

Pollution due to non-industrial activities and waste disposal, their effects and mitigation

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Presented by

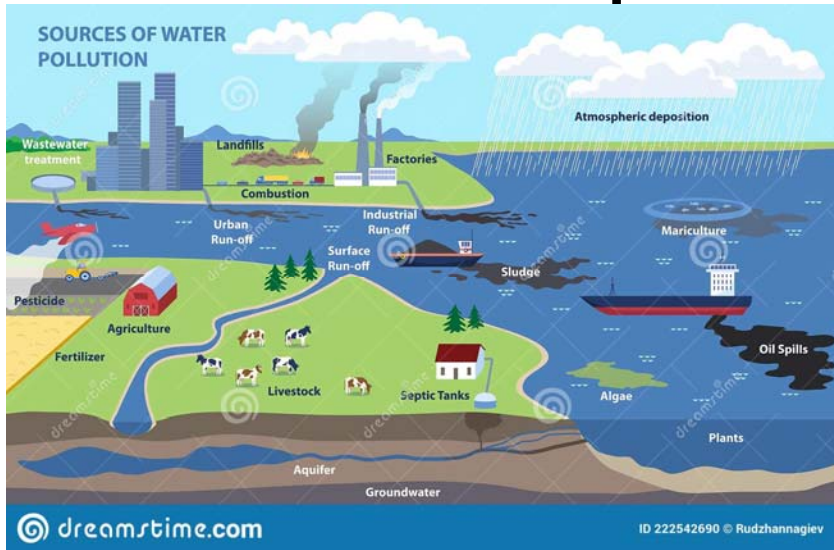
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Introduction

- Mostly the water sources are rainfed or glacier fed or Ocean or Lake.
- Water bodies based Economy and Habitation:
 - water bodies are Lake, river or ocean or estuary.
 - water bodies play a vital role in shaping up the natural, cultural, and economic aspects.
- Water Pollution due to **Non-Industrial Activities** is one of the main concerns for most of the metropolitan cities, Suburban and Rural areas
- Water pollution is a serious concern in India:
 - Almost 70 per cent of its surface water resources and to some extent groundwater reserves are contaminated
 - Contamination covers biological, toxic, organic, and inorganic pollutants.
 - In many cases, these sources have been rendered unsafe for human consumption, irrigation and industrial needs.
 - degraded water quality can contribute to water scarcity
 - Contributing to health hazards and substantial annual deaths (human and animal)
 - lack of water, sanitation and hygiene results in the loss of **400,000 lives per year** in India. India, China, and Nigeria are the top three nations

Water pollution illustrations



Introduction

- **Pollution due to Non-Industrial Activities in India:**
 - more associated to the Behavioural, Sociocultural, Religious reasons.
 - unique country to historical, geographical, religious, political, and sociocultural reasons.
 - Pollution of the river water, local water bodies, ground water and coastal water:
 - Numerous contaminants due to artificial and natural sources
 - caused severe changes in aquatic environments over the last few decades.
 - Serious questions raised for safe use of river water and local water bodies
- **Pollution Statistics India In 2019,**
 - 387 districts were contaminated by Nitrate (prime contaminant),
 - Niti Aayog: 70 percent of the freshwater sources contaminated and
 - Ranks 120 out of 122 countries in terms of water quality.
- **Water pollution crisis origin:**
 - pollution loads exceed the natural regenerative capacity of a water resource.
 - Shortage of surface water both due to unplanned growth of human habitat and climatic changes
 - Heavy demand based load on the use of ground water.
 - Major sources: landfills, septic tanks, leaky underground gas tanks, and from overuse of fertilizers and pesticides.
 - Untreated domestic sewage discharged into local water bodies is major source of pollution.

Water Quality Indicators

- Physico-chemical indicators: **dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus)**
- Physical, chemical, and biological compositions determine the quality of water ([Allee and Johnson, 1999](#)).
- Heavy metals, pesticides, detergents, and petroleum form the chemical composition ([Tiwari et al., 2020](#)).
- Turbidity, color, and temperature comprise the physical composition, whereas the biological arrangement includes pigments and planktons.
- Observation and analysis of these water quality parameters need sampling from extensively distributed locations, which is time consuming and requires a lot of field and lab efforts.

