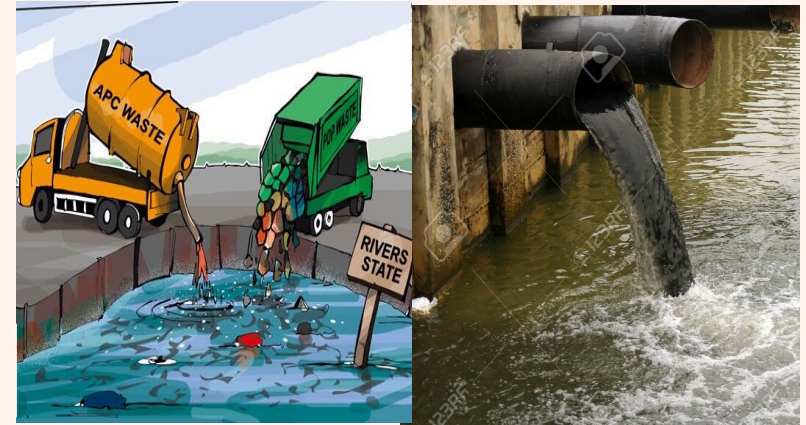


Faculty of pharmacy

Microbiology department



What goes on the ground ends in our water

Water Pollution

6th October campus

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B. Groundwater safety measures

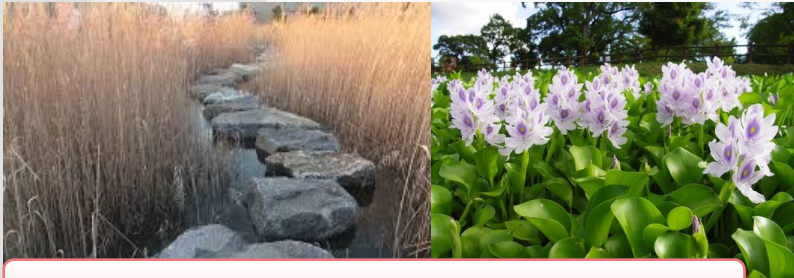
1. Securely burial of the waste in some specific deserts, they might leak and threaten the groundwater
2. The imposition of precautions on a large scale in order to maintain the integrity of groundwater as a source of security of drinking water sources and especially in Valley and Delta.
3. Reduction of air pollution, which contributes to pollution of rainwater

III. Administrative approaches

1. In specific places citizens committed to installing filters on high-precision on water tapes to drink.
2. State imposes a financial penalty on large ships and factories, which dispose waste in the Nile (support treatment and removal of the damage).
3. Raising awareness of the population to preserve water clean.

B. Aquatic plants (reed, papyrus, and hyacinth):

They are very useful in getting rid of a lot of water pollutants. They can get rid of 73% of lead and 83% of cadmium present. They grow in lakes, they can absorb (iron, copper, chromium, zinc, lead and cadmium) and concentrate them in the roots of plants

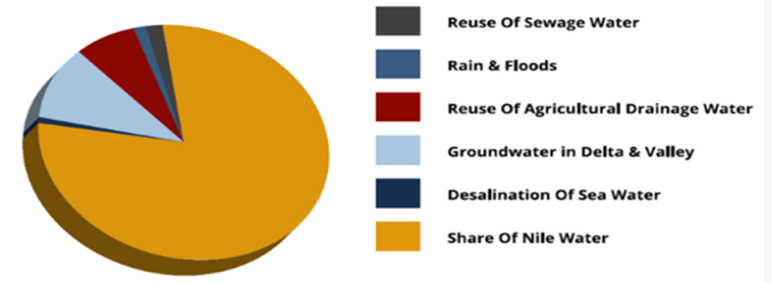


II. Preventive approaches

A. Wastewater treatment:

1. wastewater treatment following the rules and criteria to maintain the quality of drinking water and limit the growth of aquatic plants which affect the validity of water used in irrigation.
2. prevent any contamination in lake Nasser which may accelerate aging of lake.
3. sanitary drainage stations should be established in places deprived of services as the ground water contamination is mostly due to unsafe disposal of wastes
4. Attention to wastewater treatment, including possible re-use for irrigation in the fish farms and lakes in order to increase water resources and the protection of water sources from pollution

