



**The health  
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By Sawsan Ramahi

## The health risks posed by water pollution in the Gaza Strip

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The worsening problem of water in the Middle East is one of the most significant and dangerous struggles currently facing the region today. From issues of continuous deterioration in quality, to those of limited availability and high competition for that available, the situation is critical. All of this and more has made the search for alternative sources of this resource an imperative, and a solution to the problem needs to be speedily implemented before a point of no return is reached.

In the regional struggle for this indispensable resource, the situation in Palestine stands out above all others. Not only are Palestinian water resources continually faced with the danger of severe deterioration, depletion and draught, but additionally, Israel maintains illegal control over its surface drinking water basins and appropriates its subterranean reserves by pumping them into its settlements.

The situation in the Gaza Strip is singular given its steadily increasing population and the lack of any kind of balance between the water available in its coastal subterranean reservoir and the needs of its population. It is estimated that the population of the Gaza Strip is around 1.5 million and that this figure will reach 2.79 million by 2025. Looking at the current overall water consumption in Gaza estimated at between 150-170 million cubic metres and all sourced from the subterranean reservoir, the amount of water consumed in the Sector per person is approximately 80 litres a day. This figure is far below that recommended by the World Health Organisation which is 150 litres per person per day.

In terms of quality, the majority of the available drinking water is incompatible with the recommendation of the World Health Organisation.

The source of the problem in the Gaza Strip stems from the fact that between 1967 and 2005, the Israeli Occupation caused groundwater depletion by cultivating crops which consume large quantities of groundwater in their Gaza settlements. Crops grown such as flowers, fruits and vegetables were then exported to Europe. Similarly, during Israel's occupation of the Sector, it appropriated Gaza's water resources through the Zionist company 'Makrouf' and either used it in the development of the occupied Negev desert region or desalinated it and sold it back to the people of Gaza at extortionate prices.

Following Israel's withdrawal from the Gaza Strip when it was no longer able to utilise the geographic space, it constructed what are known as the water fisheries along the stretch of its eastern border with the Strip. Here it drilled approximately 27 extremely deep wells through which it is able to capture water cascading from the east to the west. It also constructed several bridges over the [Gaza valley](#) in order to appropriate its water.



The water situation in the Gaza Strip has become critical such that it is no longer possible to obtain fresh natural drinking water from the groundwater basins except in extremely small quantities. 95% of Gaza's water resources are salty and contaminated to varying degrees with toxic organic and inorganic substances. As such, residents are obliged to purchase desalinated water from small desalination plants administered by merchants and contractors. The majority of these do not meet health standards, while the vast majority of residents shower with salt water.

It is estimated that the amount of water currently being pumped from the drinking water basins is in the region of 150–170 million cubic metres while the average annual rate of replenishment from precipitation does not exceed 45 million cubic metres. This is in addition to about 26 million cubic metres of irrigation water that returns to basins, along with other quantities of untreated water estimated at 18 million cubic metres. That is, the total annual amount of water going into the basin is estimated at 90 million cubic metres while the cumulative annual deficit is more than 80 million cubic metres. This exposes the rock layer system which carries groundwater to erosion, expands the areas of high salinity and allows the leakage of agricultural and industrial pollutants. The levels of fluoride and nitrate concentration have increased to very significant levels when compared to acceptable standards according to the World Health Organisation. In addition, concentrations of other toxic inorganic substances have also been recorded which exceed allowable levels and which constitute a serious danger to general health. It is believed that 50% of diseases in the Gaza Strip are the result of contaminated water.

What follows is an account of the most important sources of water pollution in the Gaza Strip:

### **Sewage**

It is estimated that the volume of sewage produced across Gaza's residential areas is around 38 million cubic metres annually. Approximately 25 million cubic metres or 65% of this is discharged across sewage networks while the remainder – approximately 13 million cubic metres is discharged in underground cesspits. The bulk of that discharged through the networks - 80% of it or about 20 million cubic metres, ends up in the sea. The remainder - 5 million cubic metres or about 20% of it is discharged into the subterranean reservoir.

