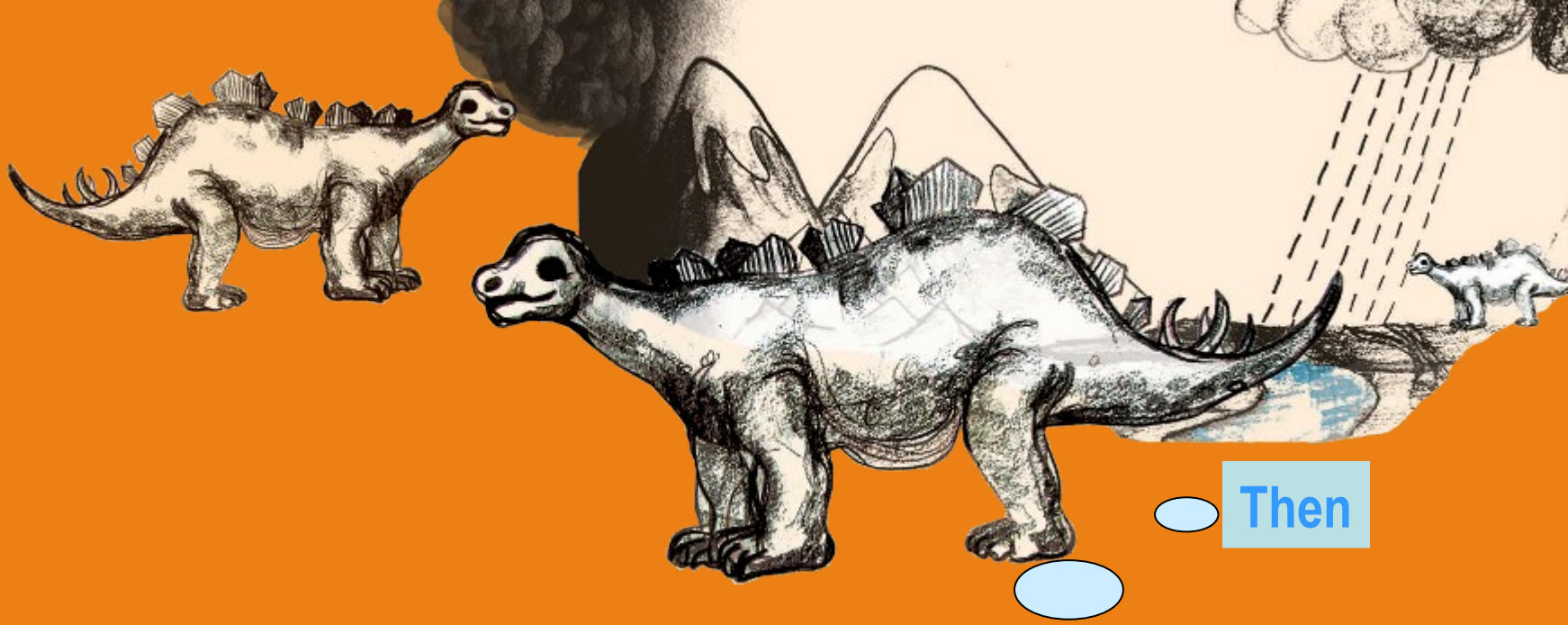
THE BLUE PLANET

From outer space, the Earth looks **BLUE** in colour. That's because approximately 70% of the Earth is covered with water



Q. Do we have less water today than a million years ago?

A. The same amount of water

Now

The water cycle

Is there a water problem?