Sources for drinking water and water used in agriculture in Egypt



Surface Water

Nile River

Nile is the main source of water in Egypt which comprises about 97% of Egypt renewable water supplies. The Nile water agreement with Sudan specifies 55.5 BCM/year to Egypt.

Lacks

- Lake Nasser is the main Egyptian lake; it is created by the High Aswan Dam.
- Lake Qarun in the Fayoum depression is completely fed by water drainage.
- Wadi Al Rayan lakes are also fed by excess drainage water that was transferred there since 1973, giving 2 interconnected lakes.
- There are a few lagoons on the coast which are Bardaweel, Burullus lakes, Edku, Manzalah and Mariot.

Sources for drinking water and water used in agriculture in Egypt (cont.)

Ground water

It's is the only source of water for people living in the desert areas which present in aquifers. Its total volume is about 40,000 BCM.

The major systems in Egypt are:

- Nile aquifer: recharged by infiltration of water irrigation initially from the Nile stream. It provides about 85% of the total groundwater abstractions in Egypt.
- Moghra: towards the Qattara Depression, it is recharged by lateral inflow from the Nile and rainfall.
- Nubian sandstone: fossil groundwater in the south west portion of Egypt imparted to Sudan, Chad and Libya.
- Fissured carbonate: generally spread over the greater part of the nation's range, on top of the Nubian aquifer.

Approaches of Solutions of water pollution in Egypt



1. biological methods of water treatment

A– Silver carp fish

Silver carp fish is a type of fish used to purify Nile water. Each kilogram of fish consumes around 80 kilograms of contaminated algae

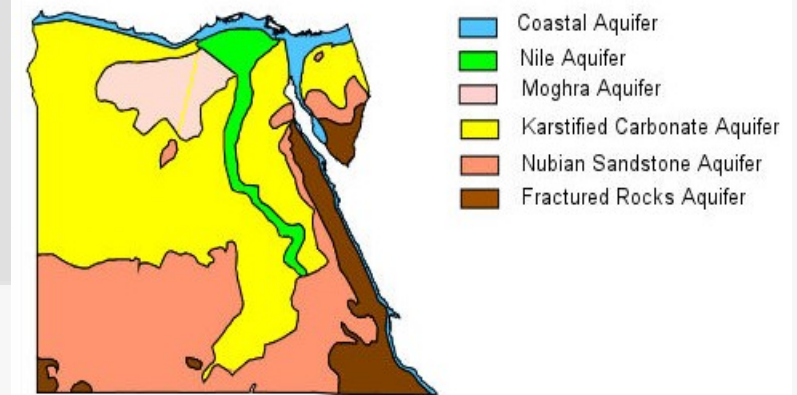


Household water treatment

- Filtration system: to remove water impurities by physical, chemical and biological process.
- Distillation system: water boiled and the steam is collected in separated container.
- Disinfection: by applying heat or adding chlorine, chlorine dioxide or ozone.
- Water softener: device used to replace hard ions with sodium and potassium ions.

The major systems in Egypt (Cont.)

- Hardrock aquifer: generally in southern Sinai and eastern deserts.
- Coastal aquifer: on western and northern coasts and recharged by rainfall.



Rainwater

The northern coast receives winter rainfalls with a mean level of 150 mm/year and reduces to 100 mm/year to the east in El-Arish region then increases again to 250 mm/year at Rafah and northeast Sinai. Due to high temporal and spatial variability in the amount of rain water, it cannot be considered as reliable water source. Rainwater is collected in reservoirs however its amount is just sufficient for pastoral purposes and to some extent for seasonal agriculture.

