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The Environmental Context in the Gaza Strip and the Role of NGOs

The area of the Gaza Strip is 378 square kilometers and is inhabited by approximately 2.2 million people. The Strip is considered as one of the most densely populated places on earth, with an average density of more than 5,800 people per square kilometer [1], and rising to 20,000 people per square kilometer in urban areas [2]. The population has increased more than 27 times over the past 73 years, from 80,000 people in 1948. This rapid growth can be attributed to two main factors, the first one is the high birth rate, which is the population growth rate in the Gaza Strip was estimated at about 3.45% in 2014 (the population in the Gaza Strip increases by more than 6300 people/month). The second one is that the population of the Gaza Strip is characterized by young people, as about 43% of them are under the age of 14. The influx of more than 197,000 refugees since the establishment of the Israeli occupation state in 1948. Today, more than 70% of the population of Gaza are refugees, which bears the occupation full and primary responsibility for all the crises and problems that the Strip has been experiencing for more than 70 years. Going forward, UN projections indicate that the population of the Gaza Strip will double in the coming years, reaching a population density of more than 20,000 people per square kilometer in urban areas.

The Gaza Strip lives in very different complex conditions in several aspects, as a result of the continuous changes on all local political, economic, and social levels. In addition to the regional circumstances surrounding the Strip. This would, directly and indirectly, affect the topic of this research paper «Environmental Reality in the Gaza Strip», which would affect all aspects of life and the sequence of life processes. Especially, the health reality of the population. In light of the above, it has become necessary to study and evaluate in details the environmental situation in the Gaza Strip to search for ways of development and mechanisms for its improvement. Also, to strive, in a real and effective way, to develop a clear and strong methodology to ensure the stability of the environmental situation in the Strip. This necessarily includes evaluating, analyzing, and developing the role of NGOs and civil society institutions in protecting and developing the environment. Those institutions that have become an essential pillar of stability and development in the Palestinian scene, especially in Gaza, will be presented in detail throughout this paper.

The human right to a healthy and clean environment is one of the fundamental

and inalienable rights, which is based on joint cooperation at the national, regional, and international levels. Contemporary environmental problems have become a priority of issues of concern to the international community and the United Nations in particular. This due to their direct and strong impact on international peace and security [3]. NGOs also play an important role as an effective regional administrative, economic, and social group in solving many issues, especially, the complex ones, due to their proximity to society and their familiarity with all its problems and details [4].

The existence of development and civil institutions and their connection with the obligation to protect the environment from risks (depletion and pollution) under the concept of sustainable development will not be effective unless by strengthening and activating international and national mechanisms. These mechanisms are specialized in protecting the environment. This will be achieved by raising the level of environmental awareness among individuals and institutions and raising awareness of the importance of preserving the environment and reducing pollution [5].

The environment is defined as a set of natural and non-natural (constructed) systems in which humans live with other living organisms (products/plants and consumers/animals and decomposers/microbes) in the presence of all other non-living elements and components such as water, air, soil, climate, gravity, etc., these are the ecosystems from which humans derive their livelihood and perform their activities. Also, it consists of all forms of mutual interaction and common influence between all those resources and components.

1.1. Project background:

The Palestinian Non-Governmental Organizations Network is an independent, civil, and democratic grouping that aims to support and empower Palestinian society within the framework of promoting democratic principles, social justice, sustainable development, and respect for human rights. The network includes 145 members of Palestinian NGOs, working in various humanitarian, social, and development fields. The network was established in September 1993, with the aim of enhancing cooperation, consultation, coordination, and

networking among the various civil society groups. Since then, the PNGO has become one of the important components of Palestinian society, especially as a link and reference framework for coordination between NGOs at the local, regional, and international levels.

During this paper, environmental issues with their various components will be studied, such as water and wastewater, solid and hazardous waste, energy, marine environment, soil and agriculture, air, biodiversity, as well as environmental pollution in all its forms and many other environmental titles. In addition to defining the role of NGOs in protecting and developing the environment in the Gaza Strip.

1.2. Paper preparation methodology:

The methodology for preparing this paper includes a review, study, analysis, and reformulation of all research, reports, and studies (academic, technical, local, and international) related to the environmental situation in the Gaza Strip within one updated and comprehensive scientific research paper. In addition to reviewing, analyzing, and formulating the most

important recommendations related to the role of NGOs in protecting and developing the environment in the Gaza Strip.