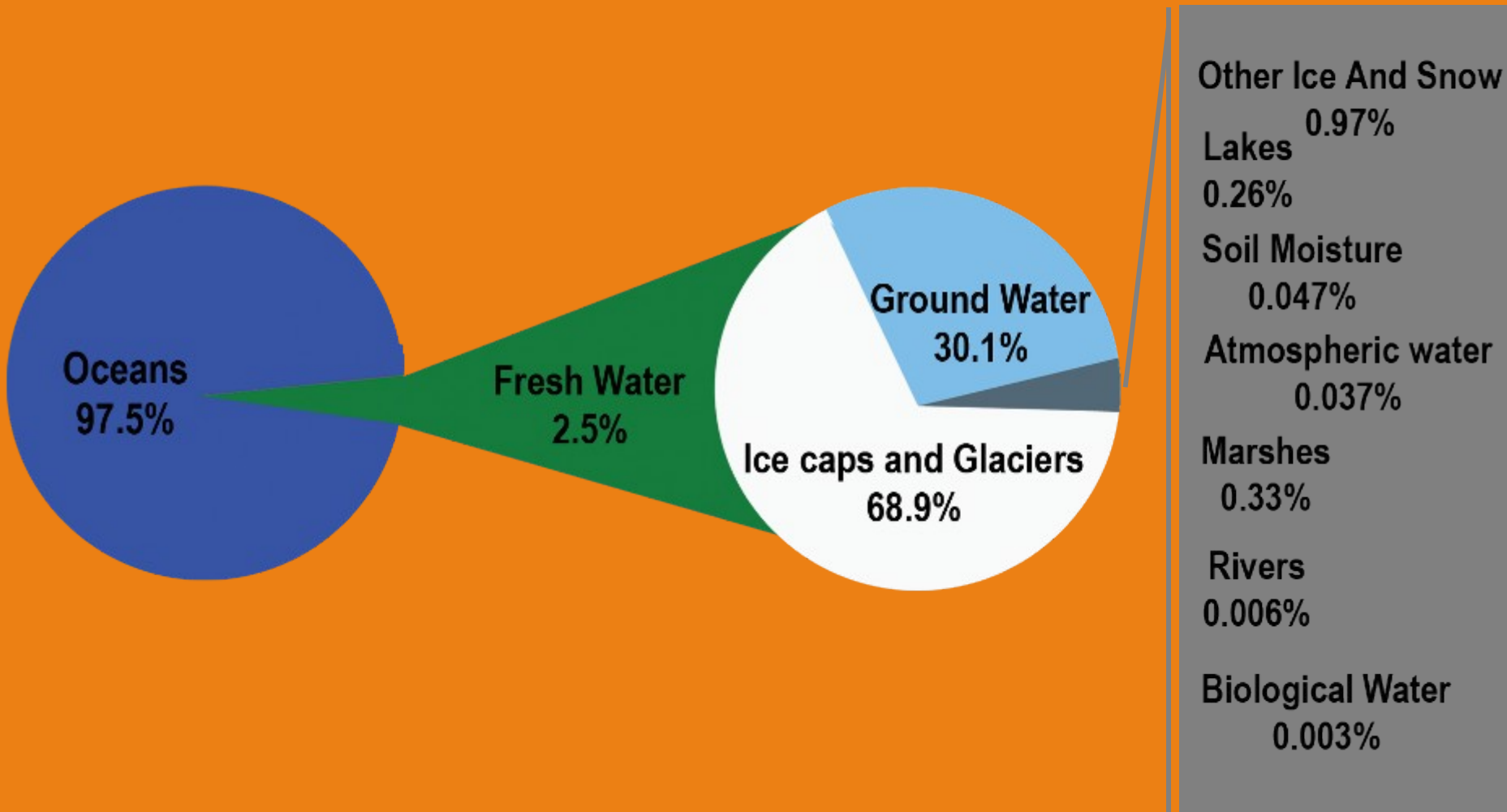
Approximately **70%** of the Earth's surface is covered with water.

The absolute quantity of water has not changed over the years.

Then why are we talking of a **water crisis?**

Why do we need to conserve water?