Consequently, approximately 18 million cubic metres of untreated sewage leaks into the subterranean reservoir which is a significant quantity in light of the distance and depth of the subterranean reservoir and its geological composition. As such, these levels of sewage pose a significant threat to the safety and sustainability of the subterranean reservoir given the situation of persistent and extreme erosion which this complex system is exposed to. Similarly, the quantities of [sewage discharged](#) into the sea pose a huge threat to the beach areas as a consequence of the resulting pollution and stench.

In terms of sewage treatment, there are three treatment plants in the Gaza Strip which are no more than sedimentation pools which solid material still leak from. Moreover, some of the water passes through the Gaza Valley where it forms a sewage lake or swamp on the beach forming an epicentre that gives off a stench and is a breeding ground for harmful insects. Since that waste water consists of various nutrients, it may be utilised if properly treated and may be used as an agricultural fertiliser providing plants with nitrogen, phosphorous and potash.

In view of the lack of availability of suitable drinking water and its high cost, in some areas of both the [Gaza Strip](#) and the [West Bank](#), untreated waste water is used on agricultural land and in areas where there are open drainage channels which leads to parasitic intestinal diseases.

### **Solid waste**

This is the non-liquid remains that result from domestic human activities as well as agricultural, industrial, commercial and craft activities. The volume of such waste produced across the Gaza Strip is estimated at around 1,600 tonnes per day or approximately 600,000 tonnes per annum. The disposal of this huge amount of waste; collection, transportation, incineration or even interment, requires significant and expensive capabilities to deal with and produces conditions of significant environmental danger and risk as well as posing a real threat to groundwater reserves.

Local authorities do not possess the suitable or adequate capabilities to fully overcome this problem, and despite exerting significant effort, it is true that very often there are delays in the transport of waste on a regular daily basis. This results in a proliferation and spread of insects and rodent infestations as well as the emission of toxic gasses detrimental to public health. Additionally, the fermentation of large amounts of waste and its transfer underground is such that contaminated and toxic substances reach the [groundwater reserves](#).

### **Chemical fertilisers and pesticides**

Components of chemical fertilisers, such as nitrogen, sulphur and phosphorous dissolved in irrigation water cause water contamination by leaking into the groundwater reserves. The use of these fertilisers without controls or restrictions also adds to the levels of pollution.

### **Radioactive contamination and heavy metals**

Radioactive materials such as uranium and heavy metals like mercury, lead and arsenic are water contaminants and lead to numerous diseases including damage to brain tissues, muscle weakness, diseases of the digestive system, liver disorders and growth disorders.

The US International Action Center and the Dutch Lake Foundation have made various discoveries regarding Israel's use of ammunition containing [depleted uranium](#) during the 2008-09 war on Gaza.

### **Israel's 2008-09 war on the Gaza Strip and its impact on water pollution**

The continuing effects and environmental repercussions of the 2008-09 Israeli war on the Gaza Strip has meant a significant impact on water, air and soil pollution in the Sector resulting from the use of internationally proscribed weapons.

The impact on the water sector is a result of concentrated Israeli aggression in northern areas of the Gaza Strip where many of the wells, water systems and wastewater treatments plants are located and sustained heavy damage.



The total amount of direct damage inflicted on the water sector by the war amounted to around \$6million worth. Three water wells were completely destroyed while ten others were partially damaged. Additionally, components of the water network system in areas east of the Jabaliyah Refugee Camp and in the south of the Strip were destroyed alongside treatment plants in the Sheikh Ajleen area to the south west of Gaza City.

Nearly 20,000 cubic metres of waste water leaked into the subterranean reservoir daily, while during the war itself a total of about a half million cubic metres spilled as a result of damage sustained by the water filtration basins. In addition, an estimated 3,000 litres of diesel fuel was spilt when [Israel destroyed a fuel tank](#) resulting in contamination to the reservoir.