WATER QUALITY DATABASE

Maintained by CPCB

National Water Quality Monitoring Programme (NWMP)

- Water Quality of Rivers 2019
- Water quality of Medium and Minor Rivers 2019 (State wise)
- Water quality of Canals, Seawater, Drains, STPs & WTPs 2019
- Water quality of Lakes, Ponds and Tanks 2019 (State wise)
- Water quality of Ground Water 2019 (State wise)

River	Location	temperature		Dissolved Oxygen (Mg/L) >5Mg/L		pH 6.5-6.8		Conductivity Mmho/Cm		Bio-Chemical Oxygen demand (Mg/L) <3Mg/L		Nitrate (Mg/L)		Faecial coliform (MPN/ 100 mL) < 2500 MPN/ 100 mL		Total Coliform MPN/ 100 mL	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Mahanadi	SIHAWA, CHHATISGARH	23	29	6.2	6.8	7.2	7.8	308	358	-	-	-	-				
	Cuttack, Odissa	18	34	6.2	8.7	6.9	8	147	264	0.5	1.8	0.1	0.6	45	7900	78	17000
Godavari	Nashik, Maharashtra	20	30	5.7	6.5	6.9	7.9	198	782	2.2	4.4	0.3	4.3	1.8	1.8	120	220
	Pollavaram, Andhra	25	34	5.9	8.5	7.1	8.4	147	284	1	2.4	0.27	6.03	5	14	45	150
Krishna	Mahabaleswar, maharashtra	22	31.5	2.9	6.9	7.1	8.2	82	1174	1.8	11	0.3	3.3	7	195	45	1600
	Vijaywada, andhra	22	28	7	7.4	7.1	8	286	1041	0.8	1.6	0.36	1.36	1.8	3	210	800
Ganga	Gangotri, uttarakhand	-	-	9.8	9.8	-	-	-	-	-	-	-	-	7	7	9	9
	Kanpur, UP	16	32	6.1	10.6	7.9	8.8	203	350	2.3	4.4	-	-	1400	3400	3300	5800
	Patna, bihar	19	34	6.3	8.8	7.7	8.6	250	479	1.7	2.6	0.11	1	1100	28000	11000	160000
	Diamond harbor, WB	19	36	4.3	7.8	6.8	8	319	8049	1.2	4.1	0.09	3.81	400	11000	11000	220000
Yamuna	Yamunotri, Uttarakhnad	-	-	9.8	9.8	7.3	7.3	64	64	BDL	BDL	0.4	0.4	2	2	4	4
	Nizamuddin, Delhi	14.7	32.5	BDL	2.4	6.9	7.3	589	1550	7.3	35	0.3	1.2	490000	920000	490000	240000
	Allahbad, UP	22.7	33	6.8	11.7	7.4	8.3	5	452	1.9	2.6	1.3	1.5	1700	7900	4600	14000
Brahmaputra	Dibrugarh, Assam	13	29	5.2	9.1	7.1	8	47	216	1.1	2.2	0.8	2.3	300	1100	360	4300
	Guwahati, Assam	22	32	6.2	9.2	7.2	7.9	72	174	1.2	2.2	1	3	300	730	700	2100

Non-Industrial activities

affecting water bodies in India

- Untreated unplanned sewage from households
- Agricultural runoffs
- Massive Domestic uses of the water bodies for bathing, cleaning, washing
- Disposing dead bodies and idols in water bodies
- Indiscriminate littering of by products of Consumer goods and its packaging materials
- deforestation effects of water bodies.
- Natural disasters effect on water bodies
- Oil spill of Motored boats in coast, estuary and River

