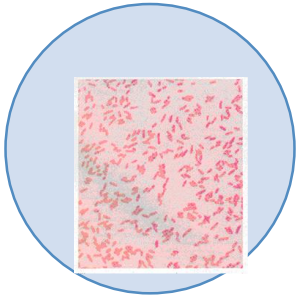
Two categories of parameters can be used for water quality assessment:

Physical

(Temperature, turbidity, solids Conductivity, etc.)

Chemical

(pH, DO, organic matter, nutrients, heavy metals, trace organics)



Microbiological

(indicators of pathogens)

Biological

(bio-monitoring, parameters related with primary production/bioaccumulation /bio magnification, toxicity etc.)

Cause parameters

Effect parameter

PARAMETERS USED FOR ASSESSMENT OF WATER BODIES

1. Notified parameters for bathing water quality under Environment (Protection) Act:

Parameters	value
Fecal coliform (MPN/100 ml)	500 (desirable); 2500 (maximum permissible)
Fecal streptococci (MPN/100 ml)	100 (desirable); 500 (maximum permissible)
pH	6.5-8.5
DO (mg/l)	≥ 5
BOD (mg/l)	≤ 3

2. Parameters used in Designated best use classification:

Designated Best Use	Class of Water	Water Quality Criteria
Drinking water source without conventional treatment but after disinfection	A	**Dissolved Oxygen (Min.): 6 mg/l.; BOD (Max.): 2 mg/l; Total Coliform organisms (Max.): 50 MPN/100 ml; pH: 6.5-8.5**
Outdoor bathing (organized)	B	**Dissolved Oxygen (Min.): 5 mg/l; BOD (Max.): 3 mg/l; Total Coliform organisms (Max.): 500 MPN/100 ml; pH: 6.5-8.5**
Drinking water sources after conventional treatment	C	**Dissolved Oxygen (Min.): 4 mg/l.; BOD (Max.): 3 mg/l; Total Coliform organisms (Max.): 5000 MPN/100 ml; pH: 6-9**
Propagation of wild life, fisheries	D	**Dissolved Oxygen (Min.): 4 mg/l.; pH: 6.5-8.5; Ammonical Nitrogen (Max.): 1.2 mg/l**
Irrigation, industrial cooling, controlled waste disposal	**E**	**pH: 6-8.5; Electrical Conductivity (Max.): 2250 µmhos/cm; Sodium Absorption Ratio (Max.): 26; Boron(Max.): 2 mg/l**

CAUSE PARAMETERS

Cause Parameters	Source	Significance
Physical :		
Temperature	Domestic and industrial	effects aquatic life, causing DO depletion, effects chemical reaction and rate of reaction
Solids	Domestic and industrial waste, soil erosion etc.	Suspended solids- facilitates sludge deposition, anaerobic condition and affects light penetration TDS- important for balancing cell density aquatic flora/fauna
Conductivity	Dissolved ionic substances	Physiological effects on plants/animals
Turbidity	Clay, silt, finely divided organic and inorganic matter, color organic compound, plankton and other microscopic organisms	Reduces light penetration in water thus affecting rate of photosynthesis
Chemical:		
pH	Domestic/commercial and industrial waste	High or low pH is harmful for aquatic life, affects chemical constituents of water
DO	Photosynthesis and diffusion from atmosphere	Essential for aquatic life
Organic matter	Domestic/commercial and industrial sources	Causes depletion of oxygen leading to septic conditions
Sodium Absorption Ratio (SAR)	Natural runoff	High SAR leads to base exchange(replacement of Ca/Mg by Sodium) affecting characteristics of soil
Boron	Natural runoff	High concentration affects crop production
Ammonical nitrogen	Domestic/commercial and industrial	Toxic for aquatic life
Nutrients	Domestic/commercial industrial, natural runoff	Essential for growth of aquatic organisms, excess level causes undesirable growth of aquatic life (eutrophication)
Microbiological:		
Pathogens	Domestic/commercial sources,	Leads to various water borne communicable diseases