Oxfam UK has carried out a study into the areas of Gaza most affected by the war with a view to assessing, documenting and analysing their water, environmental and health situation so as to determine suitable mechanisms of intervention. The study relied on the results of 12 focus groups; 6 consisting of men and 6 consisting of women. 100 questionnaires were randomly distributed in the study's target area which, from the northern governorate included the province of Abed Rabbo; from the Gaza governorate included the Zeitoun area; from the central governorates were the Hajr al-Dik area; from the Khan Younis governorate were the al-Qarara and Abu Dhahir areas adjacent to the Green Line; in addition to the Khuza'a area and finally the Yibna area from the Rafah governorate.

The results showed an increase in the proportion of water pollution and the need for health and environmental intervention in the region covered by the study. There is a need to develop sanitation facilities and to improve water services in addition to the urgent need to implement educational programs so as to modify behaviour in relation to personal hygiene. This will help to avoid exposure to diseases that are directly related to hygiene or limited and contaminated water, which lead to a number of [diseases](#) and common ailments including recurrent diarrhoea.

### **The siege aggravates the crisis**

This crisis which has persisted for decades is aggravated by the five year siege that has been imposed on the Gaza Strip; the crisis of water pollution, particularly that resulting from delays in the entry of equipment, materials and spare parts has a severe impact on the water sector and sanitation.

The freezing of donor organisations that invest in water sector projects after the second Palestinian elections led to a halt in a number of projects vital to the sanitation and water sectors. This has led to a continuation in the pace of deterioration in the water sector and increased levels of pollution in the subterranean reservoir – the only source of water in the Gaza Strip.

This has also led to a shift in the majority of aid from donor organisations from funding naturally sustainable projects, to funding emergency projects. This has had a serious, negative and persistent overall impact on water and [sanitation services](#).

## Damage and diseases resulting from water pollution

### 1. Damage and diseases resulting from increased concentrations of nitrate in groundwater:

A German study highlighted the danger after analysis showed that drinking water samples from the Gaza Strip confirmed the presence high levels of oxidised nitrates which lead to health damage in small children.

According to the Helmholtz Centre for Environmental Studies in the city of Leipzig in East Germany, the percentage of nitrate in drinking water recommended by the World Health Organisation is 50milligrams per litre. Its concentration in Gaza's drinking water ranges from twice to eight times this amount. Results of the research found that tests carried out on small children in the Gaza Strip showed that more than half of them had red blood cell deficiencies.

The study in which both [Palestinian scientists](#) and scientists from the University of Heidelberg took part, called on the authorities responsible to work toward providing suitable drinking water.

### Diseases resulting from increased nitrate concentrations:

#### 1 - Blue Baby syndrome:

This disease is contracted when metal nitrate elements present in haemoglobin, a component of red blood cells, are oxidised. This causes the haemoglobin molecules to be converted into methemoglobin which limits the ability of red blood cells to carry oxygen and results in a health disorder known as Blue Baby Syndrome. The effect of the nitrate is visible in children but not in adults as children contract the disease following only limited exposure to the element. The symptom of bluish skin is also accompanied by other symptoms such as difficulty in breathing, cyanosis, headache fatigue, dizziness and loss of consciousness. Severe cases may lead to coma and death as a result of suffocation if it is not treated quickly.

A study into the relationship between the concentration of nitrates in drinking water and the disease of Methemoglobinemia in children under 6 months old was conducted by Dr Ahmed Abu Nasr in 2001. Twelve Ministry of Health primary care centres were involved in the study and results showed a strong positive relationship between levels of nitrates and contraction of the disease.

The highest incidence of the disease was found in the district of Khan Younis coinciding with the highest levels of water nitrates. Moreover, the proportion of Methemoglobinemia incidence was highest in children between 1 – 3 months old due to their dependence on milk and hence their higher intake of nitrates, while it decreased in those between 3 – 6 months old.