Household borne effluents India

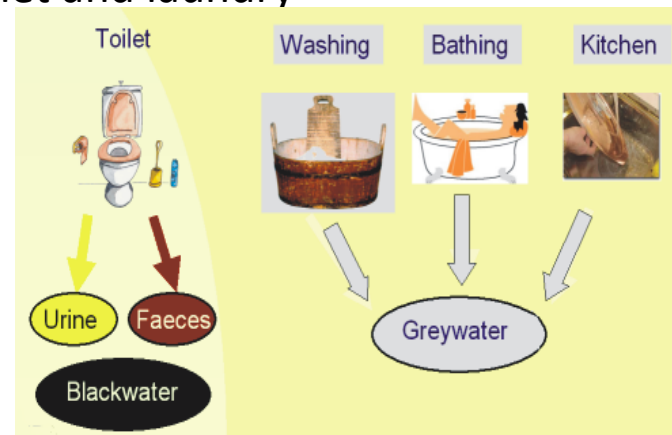
Discharge of domestic sludge containing organic substances and soaps.

- origins from kitchen, shower, wash basin, toilet and laundry

These untreated substances generally pour into superficial river flows but sometimes reach aquifers.

Can be reduced through purification methods and technologies.

contribute a substantial proportion of water pollution. 70 % of effluents are not treated before disposed off to water bodies.



Responsibility of treatment:

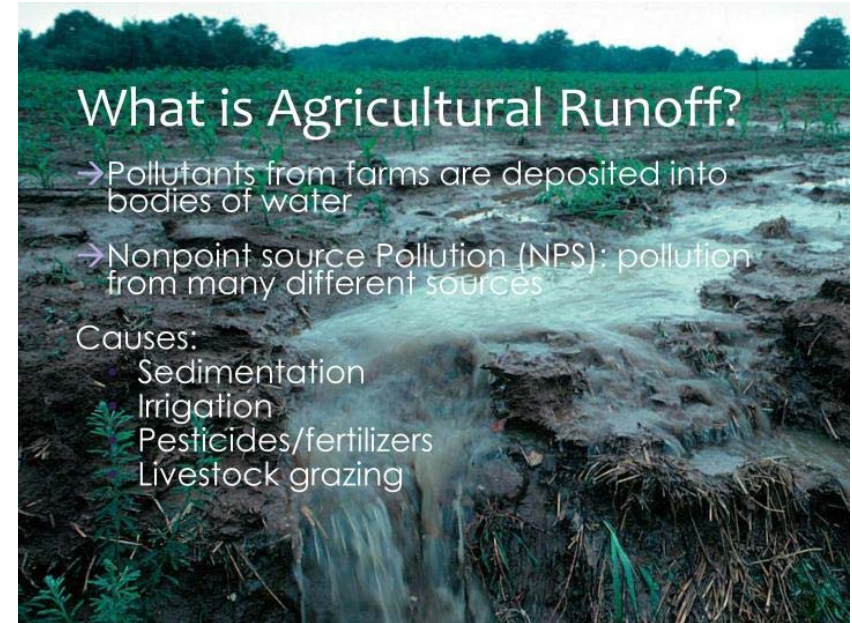
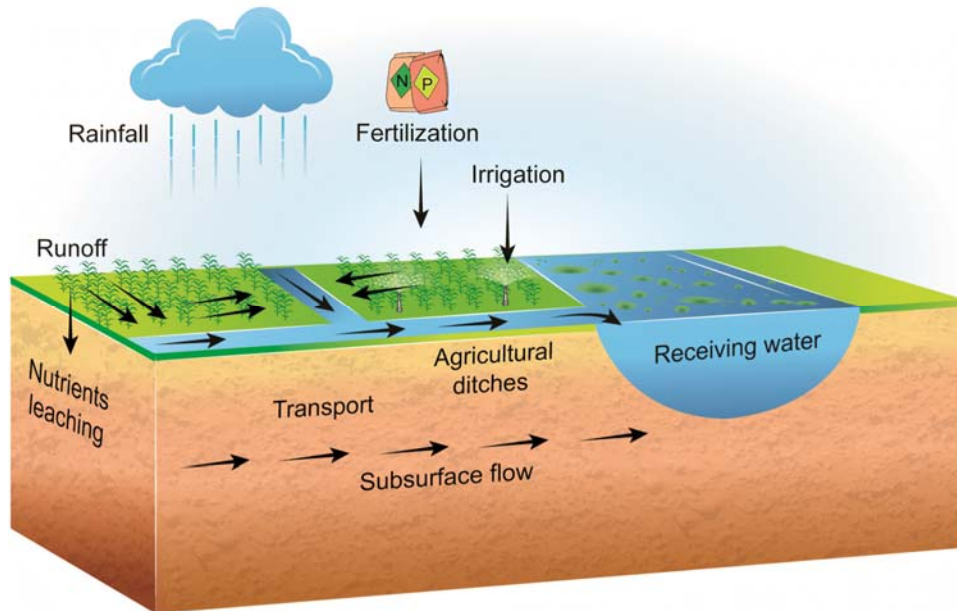
Local governments (city corporations, municipalities, and panchayats) as per national water pollution standards or minimal national standards (MINAS)