ISTRIBUTION OF GLOBAL WATER



If all the world's water could fit into a bucket

Water available for drinking would be less than a teaspoon

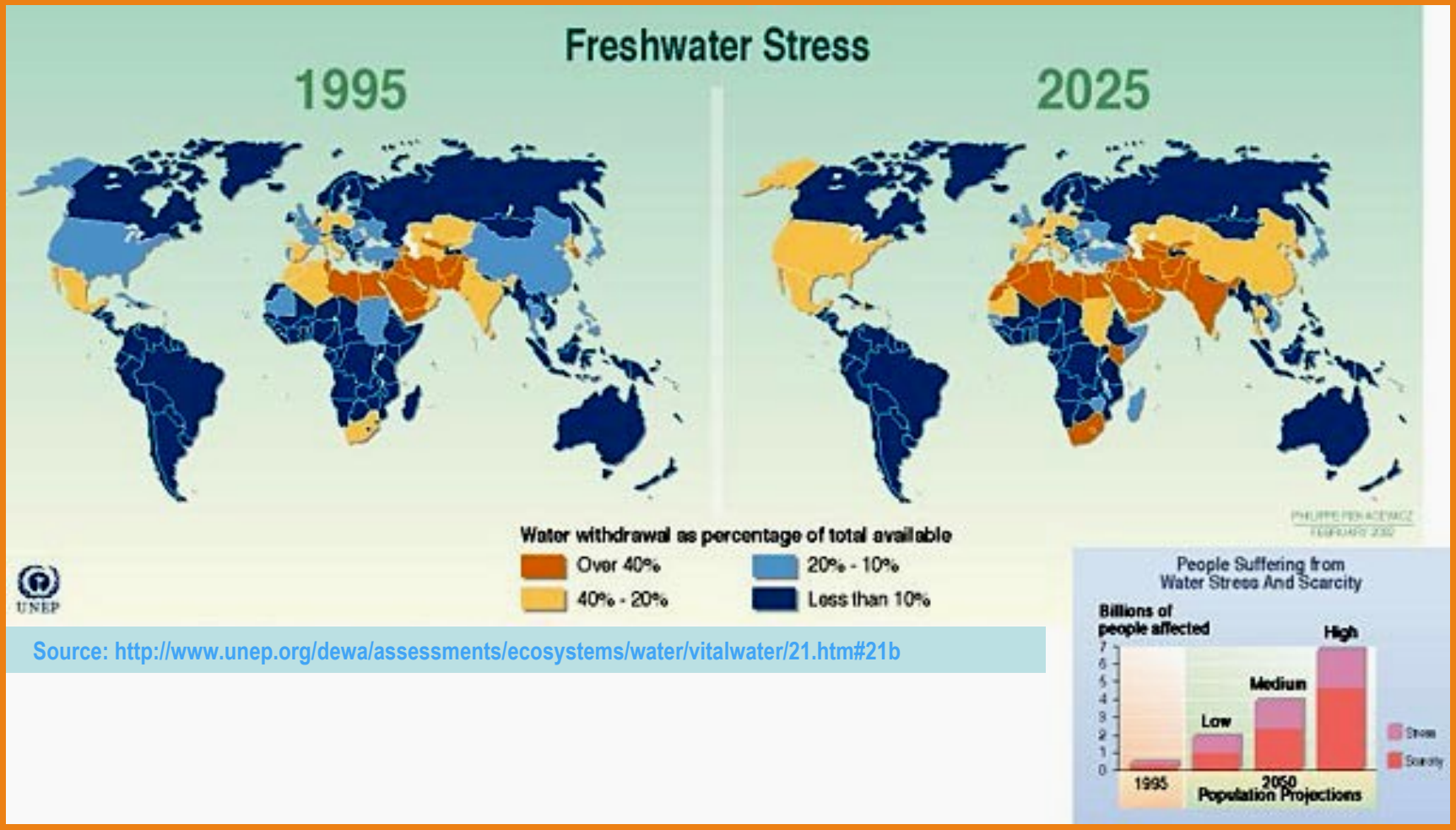
Salt Water = 97.5%

Sustainable freshwater supply for human use = 0.01%

Recommended activity - A drop of water

Fresh Water Stress

Mismatch between regions of large population and available freshwater resources



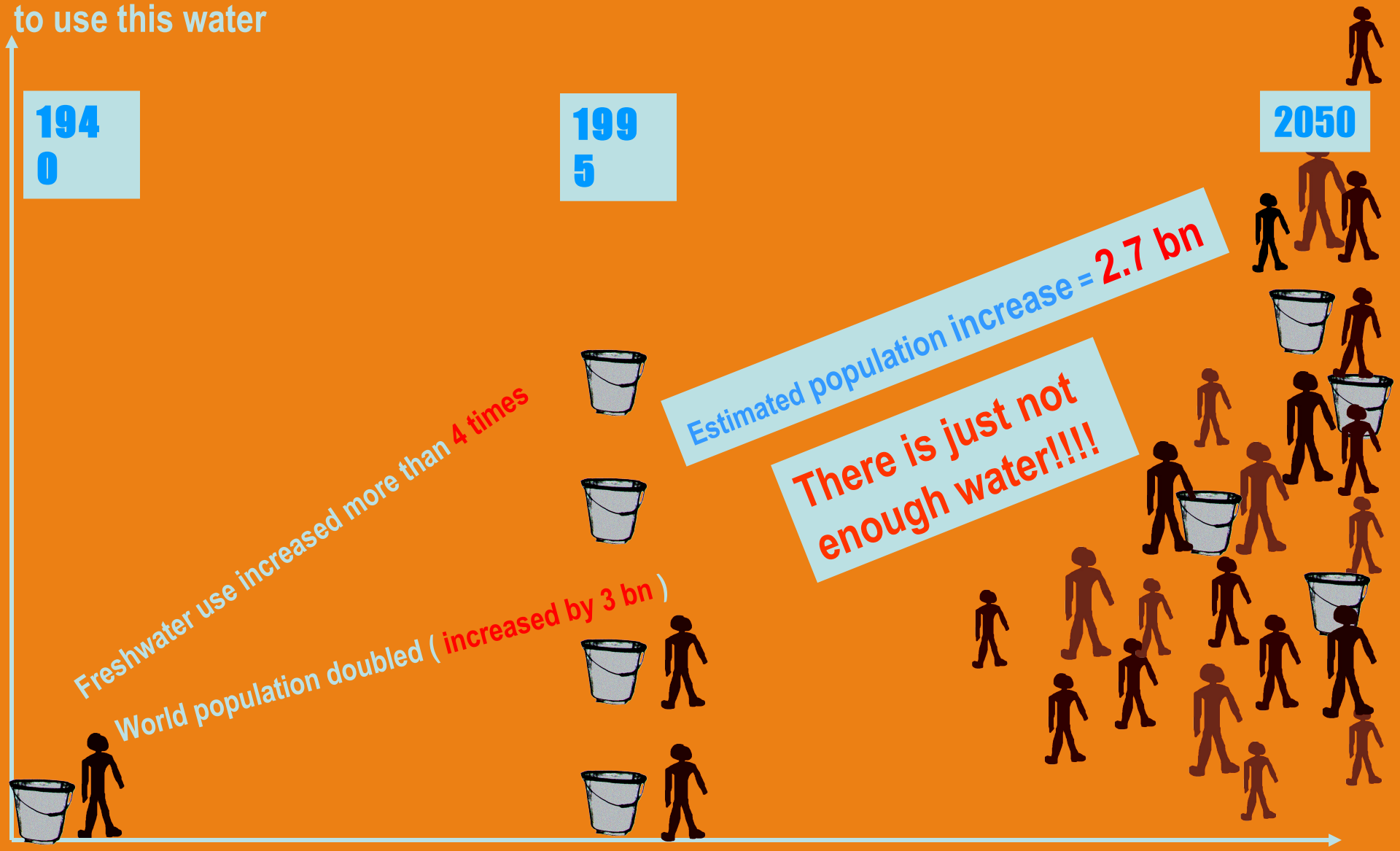
Source: http://www.unep.org/dewa/assessments/ecosystems/water/vitalwater/21.htm#21b

By 2025

2 / 3 of the world's population estimated to be underwater-stress conditions.
3 billion people may be affected by water scarcity.