#### 2 – Cancer:

Excess concentrations of nitrate in drinking water or in food may cause cancer and should not exceed a recommended daily intake of 200mg. If it goes over this amount, it becomes toxic to the human body through the formation of ammonia [nitro-ammonia] which is carcinogenic and can lead to liver or oesophageal cancer.



### **Damage and Diseases resulting from increased concentrations of fluoride in groundwater**

Increased fluoride pollution above the normal levels of 0.7 – 1.2 ppm causes osteomalacia as well as staining and erosion of teeth, particularly in children. A study conducted by the Centre for Health Research, part of Gaza's Department of Health, has found that the level of fluoride in Gaza's drinking water range between 0.8 – 3.8 ppm. It also found that there was an increase in the incidence of fluoride poisoning in areas where increased concentrations of [fluoride](#) have been recorded.

High doses of fluoride are highly toxic and may result in haemorrhagic gastroenteritis, acute kidney poisoning and various degrees of liver and [heart damage](#).

### **3 - Damage caused by increased concentrations of chloride in groundwater:**

Levels of chloride concentration vastly exceed reasonable limits; internationally accepted safe levels are 250 mg/litre while the proportion of chloride in some areas is as high as 9,000 mg/litre. A study conducted by the [Palestinian Water Authority](#) found that according to 'Anjut' standards, Gaza's water is alkaline as a result of its high levels of chloride.

High concentrations of fluoride in drinking water does not necessarily mean that it is toxic to human health, however it has a definite impact on the taste of the of the water. Moreover, high concentrations of chloride can lead to water reacting with the metal pipes it is carried in and corroding them and causing serious damage to the industrial sector.

### **4 – Damage and disease resulting from increased concentrations of lead and sulphur in groundwater**

It is important to highlight that increased proportions of salts in the water causes damage to public health, as increased proportions of sulphur cause skin disease while increased proportions of lead cause [poisoning and retardation](#) in children.

### **5 – Diseases caused by water contaminated with bacteria and parasites:**

- Acute diarrhoea – both inflammatory and watery

This is the main cause for transitional diseases reported by the refugee populations of Gaza. High numbers of cases are recorded throughout the year with a marked increase during the summer and autumn. The risks of this type of diarrhoea are dehydration and [malnutrition](#), particularly in children under the age of 5.

According to estimates by the Palestinian Water Authority as well as international relief organisations, approximately 40% of cases of illness in the Gaza Strip are linked to contaminated drinking water. In about 20% of families in the Gaza Strip, there is at least one child below the age of five suffering from diarrhoea as a result of water pollution. Research released by the United Nations in 2009 estimates that diarrhoea is the cause for 12% of the deaths among children in the [Gaza Strip](#).

Similarly, both Save the Children and Medical Aid for Palestinians confirm that drinking water in Gaza contains high proportions of pollution from agricultural pesticides mixed with sewage.

Both charity organisations also highlight that the number of children who suffer from diarrhoea as a result of contaminated drinking water in the Gaza Strip has increased by 100% over the last five years. [The reason](#) for this increase is a lack of investment in the region alongside the destructive effects Israeli aggression.

### **Viral Hepatitis A**

This is a viral disease which begins abruptly. It's most important symptoms are fever, aches and pains in the body, nausea, abdominal discomfort and a clear lack of appetite. Yellowing or jaundice occurs after a few days and the disease lasts for several weeks. It is reportedly referred to as Jaundice in the Gaza Strip.