Swach Bharat Abhiyan is coming up with solutions regarding open defecation, solid & liquid waste management and ensuring pipeline water supply.

Agricultural Run-Offs

- [Agricultural Runoff](#) is water from farm fields due to irrigation, rain, or melted snow that flows over the earth that can absorb into the ground, enter bodies of waters or evaporate.
- Contain pesticides, sediment (soil particles), nutrients (phosphorus, nitrogen and potassium from fertilizers) and metals.
- Pick up other pollutants in the course of flow.
- Affect groundwater and surface water sources.
- Fertilizers allow organisms to proliferate by increasing the nutritional content of water courses. These organisms may be disease vectors or algae.
- Also these runoffs gets absorbed into the **plants and animals and fishes**. This creates **metabolic nuisance** with the secondary and subsequent user of these plants feeders (including human) and fishes.
- These impacts can be reduced by adapting management practices to local conditions. These practices can include implementing nutrient management plans, using high-efficient irrigation equipment, and limiting pesticide use.
- fertilizer use increased from 7.7 MT in 1984 to 13.4 MT in 1996 and pesticide use increased from 24 MT in 1971 to 85 MT in 1995 (Bhalla et al. 1999).

Agricultural run-offs Illustrations



Bathing, Cleaning, Washing

Human and Animals in

Stagnant and Running water sources

A study on 30 Lakes in Navi Mumbai by Greenline and SIES College, Nerul :

- No industrial effluents were being discharged into any lake.
- Of the 30 lakes the study found 60% were polluted, 13% had a foul stench and only 20% were clean. Majority unfit for drinking.
- While water from 36% of the lakes was being used to wash clothes, vehicles were washed across 19%, and another 19% were used for bathing.
- All lakes are used for idol immersions, dumping of solid waste like food packets, wrappers, and Nirmalaya [flower waste].
- At certain lakes, the water appeared black with an oily film on the surface.

With increasing population the human and animal use load increasing on water bodies. Individual washing has changed into commercial washing

With consumerism gripping to whole urban and village domain – Besides simple bathing and washing clothes **the changed habit** is dumping huge wastes and chemicals into water bodies

Bathing, Cleaning, Washing illustrations



Dead bodies and Idols Disposal

- Dead bodies surfaced in the Ganga river
 - The NGT criticised the government for its failure to curb river pollution
 - Human body and Animals
- Idol immersion
 - Ganesh Chathurti, Durga Pooja and remnants of Chhat Pooja
 - Plaster of Paris, toxic paints, cloths, plastics and other material.



Deforestation Effects on Water Pollution.

- Forest dependency:
 - 2018 [FAO report](#), three-quarters of the Earth's freshwater comes from forested watersheds,
 - The UN's [2018 State of the World's Forests report](#) : over half the global population relies on forested watersheds (drinking water, agriculture and industry).
- The loss of forest cover:
 - increases runoff, hence accelerate soil erosion and **increase the sediment load and turbidity of water sources**, thus decreasing the water quality.
 - causes **climate change, desertification, soil erosion, fewer crops, flooding.**
 - **forest areas lost for other uses such as agricultural croplands, urbanization, commercial use of wood or mining activities.**
 - Negatively affecting natural ecosystems, biodiversity, and the climate.
- Strategy to reduce deforestation:
 - Plant a tree, Use less paper, Use recycled products, Buy only sustainable wood products, Do not burn firewood excessively, Practice eco-forestry, community forestry, respect rights of indigenous people,
 - Raise awareness on all the above.