Population and water Resources

The total amount of water in the world is the same, but there are more people wanting to use this water



CAUSES FOR WATER STRESS

Increase in Population

Domestic

bathing, flushing, washing, cooking, drinking…

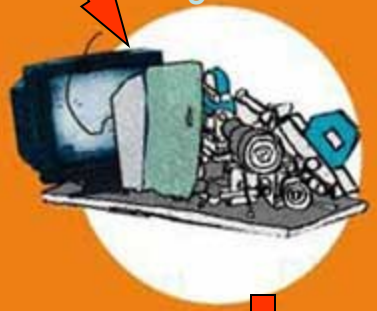
Agriculture

People require food to eat

Extensive farming.
High usage of water

Industry

Increased demand for goods



Every item that we use needs water for production

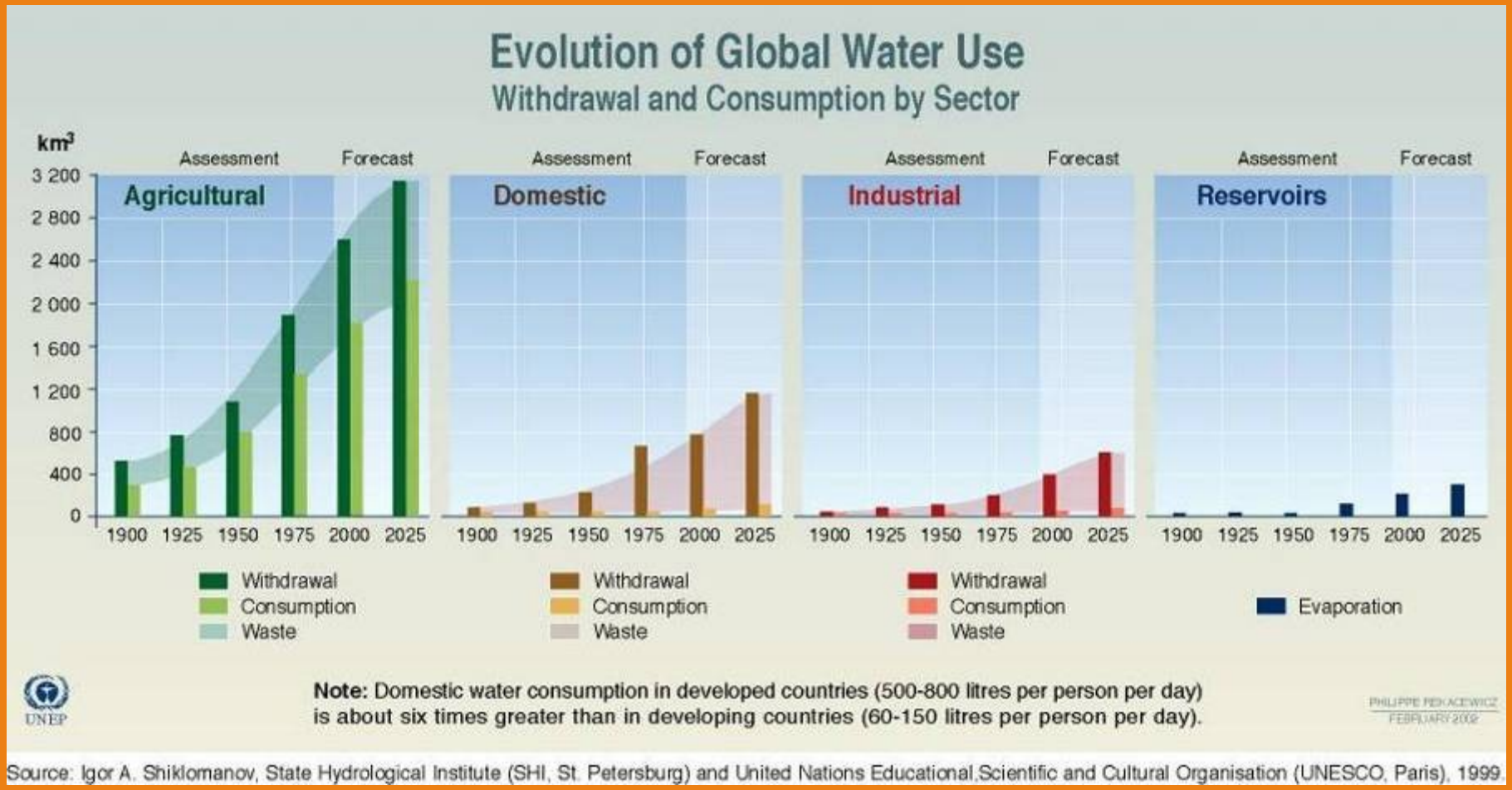
Power

Water evaporation from reservoirs of large hydro power projects

Water stress!!!!

Global water use by Sector

Evolution Of Global Water Use



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational,Scientific and Cultural Organisation (UNESCO, Paris), 1999

Source: http://www.unep.org/dewa/assessments/ecosystems/water/vitalwater/15.htm, accessed November 2008

Agriculture

India, with more than a billion people, needs a lot of water to grow food for its population

Source: http://www.unep.org/dewa/assessments/ecosystems/water/vitalwater/15.htm

It's not just increased consumption...