Seawater Desalination

It has low priority in Egypt due to the high treatment cost. Desalination is performed in the Red Sea coastal area to supply water to tourism resorts and villages because the economic value is sufficiently high to cover treatment cost.

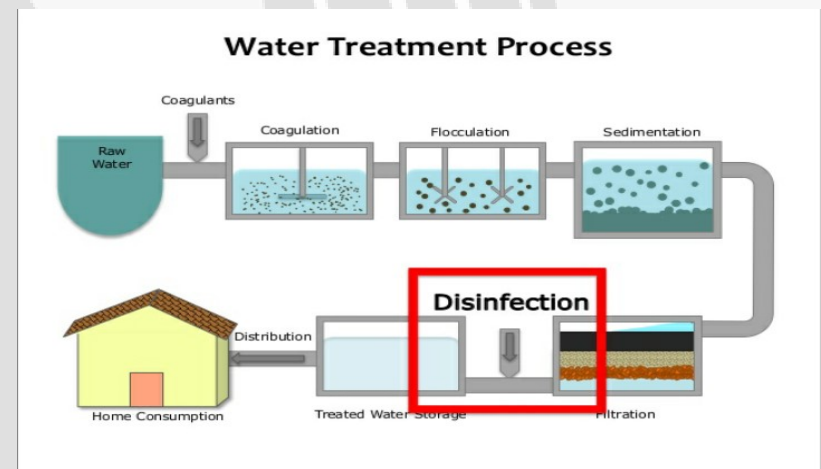
Treated Sewage

Its estimated total quantity in Egypt is about 0.3 BCM in 2013. It is reused for irrigation with or without blending with fresh water.

Strategies of water treatment

There are several methods and technologies for control and prevention of water pollution that present in sewage treatment, prevent pollution of rivers, wastes treatment and treatment of drainage water. As the treatment can be carried out by certain process

- Flocculation: chemicals are added to the polluted water leading to forming a floc.
- Sedimentation: the Floc will settle down in the bottom of water supply.
- Filtration: after process of sedimentation clear water that present on the surface will allowed to be filtered for the removal of contaminants.
- Disinfection: chlorine will be added to kill any micro-organism that present in water.



Economic benefits of water pollution prevention

1. Improving health with avoiding illness
2. Reducing patient expenses with avoiding illness
3. Decrease number of deaths
4. Saving time with reducing time lost because of treatment
5. Increasing productive days due to avoid illness
6. Value of days of school attendance gained with avoiding illness
7. Value of child days gained with avoiding illness

Source of Water Pollution in Egypt

1-Industrial Pollution:

Surface and groundwater of Egypt undergoes deterioration because of the disposal of the heavily polluted domestic and industrial effluents into its waterways. The River Nile supplies 65% of the industrial water needs and receives more than 57% of its effluents.



2-Tourism as a source of marine pollution

Spilling of oil and contaminants even in small portions leads to marine pollution. Also garbage and dead animals that are thrown from ships causes water pollution.

3- Domestic Pollution:

Water quality is affected by the domestic pollution depending on the disposal way of the pollutant. Drinking water supply is connected to about 65% of Egypt's population is and only 24% to the sewage services which is growing fast due to constructions. Those who are not connected to sewage services get rid of wastes through latrines and septic tanks. Discharging and collecting the waste water in permeable septic tanks lead to spreading of the domestic wastewater into the soil and groundwater. The main source of the groundwater pollution is the domestic wastewater. It has serious effects on the public health since it contains toxic and injurious chemical constituents.



Cost –benefit analysis of water pollution prevention comparing to cost of diseases treatment and loss of work (cont.)

One of the pioneer studies in cost-benefit analysis for control of chemical pollution was conducted in Japan. It was compared in the three main diseases in Japan as shown in table.