**What follows are the [2007 statistics](#) from the Palestinian Ministry of Health's Epidemiology Department on diseases in the Gaza Strip that result from water and environmental pollution:**

1. Cases of bacterial salmonella – 20
2. Cases of food poisoning – 261
3. Cases of epidemiological liver disease – 841
4. Cases of typhoid fever – 324
5. Cases of hepatitis virus - 20
6. Cases of diarrhoea in children 4 years old and over – over 19,770
7. Cases of diarrhoea in children 0-3 years old – 41,142
8. Cases of bloody diarrhoea – 6,870
9. Cases of Iscaris worms – 478
10. Cases of amoebic worms – 7841
11. Cases of Gardia worms – 3,618
12. Cases of Pinworm – 14
13. Cases of other types of worm – 12, 046

### **The Gaza Ravine– a source of pollution**

The Gaza Ravine is a stream of surface water which flows in the winter following downpours of rain on the Hebron Mountains and the Negev Heights which have a combined length of 105km and an area of 3,500km<sup>2</sup> intersecting the Gaza Strip at a length of 9km and an area of 60km<sup>2</sup>.

The Ravine's two main tributaries are the al-Shari'ah Ravine which originates in the Hebron Mountains, and the al-Shalala Ravine which originates in the northern Negev Heights. The two meet at a point approximately 2km east of the Israeli border with the Gaza Strip and thus begin from the armistice lines east of Sector and extend to the coast where its water drains into the sea. This positioning makes it rich with a variety of flora, vertebrates and invertebrates characteristic of the diversity found in Palestinian nature.

The ravine is the largest in Palestine and was once the most prominent preserver of nature in the Gaza Strip and divides Gaza City from the provinces of the central regions. It has been altered by the constant pillaging of its waters by Israel and through the construction of boundary dams during the



early 1970s. It is also affected by the continuous pumping of wastewater and solid waste from the municipalities in the Gaza Strip into it causing a significant health nuisance which the residents of the Gaza Strip permanently suffer from.

The population of the ravine, which is officially estimated at around 16,000, suffer from a variety of illnesses and infections including different types of allergic reactions, skin rashes and fungal infections but are unaware of the exact source of their diseases. In analysing samples of water and soil from the ravine at the Institute of Soil and Water at the al-Azhar University in Gaza, it was confirmed that levels of organic material, faecal and cholomoforma bacteria were found to be extremely high. As such, this precludes settlement or cultivation of the area in line with warnings from the Palestinian Minister of Environment. The analysis also showed that the proportion of oxygen is very low which renders the ravine and both its banks unusable.

Results of tests conducted on the groundwater in eleven wells spread along the extent of the ravine show that the concentration of dissolved solids in its western part, which is approximately 4.5 km in length and 400 metres in width, and extends from the sea to the main Salah al-Din Street, starts at 1810 mg/litre and ends at 4450 mg/litre.

Additionally, the levels of salinity in agricultural wells in the particular vicinity of the ravine are very high. Results of tests show that two of the wells situated in the western part of the ravine show salinity concentrations of 1800mg/litre and 1300 mg/litre respectively. In addition, there is significant faecal pollution of the ground water near its mouth rendering it unsuitable for human use but can be used for agricultural purposes.

According to a Red Cross study, the groundwater at its mouth is contaminated with levels of nitrates which far exceed the 1000% of international standards. As for private agricultural wells, they are contaminated at levels between 22 – 34 mg/litre. According to the World Health Organisation [WHO], the nitrate concentration of drinking water should not exceed 50 mg/litre. However, according to the study and applicable international standards, this ratio is exceeded in areas downstream as well as other areas.

Continuing illegal gravel quarrying along the course of the ravine has led t the leakage of waste water into the subterranean reservoir, particularly given that gravel constitutes the main barrier separating contaminated water from subterranean water very close t the surface.

According to the study, previous leakage has raised the level of metals such as lead, cadmium and zinc in the groundwater, which were originally present as a result of burying solid waste such as batteries and electronic devices in the soil. The concentration of lead in two consecutive wells near the mouth has now reached 0.228 mg/litre and 0.37 mg/litre. Both these wells are also contaminated with cadmium and zinc.