Soaps
Detergents
Chemicals

Untreated
municipal sewage

Run off
from agricultural
fields

Pesticides
Fertilizers

Untreated
industrial
wastes

Chemicals
Smoke

Smoke
from the
exhaust

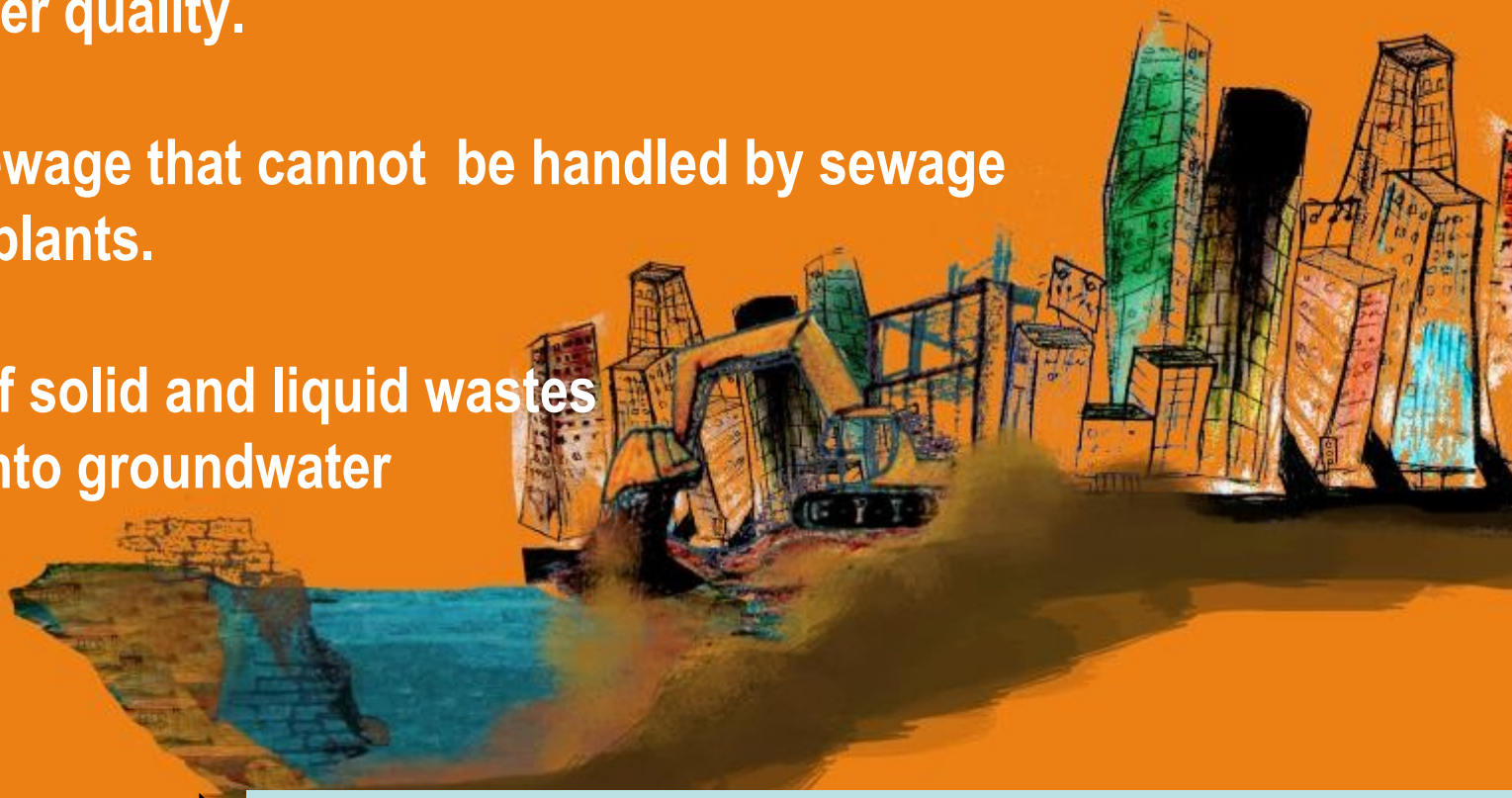
Air pollutants
Dissolve in
rainwater

Increasing pollution of freshwater sources (surface and groundwater)

For more details refer to the presentation on 'Water pollution'.

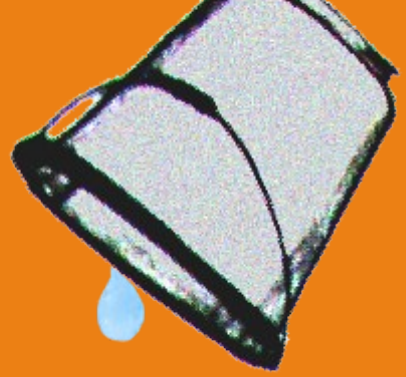
Additional stress in urban areas

- Lakes, tanks and ponds being destroyed. Land filled for construction purposes.
- Unsustainable extraction of groundwater in urban areas, affecting groundwater quality.
- Receive sewage that cannot be handled by sewage treatment plants.
- Disposal of solid and liquid wastes above or into groundwater aquifers.



For more details refer to the presentation on 'Water resources of our city'

SO…
Is there a Water Problem?