Pollution disease	Main pollutant	Pollution damage costs			
		Pollution control costs	Health damage	Livelihood damage	Environmental remediation
Yokkaichi asthma	SO ₂ , air pollution	14,800	21,000	Not estimated	Not estimated
Minamata disease	Mercury, water Pollution	125	7,670	4.270	690
Itai-Itai disease	Cadmium, water and soil pollution	600	740	880	890

This study shows that the costs of the pollution are very high comparing to costs need for prevention of that pollution either water or air pollution

Cost –benefit analysis of water pollution prevention comparing to cost of diseases treatment and loss of work (cont.)

Waterborne diseases can have an important impact on the economy of the country, internationally as well as locally. Infected persons usually suffer from financial loss that is caused by e.g. costs of medication, costs of special food and costs of hospitalization in emergency cases. On average, most families spend on the infected person about 10% of the monthly household's income. The cost of control of pollution and its avoidance is much lower than damage costs. In 1995, India lost 366 billion Rs which are approximately 3.95% of GDP (growth domestic product) due to water pollution. But if India made any activities to provide better sanitation this would account between 1.73 to 2.2% of GDP.



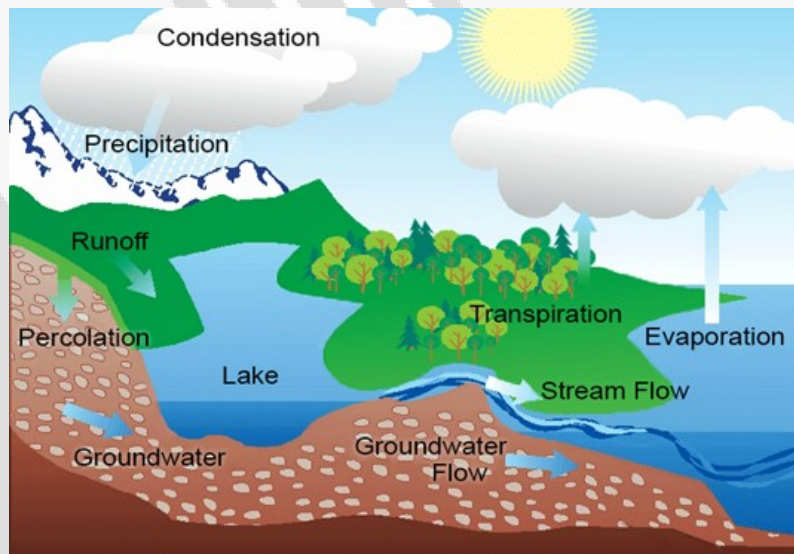
4- Agricultural Pollution

In agriculture, the usage of pesticides and fertilizers leads to water pollution problems. Local surfaces and groundwater in the agricultural areas are contaminated due to nitrates that leach from fertilizers and bacteria from livestock and feed wastes.



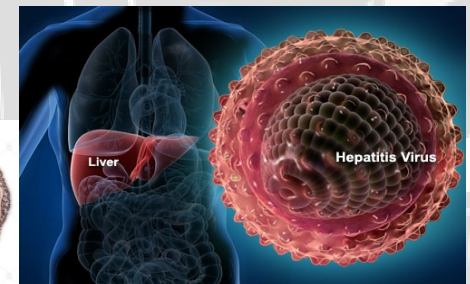
5-Runoff:

Runoff which is originated from storms is not clear water since it contains a tremendous amount of wastes. Moreover, it considers a one amongst the most serious resources of contamination contrasted and municipal pollution. Runoff can prompt numerous issues, for example, direct contamination and over-loading which is originated from sewage treatment offices. These issues referred to hydraulic over-loading and different sorts of contamination that accompany overflow



Cost-benefit analysis of water pollution prevention comparing to cost of diseases treatment and loss of work

Diseases associated with water pollution (poor water and sanitation) in our developing world still have significant public health problem. Pathogenic microorganisms are present in large numbers in untreated sewage like schistosomal ova cercaria, hepatitis A and bacterial dysentery as well as infectious diarrhea. Moreover the most common para-cholera and typhoid. The incidence rates of typhoid annually in Egypt showed to have an average of 13/100,000 persons. According to WHO, another study was conducted in India indicates that the lack of water hygiene and sanitation results in annually loss of 0.4 million lives in India. 1.5 million Children under 5 years annually are lost and the country loses around 366 billion each year.