Effects of Deforestation

- Disrupts water and Carbon Cycle
- Loss of Biodiversity

- Soil Erosion
- Poor water Quality

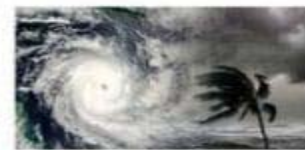


Natural Disasters

- **floods, hurricanes, tornadoes, earthquakes, and tsunamis,**
- Disrupt and contaminate water supplies.
- Flooding and other disasters damage drinking water wells and soil erosions
- livestock waste, human sewage, chemicals, and other impurities contaminate water body



NATURAL DISASTERS
TYPES, EXAMPLES AND PRECAUTIONS



Oil spill of Motored boats

in coast line, large lakes, estuary and River

- **National Green Tribunal** (Eastern Zone Bench, Kolkata) on **polluting the Sunderban atmosphere**: It's order dated 01/07/2015 regarding pollution caused by motor boats using adulterated fuel.
- **Ganga River** is getting polluted with **harmful gases like sulphur dioxide (SO₂) and nitrogen dioxide (NO₂)** due to uncontrolled operation of motorboats (2016 news).
- **View of DFO**: Boats pose pollution threat to Mattupetty lake, kerala. It's a small reservoir and does not justify the use of motor boats. **Row boats or pedal boats** would be a better option”.
- **The fossil fuel driven motor boats** pose threat to the coast line, large lakes, estuary and River. **Solar and Electric boats** may be promoted to reduce the effect of gasses, noise, oil spil related pollutions.
- **The commercial operation of boats** increases the plastic and organic wastes in these water bodies. Adequate, **segregated waste collection and disposal** needs to be inbuilt in the motor boats and Ghat Platforms.

Oil spill of Motored boats



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The control of water pollution

- **Ways to control water pollution:**
 - To reduce the pollution loads from anthropogenic activities to the natural regenerative capacity of the resource.
 - Prevention
 - Segregations of wastes at source
 - Cleaning of water bodies from solid wastes
- **Benefits of Abatement of water pollution**
 - marketable benefits: reduced water borne diseases, savings in the cost of supplying water for household, industrial and agricultural uses, control of land degradation, and development of fisheries,
 - non-marketable benefits: like improved environmental amenities, aquatic life, and biodiversity.