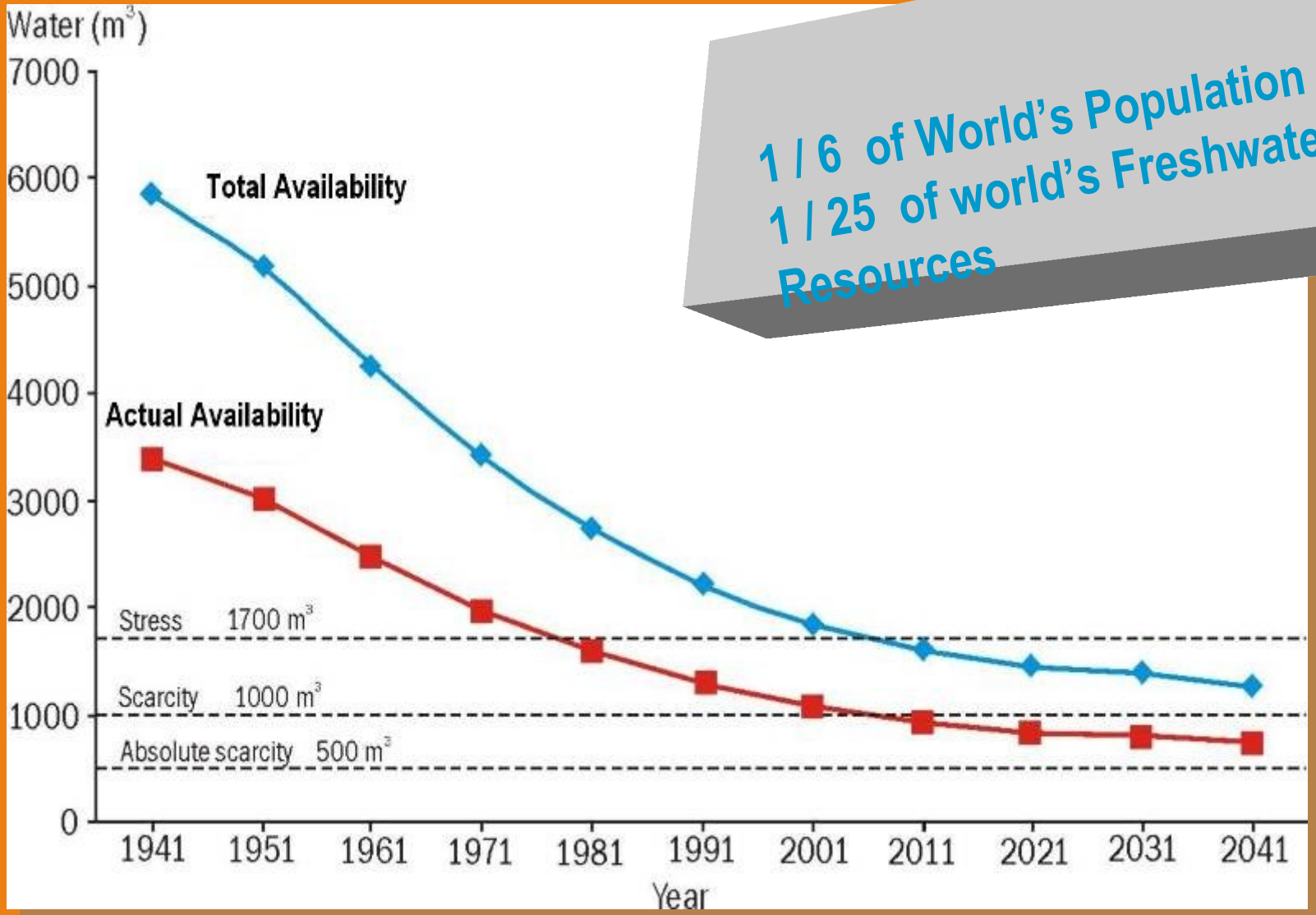
Yes, there definitely is.

There is a **greater demand for freshwater**

Freshwater resources are being **polluted and are therefore unfit for consumption**

Skewed distribution of population and freshwater resources leads to unequal access

ndia – status and projections



1 / 6 of World's Population
1 / 25 of world's Freshwater Resources

Source: TERI

Importance of Water:

- Water is an essential commodity to all life
- Without water, there can be no life.
- Every living thing--plants, animals, and people--must have water to live.
- Water is used in almost all activities of life support systems
- Water is a major abiotic factor in the environment

Natural water:

- The endless circulation of water between atmosphere, lithosphere, hydrosphere and biosphere is known as hydrologic cycle.
- We get water from Precipitation of water vapor in the atmosphere

World's Water Distribution:

- Earth has tremendous amount of water
- Three fourth's of the earth surface is covered by water
- 97% of World's water is in the seas and oceans. This water is saline.
- Only 3% is present on the continents. This water is fresh.
- The distribution of water over land is uneven.

Water is everywhere:

- Water is a common substance.
- It fills the oceans, rivers, and lakes.
- It is in the ground and also in the air we breathe.
- Water is used for drinking, all domestic purposes, agriculture, industrial applications, cleaning and recreation.

Quality determines its Usage:

- Water has its own taste, color, smell and constituents.
- Not all water can be used for all purposes.
- Eg. Sea water can not be used by us for drinking.
- The suitability of water for different purposes is determined by its quality parameters.