Most common Microorganisms contaminate water used for agriculture and can infect plants

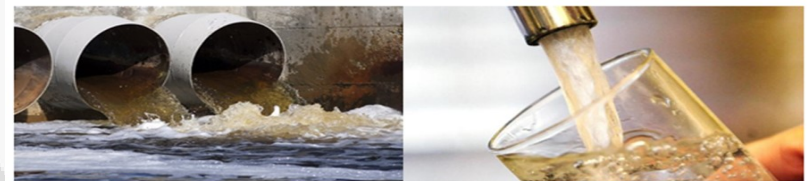
Fungi	
Causative agent	Diseases
<i>Phytophthora infestans</i>	Potato blight
<i>Colletotrichum graminicola</i>	Anthracnose Stalk Rot
<i>Diplodia maydis</i>	Diplodia Stalk Rot
<i>Puccinia sorghi</i>	Common Rust of Corn
Bacteria	
Causative agent	Diseases
<i>Pectobacterium carotovorum</i>	Basal rot
<i>Pseudomonas syringae</i>	Bacterial speck on tomato
<i>Rhizobium radiobacter</i> ,	Crown Gall
Virus	
Causative agent	Diseases
<i>Topocuvirus</i>	curling of the leaves and leaf distortion
<i>Curtovirus</i>	curly top disease
Nematodes & Oomycetes (Water Molds)	
Causative agent	Diseases
<i>Meloidogyne</i>	Root knot nematode
<i>Peronospora farinosa</i>	Downy mildew
<i>Phytophthora infestans</i>	late blight

Microorganisms contaminating water

A. Microorganisms contaminating drinking water that can infect humans

There are over 500 waterborne pathogens of potential concern in drinking waters, identified by the US Environmental Protection Agency (EPA)

Drinking Water contaminated by pathogens causing diarrheal disease, which is the most important sign of drinking water quality. The problem starts with consequence of contamination of water by human or animal fecal matter containing pathogenic organisms.



Coliform bacteria are used as indicators for harmful bacteria that exist naturally in the environment, while *Enterococci* is used as Fecal indicator for human or animal wastes in water. Contaminated water with human or animal wastes will be detected with presence of *E. coli* and fecal coliform.

Microorganisms that may cause waterborne diseases are:

- . Protozoa
- . Bacteria
- . Intestinal parasites
- . Viruses

Bacterial Infections

Vibrio cholera

It is small and curved-shaped Gram-negative rods. It has a single polar flagellum, and is considered as facultative anaerobes, which is capable of fermentative and respiratory metabolism. Cells of *V. cholera* have pili (fimbriae), and structure mainly composed of protein TcpA which is co-regulated with cholera toxin expression

Vibrio cholera causes Cholera disease which characterized by an acute and very intense diarrhea that can exceed one liter per hour, feel thirsty, muscular pains, general weakness, and oliguria, hypovolemia, hemoconcentration, followed by anuria



Microorganism found in water that infect plants (cont.)

Viruses	Locations	Plant Affected
Pelargonium flower break	Ebb and flower system	Pelargonium
Tomato Bushy Stunt	Lake , River	Chenopodium
Carnation mottle	Lake , River	Chenopodium
Tobacco mosaic	Lake , River	Chenopodium
Tomato mosaic	Hydroponic System	Lycopersicon, Capsicum
Cucumber green mosaic	Rock wool / continuous recycling nutrients	Cucumis
Tobacco necrosis	Rock wool / continuous recycling nutrients	phaseolus

Microorganism found in water that infect plants (cont.)