Urbanisation Process and Effects

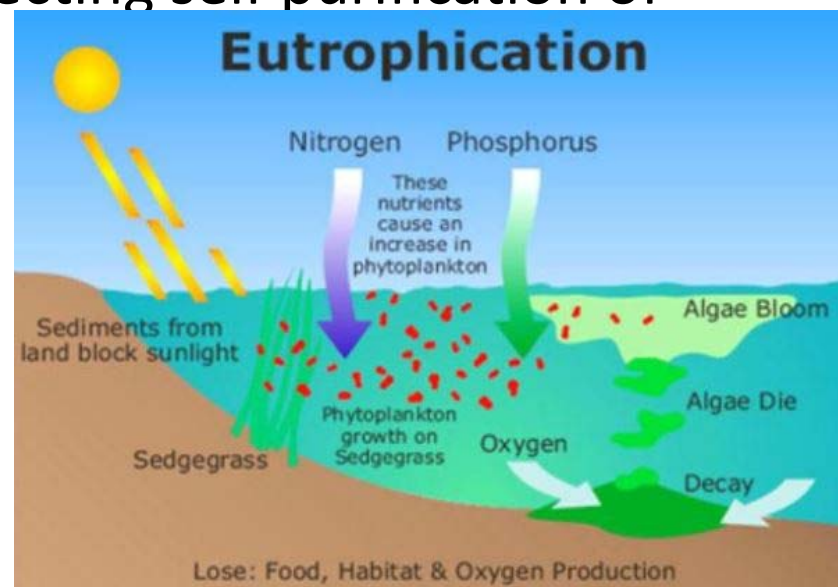
- The process of shifting of people: Rustic areas=>the town areas (brighter future perspective) = **URBANISATION**.
- Weak planning and mass movement => unthoughtful plundering => deterioration of natural resources
- Exponential increase of cities => stress on the weakening natural resources.
- **Artificial infrastructure** <= unmatchable => **Agricultural and natural wetlands**
- The rate of infrastructure expansion <= unmatchable=> amplified requirement of water, deficiency of sewage facilities
- the pace of urbanization <= unmatchable=> available amenities => **Forceful Environmental nuisances**
- Urbanisation effects:
 - **The random and huge constructions** blocks the natural flow path of water causing floods in city
 - **Excess habitual and forced littering of wastes:** flows to the water body and chokes the flow pathway
 - **The organic wastes** create pathogenic issues and excess nutrient to water bodies.
 - **Heavy metals and organic wastes** turn the water unfit for human and animal consumption
 - The **collective effect of all above** change the environment and ecology

EFFECTS OF WATER POLLUTION

- Destruction of biodiversity.
- Contamination of the food chain. ...
- Lack of potable water. ...
- Disease. ...
- Infant mortality.
- Contaminated water can
 - transmit diseases such **diarrhoea, cholera, dysentery, typhoid, and polio.**
 - Chemicals in the water also have negative effects on our health.
- water-borne diseases are **Typhoid, Cholera, Paratyphoid Fever, Dysentery, Jaundice, Amoebiasis and Malaria.**

EFFECTS OF WATER POLLUTION

- Causes water-borne disease.
- Destroys microorganisms affecting self purification of water.
- Decreases dissolved Oxygen.
- Changes water temperature.
- Disturbs aquatic life.
- Kills aquatic organisms.
- Destruction of biodiversity:-
 - depletes aquatic ecosystems and
 - triggers unbridled proliferation of algae and aquatic plants hence eutrophication.

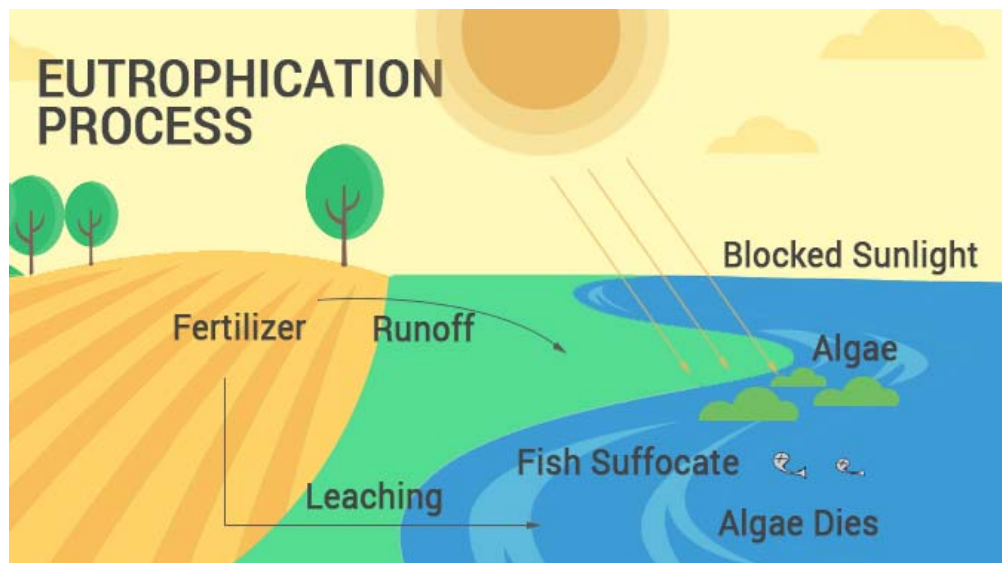


Eutrophication



Eutrophication occurs in 4 simple steps:

- NUTRIENTS:** Excess fertiliser nutrients run off and detergent from washing
- ALGAE BLOOM:** the nitrate and phosphate spark the overgrowth of algae
- OXYGEN DEPLETION:** Algae blocks sunlight and uses up oxygen. oxygen-depletion process in water starts.
- DEAD ZONES:** completely depleted of oxygen becomes a dead zone and can no longer support life.