Quantity and quality:

- On an average, each person in a developed country uses about 260 litres of water a day in the home.
- The Quality of water is equally important than quantity.
- Even if present in huge amounts, we can not use salt water in many life support activities.

Characteristics of Water:

- Water is a good solvent
- Water never occurs in its pure form
- All waters contain some dissolved substances
- The quality of water is determined by these substances.
- It has the ability to dissolve many inorganic and organic substances.

Water Quality Parameters:

Water has its own

- Physical properties
- Chemical composition and
- Biological Properties

Physical Properties:

- Temperature
- Colour
- Odor
- Turbidity
- Electrical Conductivity

Temperature (T) of Water:

- Essential for all environmental studies
- Controls many ecological processes including chemical reactions.
- T of surface water varies from space and time
- T of groundwater varies not only with reference to space and time but also with reference to depth.

Temperature of Water:

- Measured using Thermometers
- It ranges from 0 to 100 degree Celsius
- Unit of measurement is degree Celsius
- The temperature of Surface water is influenced by the atmospheric conditions
- The temperature of groundwater is controlled by the thermal characteristics of bedrocks and the depth.

Color of water:

- The color of water is due to the suspended particles and organic matter
- Ranges form light to dark brown
- Brownish color in water comes due to the presence of iron
- Greenish color in pond water is seen due to the presence of organic substances including algae

Odor:

- Pure water is odorless
- When water dissolves other substances, the odor is determined by them
- Mostly decayed organic substances give fouling smell
- Inorganic substances give earthy smell

Turbidity:

- Muddiness in water
- Comes due to suspended particles from clay, silt and organic matter
- Controls the transparency of water
- Transparency is measured using Secchi Disc
- Water Turbidity is measured using Nephelometer

Electrical Conductivity(EC):

- Ability of a substance to conduct an electrical current.
- The presence of charged ionic species makes water conductive.
- It is measured using EC meters.
- Directly related to temperature of water.
- Unit of measurement is mmhos/cm at std temperatures. Ranges from 100-1,00,000
- Pure water is less conductive

Chemical properties:

- pH
- Total Dissolved Solids(TDS)
- Major ions
- Minor or trace elements
- Hardness
- Salinity
- Alkalinity

pH of water:

- Refers to the effective concentration of hydrogen ions in water
- It ranges from 0 to 14. Measured using pH meters
- Water is said to be acidic(less than 7)

or alkaline (above 7) depending on the relative concentration of hydrogen ions from the neutral value which is 7.

Total Dissolved Solids(TDS):

- Concentration of non-volatile substances present in colloidal or molecular state
- Total of all ions present in water, expressed in ppm or mg/L
- Increases due to dissolution of more mineral substances by water on its path
- TDS determines the suitability of water for our use and consumption.

Quality of Water :

- Total dissolved solids(ppm)
- < 1000 fresh water
- 1000-10,000 brackish water
- 10,000 to 1,00,000 saline
- > 1,00,000 hypersaline or brine

Classification of Dissolved constituents:

- Basis of concentrations- mg/L
- Charges(positive or negative)
- Level of Toxicity (toxic or non-toxic)

Based on Concentrations:

- **Major ions(> 10 mg/L)**
  - **Mostly Bicarbonate, calcium, Magnesium, Chloride, sodium, sulphate and silicon**
- **Minor ions (0.1-10 mg/L)**
  - **Mostly Carbonate, fluoride, nitrate, potassium, iron, strontium, boron.**
- **Trace elements(< 0.1 mg/L)**
  - **Mostly Aluminium, Arsenic, Barium, Bromide, Cadmium, Chromium, Cobalt, Copper, Lead, Zinc, Nickel, Phosphate, Silver, Tin and Vanadium.**

Based on ionic Charges:

- **Major ions**
- Positively charged = Cations
- Negatively charged = anions

Major Cations in water:

- Calcium
- Magnesium
- Sodium
- Potassium

(Source: lithosphere)

Major Anions in Water:

- Bicarbonate
- Carbonate
- Chloride
- Sulphate
- Nitrate
- Phosphate

Trace elements in water:

- Play a significant role in the use of water
- Some are essential elements for health & growth
- Some are injurious to health and toxic also.
- Deficiency or excess intake of some of these elements may cause serious health problems to life.

Hardness:

- Hardness of water is defined as its content of metallic ions which react with sodium soaps to produce a residue
- Expressed as total concentration of Calcium and Magnesium in ppm.
- Total hardness= 2.5 Ca + 4.1 Mg.
- Softwater (Temporary)
- Hardwater (permanent).

Salinity of Water:

- Comes due to sodium and chloride
- Sea water contains 35,000 ppm or mg/L of dissolved salts

Alkalinity of water:

- Combined effect of Bicarbonates and Carbonates with calcium ions
- It has a direct relationships with pH.
- Carbonates will be noticeable for water having a pH of more than 8.2

Biological Properties:

- Dissolved Oxygen (DO)
- Biochemical Oxygen Demand(BOD)
- Chemical oxygen Demand(COD)
- Microorganisms-Bacterial counts

Dissolved Oxygen(DO):

- Is related to the solubility of air in water at 0 deg. C
- Solubility of oxygen in water decreases with high temperatures
- Important property for aquatic organisms
- Surface water bodies should have enough DO
- If DO depletes, it will be difficult to many aquatic organisms for their survival.