According to the environmental research of Dr Zahid Qari', "the particular increase in the level of lead causes anaemia and haemoglobin deficiency of the blood as well as damage to the kidneys, liver and brain not to mention renal colic, gout, inflammation of the kidneys and chronic renal failure." It also



causes hepatic hepatitis and may develop into fibrosis and oesophageal varices and increases stomach and duodenal acidity.

A questionnaire into the extent of the damage inflicted on inhabitants of the ravine showed that 100% of homes suffer from rodent and insect infestations such as mosquitoes, rats, cockroaches, and snakes which lead to the spread of allergies, rashes and fungal infections in 90% of inhabitants on both sides of the ravine.

70% of the population of the ravine believe that pollution in the area and the proliferation of mosquitoes has had an impact on the educational attainment of their children, and 95% of residents assert that mosquitoes, bad odours and the spread of insects and rodents are the most common nuisance they face as a result of their proximity to the ravine.

80% of residents on both banks of the ravine use antibiotic drugs, 35% of residents drink from wells they have dug themselves in their home near the ravine despite the presence of harmful pollutants which seep through from cesspits and despite knowing the water is completely unclean while 65% of residents do not drink it at all.

The general practitioner at the al-Mughraqa Health Centre has asserted that “pollution is a major cause of the widespread incidence of amoebic infection in the region, in addition to infection by *Gardia* worm and the spread of [typhoid](#) which is fatal to residents.”

Civil society institutions and universities have highlighted the danger to residents living along the ravine and the serious environmental damage to the ravine’s protected environment. In one workshop organised by the University of Palestine in collaboration with the United Nations Development programme, participants called for the Palestinian Environmental law to be activated, for pollution to be monitored and for there to be work toward bringing an end to all infringements and violations against the ravine environment.

Officials of the Environmental Quality Authority assert that they are faced with quantities of waste water that are beyond their capacity to deal with or to treat. They blame Israel for preventing the completion of a wastewater treatment plant in the central region which has prompted municipalities in the neighbouring areas to pump their [wastewater](#) into the ravine.

### **Conclusion:**

From this, the scale of suffering lived in the Gaza Strip as a result of pollution to its most important source of life is clear. This is borne out by a recently published UN report entitled ‘Gaza 2020: will it be a place possible to live in?’ which states with regard to the water sector, sanitation and infrastructure that by 2016, the only water source in the Gaza Strip, the subterranean reservoir, could become unusable and that if the situation continues as it is, by 2020 it would have sustained irreparable damage. It also states that the demand for water consumption will have increased by 60%; that the sewage sector and the infrastructure need enormous and urgent investment presently and in the future and that it faces “unmitigated disaster in all arenas unless the Israeli blockade and occupation is

not brought to an end alongside urgent intervention to save the various service sectors from further deterioration and imminent collapse.”

In light of these findings and data as well as others besides, the difficult current conditions documented in the report or those expected by 2020 are fundamentally a direct result of the practices and procedures carried out by the Israeli occupation over the past six decades of its occupation of the Palestinian territories and displacement of its people.

What has more recently aggravated this situation is the blockade imposed on the Gaza Strip following the transparent and democratic elections of 2006. This seriously hampers progress in all spheres of development in addition to the occupation’s continued appropriation of Palestinian water resources using all available means. Similarly, its persistent obstruction of strategic infrastructure development projects in all sectors, particularly those related to water and sanitation.

From this, it is clear that a solution must be quickly found to halt the pollution of Gaza’s water. It is no longer sufficient for UNRWA to simply raise the alarm and lament for the people of Gaza. It ought to physically end Israel’s siege of Gaza and theft of its underground water. It must also help the people of Gaza to desalinate sea water, construct sewage plants and collect rainwater.

A plan must be developed imminently to ration the consumption of water, treat sewage, return Palestinian sovereignty over its subterranean reservoir, exploit rain water and soundly manage water resources in the next stage.