Algal boom around city



Solution to water pollution in India

Prevention is the one point solution:

- conservation of soil: Reduce soil erosion ⇔ Prevent water pollution => Planting more trees
- toxic waste management: use efficiency => Segregation and storage=> recycle or right mechanism for disposal => zero exposure to environment
- Other contaminant source: use efficiency with minimum exposure to environment.
- Oil Spill: efficient mechanism of car/machines wash and repair.
- Cleaning up waterways and beaches
- Avoiding the usage of non-biodegradable material like plastic

Evolving norms and actual practices

- **Topdown or a centralized approach:-**
- Economic instruments, command and controls are instruments of formal regulation are designed and implemented by the Government.
- The success of these instruments in controlling pollution depends upon the quality of governance and its ability to incur high transaction costs.
- **Bottom-up or decentralized regulation:-**
- Major involvement of civic society and local communities and with a very limited role of the government. Low transaction costs and get rid of political and bureaucratic corruption.
- The optimal level of pollution control could be realized through the bargaining between the polluters and the affected parties. The limited government intervention are:
 - Authorisation to public on environmental resources,
 - Awareness creation and
 - Public Private Participation (PPP).

Government Efforts

- **The National River Conservation Plan (NRCP)**, targeting the domestic pollution that goes into the surface water.
 - Launched in 1985, NRCP started its work with the Ganga Action Plan.
 - It covers 190 towns and 41 rivers across India.
 - Around 4704 million litres of sewage is getting treated per day.
 - The work of NRCP is done at various levels, from interception and diversion to the treatment of sewage.
 - NRCP largely failed due to lack of co-operation between different implementing bodies, funding imbalances across the sites, and inability to keep pace with the growing sewage load.
- **Central Ground Water Board:** Assessment, conservation, augmentation and maintaining quality & Standards of ground water.
 - Develop and disseminate technologies
 - monitor and implement national policies
 - Objective of protection from pollution and distribution, based on principles of economic and ecological efficiency and equity.

Government Efforts

- The **Central Pollution Control Board (CPCB)** : an apex body => **water quality** management.
 - National Water Quality Monitoring Network 1,429 monitoring stations in river and water bodies
 - **National Lake Conservation Plan (NLCP) and National Wetland Conservation Programme (NWCP)** => National Plan for Conservation of Aquatic Eco-systems (NPCA)
- National Green tribunal: The Quasi Judicial body for environmental justice.

Laws for Controlling Water Pollution in India

- **the Water Act (1974),**
- **the Water Cess Act (1977 and 1988), and**
- **the Environment (Protection) Act or EPA (1986).**
- these laws have mainly remained confined to controlling industrial water pollution. CPCB and SPCBs coordinate the activities. The act related to water cess is more of a revenue-generating legislation than a measure to restrict the consumption of water by industrial units.
- These laws do not cover the regulation of water pollution originating from the household and agriculture sectors.

GOI Instruments for Pollution Control

The government's approach:-

- Prevention of pollution has been mostly through legislation-based command and control measures
- Natural resource management has been largely carried out through programmes supported by allocations from **Central Government** (programmes of the Ministry of Environment and Forests, Ministry of Non-conventional Energy Sources, and the Ministry of Agriculture, etc.) and state budgets.
- The use of fiscal instruments (other than the expenditure policy) for the control of pollution and management of natural resources has gained recognition since the 1990s. This is very limited so far.
- market based instruments (MBIs) : Only for Industrial pollution abatement.