Biochemical Oxygen Demand(BOD):

- Is a measure of the biodegradable material
- It is determined by incubating a water sample and measuring the decrease in dissolved oxygen as bacteria decompose these materials.

Chemical Oxygen Demand(COD):

- Is determined by chemical oxidation of water with dichromate

Water Quality Parameters:

- Limits the suitability of water for different purposes
- Drinking
- Domestic consumption
- Agriculture
- Industrial Processes
- Cleaning and Recreation.

Water Quality Standards

- Permissible limits
- United States Public Health Drinking Water Standards(USPH)
- Indian Standards Institution (ISI)
- World Health Organization (WHO)

Facts:

- More than 3.4 million people die each year from water, sanitation, and hygiene-related causes. Nearly all deaths, 99 percent, occur in the developing world.
- According to WHO, diarrhoea alone claims the lives of 1.8 million people every year.
- About 12 millions people get infected by typhoid every year.
- 780 million people lack access to an improved water source; approximately one in nine people.
- More people have a mobile phone than a toilet.

Waterborne diseases

- **These diseases are caused by consumption of water contaminated by human or animal excreta *i.e.* diarrhoea, cholera, typhoid and gastro-enteritis etc.**
- **The human and animal excreta contain various disease causing microorganisms such as bacteria, virus, worms and amoeba etc.**

Water induced diseases/ Water related insect-vector diseases

- **These are caused by insects, especially flies and mosquitoes that breed in contaminated water sources and act as vectors (carriers of microscopic pathogens).**
- ***i.e.*** **malaria, dengue, sleeping sickness (*Trypanosomiasis*), JE and yellow fever etc.**

Water-washed or water scarce diseases

- **These are caused by poor personal hygiene and skin or eye contact with contaminated water, e.g. trachoma (eye infections), flea and typhus etc.**

Some examples of Water borne diseases:

Typhoid:

- **Typhoid fever is caused by *Salmonella typhosa* bacteria by ingesting contaminated food and water. Symptoms are characterized by headache, nausea, loss of appetite.**
- **It can be prevented by providing access to safe drinking water, sanitation and good hygiene.**

Cholera:

- **It is highly contagious disease and caused by *Vibrio cholerae* bacteria.**
- **Typical symptoms include diarrhoea, vomiting, rapid dehydration, muscular cramps etc.**
- **It can be controlled by early detection of the disease, improving sanitation facilities and prompt treatment.**
- **Tetracycline and Cotrimoxozole should be administered as antibiotics**

Diarrhoea:

- **It is caused by viruses, bacteria, protozoan and characterized by dehydration.**
- **This can be prevented by sanitation and good hygiene.**

Some examples of Water induced diseases

Malaria:

It is caused by parasite, *Plasmodium* sp. and is naturally transmitted by the bite of a female *Anopheles* mosquito. When a mosquito bites an infected person, a small amount of blood is taken, which contains malaria parasites.

Symptoms: After transmission, the malaria parasites start to multiply within red blood cells, causing symptoms that include fever and headache. Other symptoms are periodic fever, associated with shivering and sweating, arthralgia (joint pain), vomiting, anemia (caused by hemolysis), retinal damage etc. Fever is intermittent and occurs after 3 or 4 days.

Control: i. Destruction of mosquitoes by spraying mosquitocides.
ii. Destruction of mosquito larvae by larvaecides.
iii. Eliminating the breeding places like stagnant water body.
iv. Destruction of larvae and eggs with the help of biological control. *e.g.* fishes and some insect larvae.

Treatment: Anti-malarial drugs - quinine, chloroquinine and camoquinine.

•Dengue:

• It is transmitted by the bite of an *Aedes aegypti* mosquito infected with any one of the four dengue viruses (Genus: *Flavivirus*). It occurs in tropical and sub-tropical areas of the world. An estimated 50 to 100 million people contact dengue each year in over 100 countries. The virus is not contagious and cannot be spread directly from person to person. There must be a person-to-mosquito-to-another-person pathway

Symptoms: It appears 3—14 days after the infective bite. Symptoms range from a mild fever, to incapacitating high fever, with severe headache, abdominal pain, vomiting, bleeding, pain behind the eyes, muscle and joint pain, and rash.

Control: i. Destruction of mosquitoes by spraying mosquitocides.

ii. Destruction of mosquito larvae by larvicides.

iii. Eliminating the breeding places like stagnant water body.

iv. Destruction of larvae and eggs with the help of biological control. e.g. fishes, some insect-*i.e. Mesocyclops*, and bacteria-*Wolbachia.*

Treatment: There are no specific antiviral medicines for dengue. It is important to maintain hydration. Early clinical diagnosis and careful clinical management by experienced physicians and nurses increase survival of patients. Use of acetylsalicylic acid (e.g. aspirin) and non steroidal anti-inflammatory drugs (e.g. Ibuprofen) is not recommended.

•**Filaria (Filariasis):**

It is caused by nematodes (worms), transmitted by female mosquito *Culex.*

Symptoms: Its includes swelling legs, genitals and it disability.

Treatment: Antimony, and arsenic compounds (arseenamide) can cure disesase.