Genera	Locations	Plants affected
Alternaria	Effluent , pond	Fruit,vegetable
Ascochyta	Pond	Fruit,vegetable
Aspergillus	Effluent , pond	fruit,vegetable
Botrytis	Effluent ,well , stream, pond.	NS*
Cephalosporium	Effluent,pond	Vegetable
Chaetomium	Effluent.	NS
Cladosporium	Effluent,pond	Fruit,vegetable
Colletotrichum	hydroponics	Vegetables
Coniothyrium	Effluent	NS
Curvularia	Effluent.	NS
Diplodia.	Pond	Fruit,vegetable
Geotrichum	Pond	Fruit
Gliocladium	Effluent	NS
Microsporium	Well , stream , pond	NS
Mucor	Effluent , pond	Fruit
Penicillium	Effluent , pond	Fruit
Phoma	Well , stream , pond	Fruit , vegetable
Plasmodiophora	Pond sediment	Vegetable
Rhizoctonia	Effluent , well , stream , pond	Vegetable
Rhizopus	Pond	Vegetable
Sclerotium	Pond	Vegetable
Sclerotium	Pond	Vegetable
Scopulariopsis	Effluent	NS
Stemphyllium	Effluent	NS
Trichoderma	Effluent , pond	Fruit
Verticillium	Well , stream , pond , runoff , nutrient film	Potato , vegetable

Viral Infection

Waterborne transmission Viruses are at most those that can infect GIT and are excreted in infected humans faeces

Disease	Specific Agent	Reservoir	Symptoms of Brief
Viral Gastroenteritis	Rotaviruses, Norwalk agent, etc	Human, feces, or sewage water.	Nausea, vomiting, diarrhea, abdominal pain, low fever
Infectious Hepatitis	Hepatitis A	Feces from infected persons contaminating water	Fever, nausea, loss of appetite; possibly vomiting, fatigue, headache, jaundice

Protozoan pathogens

Water plays an major role in the transmission of these pathogens such as Giardia lamblia, Entamoeba histolyt-

Disease	Specific Agent	Reservoir	Symptoms of Brief
Amebiasis (Amebic dysentery)	Entamoeba histolytica	Bowel discharges of carrier, and infected person; possibly also rats	Diarrhea or constipation, or neither; loss of appetite, abdominal discomfort; blood, mucus in stool
Cryptosporidiosis	Cryptosporidium	Farm animals, human, fowl, cats, dogs, mice	Mild flulike symptoms, diarrhea, vomiting, nausea, stomach pain
Giardiasis	Giardia lamblia	Bowel discharges of carrier and infected persons; dog, beaver	Prolonged diarrhea, abdominal cramps, severe weight loss, fatigue, nausea, gas, fever is unusual

Virus

Cucumber Green Mottle Mosaic Virus

It infects cucurbit crops as watermelon, cantaloupe and cucumber. The infected plant will drop the fruit and the remaining will be stunted, and easily transmitted through plants in a variety of ways (Table).

The symptoms of most infected plant include chlorosis, leaf spots, stunted and abnormal growth. The identification of the virus requires special laboratory test

Microorganism found in water that infect plants

Genus and species	Locations	Plants
Corynebacterium flaccumfaciens	NS	Bean
Erwinia carotovora pv. atroseptica	River , stream , ponds	Potato
Xanthomonas campestris pv. begonia	Ebb and flow system	Ornamental
X. phaseoli	Pond	Bean