The overall effects of Water Pollution

Public Health and Economics

- Lack of water, sanitation, and hygiene:
 - the loss of life/death: **0.4 million** (air pollution : 0.52 million people)(WHO 2007).
 - The loss of disabilities adjusted life years: **30.5 million**
- Annual socio-economic costs of water related diseases(Parikh 2004). :
 - Infant death (under 5 years): **1.5 million**,
 - Days of work are lost: **200 million person**,
 - Financial loses to the country: **Rs 366 billion**
- Groundwater resources contaminated with fluoride and arsenic.
 - Fluoride problems exist in 150 districts in 17 states in the country.
 - weak bones, weak teeth, and anaemia due to High concentration of fluoride in drinking water.
- Parikh (2004) estimation for year 1995 on ill effects of water pollution and poor sanitation facilities :
 - the cost of avoidance to be much lower than damage costs.
 - **India lost Rs 366 billions =>3.95% of GDP**
 - Cost of Mitigation: **1.73 to 2.2 % of GDP** by providing better sanitation facilities and doing abatement of water pollution.
 - the abatement of pollution is socially desirable and economically justified.

Mitigation of water pollution

- Reduction of pollutant concentration by **dispersion, dilution, deposition or degradation.**
- planned **segregation and dispersal** of human habitat across the water bodies .
- Planned **supply, storage and efficient use** of surface water .
- **Recharge** the ground water aquifer with quality/clean water.
- **Prevention of pollutants in catchment areas** of water bodies

The mitigation need

- **Efficient segregation and disposal of domestic wastes**
 - Prevention of waste in catchment area of water bodies
 - Composting of organic materials
 - Recycling of inorganic, plastics and metals
- **Optimum use of fertiliser and chemicals in agricultural practices**
- **Stop all commercial cleaning and washing activities in stagnant water bodies**
- **Dead body and idols not to be disposed in water body**
- **Deforestation: tree plantation, less use of wood products, Practice eco-forestry, community forestry,**
- **Promoting Solar and Electric boats; segregated waste collection and disposal**
- **Monitoring and restriction of wastes in water bodies**
- **A changed public perception towards littering habits and clean environment**

The mitigation in practice

- **Domestic wastes:**
 - Inefficient and improper planning segregation and disposal
 - Public cooperation minimal
- **Imbalanced and heavy dosing of fertiliser due to low productivity**
- **Gradual adoption of cleaning and washing activities at home and commercial buildings. Purification of exit water not in practice**
- **Awareness on Dead body and idols non-disposal in to water body increasing. Any major change in practice yet to be seen.**
- **Deforestation: social and community tree plantation is very minimum, Non efficient land use with less productivity**
- **Mostly fossil fuel boats are running and less segregation and collection and disposal of wastes in Boats and Ghat platforms.**
- **Overall Plastic segregation and collection and disposal is yet to be seen in large scale**
- **Ban of less than 100 micron plastic: Government seems aggressive**
- **Waste disposal through recycling and conversion not seen in organised sector**
- **Very less monitoring and inefficient restrictions**

The mitigation way ahead

- **Domestic wastes:**
 - Maximum prevention and segregation at source
 - Organised approach to recycling and conversion (PPP)
 - Complete change of Public perception
- **Use of organic fertiliser and efficient use liquid fertiliser spray and other modern techniques.**
- **Complete water purification and recycling solution at home and commercial buildings. Minimum and efficient water use.**
- **Complete avoidance of Dead body and idols disposal. NGT directions and change in public perception towards alternative mechanisms. Availing ecofriendly dead body disposal.**
- **Deforestation: promotion of social and community tree plantation; Efficient land use with more productivity.**
- **Complete switch over to pedal, solar and electric boats. Complete ban of waste throwing in stagnant water bodies.**
- **Zero plastic waste in the environment to be achieved : Awareness, BAN, Penalty, widespread availability of segregated dustbins in public places.**
- **Changing Public perception towards zero waste Environment:**
 - Compulsory teaching and practice in schools
 - Promoting community practices

Thank You