EFFECT PARAMETERS:

1. Bio-monitoring/Bio-assessment :

- CPCB is using two indices i.e. saprobic score and sequential diversity score using benthic macro invertebrates (BMI).
- Saprobic Score which indicates presence of biodegradable organic matter in the water, is widely used and internationally accepted index for biological water quality evaluation of streams.
- The saprobic score is evaluated by classifying BMI into 10 categories based on their sensitivity towards pollution. Families with low sensitivity given less weightage and sensitive families are given high weightage.
- Saprobic score often gives anomalous information due to sudden and significant change in water flow, change in composition of riverbed, release of toxic chemicals in the water etc.
- On the basis of saprobic score, biological water quality can be classified into following classes:

Saprobic Score	**Biological Water Quality Class**	**Expected level of Biodegradable Organic Matter (BOM)**
7 or more	Very Good	Very low BOM/High DO
5.0 to 6.9	Good	Low BOM/High DO
3.0 to 4.9	Moderate	Moderate BOM/DO
1.1 to 2.9	Poor	High BOM/Low DO
1	Severe	Very high BOM/Very Low or No DO

- Evaluation of Sequential Comparison Index (SCI) is quite simple and based upon distinguishing organisms by colour, size and shape and requires counting/segregating them sequentially. No taxonomic expertise is required to evaluate SCI.
- This score gives an idea about overall effect of pollutants present in the water.
- In SCI method, chances of variation in index value of a sample exists and greatly depends upon the distribution of organisms in counting tray. The another limitation of this score is that it is unable to provide information about type of organisms i.e. sensitive or tolerant present at a specific site.

2. Photosynthesis/ Respiration Ratio (P/R ratio) :

- P/R ratio of a waterbody is determined by using dark and light bottle experiment for 4 to 24 hrs.
- P/R ratio provides information about the population of decomposers, producers, consumers and level of organic pollution.
- P/R ratio > 1 is good for the stability of ecosystem however, extremely high ratio reflects eutrophic condition. Ratio <1 reflects septic condition and P/R ratio 1 reflects stable condition.

3. Chlorophyll-a :

- Chlorophyll-a is the essential photosynthetic pigment present in all aquatic green plants.
- Concentration of chlorophyll-a provides information on the tropic condition of the waterbody.

4. Toxicity test:

- It is a summary parameter that reflect the combined effects of toxicants/pollutants present in the water body on used aquatic test organism.
- The test can provide information on short term (acute) and long term (chronic) effects of toxicants on aquatic animals.
- Presently toxicity test is used for compliance verification of certain industrial effluents however, it can be used to classify water quality as is applied for evaluation of CEPI.
- The classification of various waterbodies based on fish toxicity used in CEPI is excellent class with no mortality in 5 days, desirable class with no mortality in 3 days and acceptable class no mortality in 2 days.

5. **Bioaccumulation/Bio-magnification:**

- This type of study is generally used for movement, accumulation and buildup of toxicants mainly metals and pesticides from lower to higher trophic level.

QUALITY CONTROL PRACTICES FOR ASSESSMENT OF WATER QUALITY

1. Ensuring true representation of waterbody while collecting sample.
2. Periodic review of sampling location for its suitability to achieve specified objectives.
3. Proper storage and timely analysis of samples .
4. Selection of appropriate method based one expected level of analytes in the waterbody.
5. Calibration of instrument/equipment and glassware.
6. Periodic intermediate check for performance of instrument/equipment.
7. Use of CRM, replicate/ retesting, recovery exercises etc.
8. Regular participation in proficiency testing program and inter laboratory comparison exercises.
9. Ensuring quality of type I and type II water used in analysis.
10. Frequent standardization of secondary reagents in titrimetric analytical methods.
11. Preparation of fresh standard graph for colorimetric analysis whenever fresh reagents prepared.
12. Ensuring purity of critical chemicals used in analysis.
13. Controlling contamination in sample processing/analysis area specially in case of microbiological analysis.