Fungi

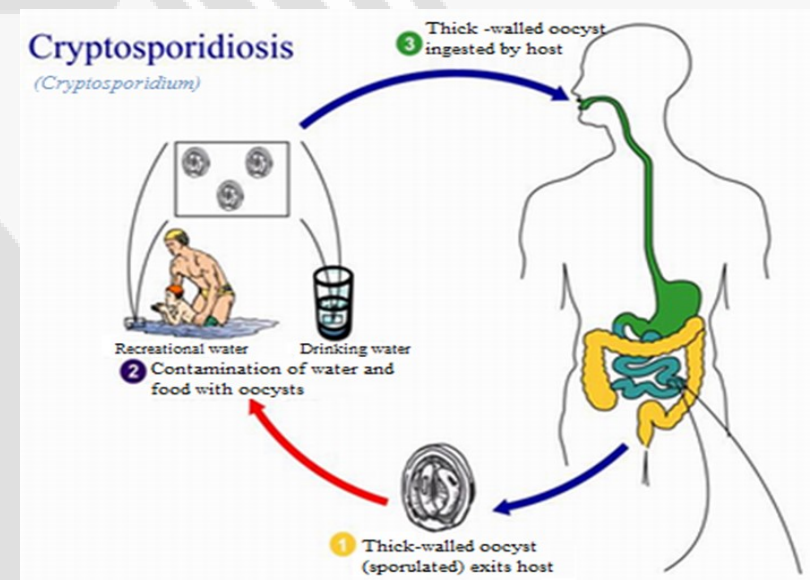
The fungi reproduce both sexually and asexually via the production of spores. Spores may be spread long distances by water, or they may be soil borne. Many soil inhabiting fungi are capable of living saprotrophically, carrying out the part of their life cycle in the soil. These are known as facultative saprotrophs.

Bacteria

Some plant diseases are caused by rod-shaped bacteria. The bacteria enter the plant through natural openings as the stomata of the leaves or through wounds in the plant tissue. Once inside, the bacteria plug up the plant's vessels that carry water and nutrients and cause the plant to wilt. Common symptoms of bacterial disease are rotting and swollen plant tissues. Bacteria can be spread by water, insects, infected soil, and contaminated tools. Bacterial wilt attacks many vegetables including corn, tomatoes, and flowers.

.a. Cryptosporidium

It is intracellular, obligate, and coccidian parasite with complex life cycle and it causes cryptosporidiosis. Sources of infection are consumption of water contaminated with animal or human feces contaminated food and direct contact with the infected animals. Its symptoms including diarrhea, nausea, fever and vomiting



Most common Microorganisms contaminating drinking water and can infect humans

Bacteria	
Causative agent	Disease
<i>Salmonella typhi</i>	Typhoid Fever
<i>Vibrio cholerae</i>	Cholera
<i>Campylobacter Jejuni</i>	Campylobacter Enteritis
<i>Escherichia coli</i>	Enteropathogenic Diarrhea
<i>Shigella</i>	Shigellosis (Bacillary dysentery)
Protozoa	
Causative agent	Disease
<i>Entamoeba histolytica</i>	Amebiasis
<i>Cryptosporidium</i>	Cryptosporidiosis
<i>Giardia lamblia</i>	Giardiasis

Viruses	
Causative agent	Disease
<i>Rotaviruses</i>	Viral Gastroenteritis
<i>Hepatitis A virus</i>	Infectious Hepatitis
Helminthes	
Causative agent	Disease
<i>Schistosoma</i>	Schistosomiasis

B. Microorganisms contaminating water used for agriculture that can infect plants

Infectious plant diseases are caused by pathogens, which contaminate water that is used for agriculture leading to infect a plant and deprive it from nutrients and water. In some cases lead to death of plant.

Irrigation also affects the plants as it offers direct spread of the microbes as water borne moulds, plasmodial pathogens and oomycetes that come from populations in the water supply. These plant diseases causing microbes that are present in irrigation source cause hazards and outbreaks such clubroot from plasmodiophora brassicae. so, it is essential and critical to evaluate and control the agriculture water to avoid any diseases to the plants, animals, and humans.

Microorganisms that cause plant diseases:

- . Bacteria
- . Fungi
- . Viruses
- Nematodes & Oomycetes (Water Molds)