1.3. The objectives of the paper:

The successive events and rapidly changing conditions that directly target all the fragile environmental elements that are already depleted in the Gaza Strip, in addition to the absence of joint and real coordination and cumulative and integrative work between all governmental, non-governmental, and international institutions. The result was many unrelated technical and academic reports, some of which are often characterized by inaccuracies, contradictions, and defects. All of this and other reasons that lead those in charge of preparing this paper to work seriously on producing a scientific paper that builds a true picture of the most important features related to the environmental situation in the Gaza Strip, to be adopted later as a short, direct and focused reference. It contains all updated and reliable figures and facts about all the details and components of the environmental situation in the Gaza Strip, which can be relied upon in building, developing,

and implementing the most important future environmental projects for all local and international institutions.

2. Preface of the paper:

The logical and systematic sequence of the national plans and policies towards achieving effective sustainable development indicates that sound environmental reality cannot be built and achieved without a stable political climate, which results in a strong and coherent economic reality, which in turn allows the implementation of real environmental development that leads to building a society in which justice and respect for human rights prevail. Humans live a healthy, safe, and secure reality that reflects into an acceptable level of morbidity and mortality, which is the essence of well-being and prosperity for people and countries across the world.

2.1. Political reality and its implications for environmental realities:

The political situation has direct and indirect effects on the environmental issues in the Gaza Strip. The Israeli occupation, which is considered the main impediment to development and

improvement in various areas of life in Palestine in general, and in the Gaza Strip in particular. The environment is considered the most affected sector as a result of the occupation practices towards the Gaza Strip. The fierce and violent wars have been waged against the Gaza Strip for years, the last war (May 2021) left huge and cumulative effects of complex and intertwined environmental problems. In addition to the siege that has been imposed on the Gaza Strip for more than 15 years, which prohibited the implementation of many major strategic projects in various environmental fields, such as constructing and developing sewage treatment plants, seawater desalination plants, developing energy production and distribution in its various forms, solid waste recycling plants, infrastructure development, agricultural development, and other areas of environmental development. In addition, the real and effective absence of the Palestinian government in its practical form and the slackness of the work of the authority's institutions due to the internal Palestinian division has cast a thick and dark shadow on the face of the environmental reality in the Strip.

The absence of the enhancement for the cadres working in governmental environmental field, such as the Environmental Quality Authority, the Ministry of Local Government across municipalities, the Palestinian Water Authority, the environmental departments of the Ministry of Health, the Ministry of Agriculture, the Ministry of Supply, and the Ministry of Economy, and others have become a major obstacle on the path of sustainable governmental environmental work that ensures integrated and cumulative environmental development at the national level as a whole. The qualitative development that includes the capabilities and capacities of cadres and employees in terms of practical experience and professionalism, in addition to the sufficient number of individuals that ensures an equitable distribution of environmental tasks in all fields. Thus, their completion in a timely manner and by the required mechanism. The absence of continuous and qualitative development in all those government institutions in terms of capabilities and material requirements, such as headquarters, equipment, tools, devices, transportation mechanisms, and other requirements, also had a severe negative impact on

the entire environmental landscape. All that weakness in the government's environmental performance resulted in an absence or difficulty of another kind, including the development and application of relevant environmental laws, legislation, and regulations, which exacerbated our environmental problems associated with societal environmental behaviors and practices.

2.2. Economic reality and its impact on the environment in Gaza:

In the context of economic reality, the Gaza Strip is living in a very difficult economic situation, which disrupts the continuity of normal life. Many economic survey studies carried out in the Strip during the past years indicate shocking numbers and statistics regarding the size of unemployment and the number of families living below the poverty line, within very complex economic, health, and social conditions. According to the Palestinian Central Bureau of Statistics, the unemployment rate in the Gaza Strip reached more than 43% of the population; while the minimum wage in Gaza was 682 shekels (\$206.6). Knowing that the minimum wage as determined by the Ministry of Finance in the Palestinian Authority

is 1450 shekels (\$439.3) [6]. Also, 79% of workers in the private sector in the Gaza Strip receive a wage that is less than the minimum wage. This reality has contributed to making 65% of the Palestinians in the Gaza Strip suffer from poverty [7]. Because of the economic hardship experienced by the residents of the Gaza Strip, more than 80% of the population, whose number exceeded two million people, is receiving relief aids provided by international institutions [8]. The stifling economic hardship also had profound psychological and social effects. Studies have shown that 65% of university colleagues in Gaza suffer from "Psychological Alienation" and about 25% suffer from a low level of orientation towards the future. In addition to the increasing rates of depression, social exclusion, and other psychological problems [9].

This crumbling local economic reality in the Gaza Strip has directly led to a noticeable decrease and a severe deterioration in the level of collection and financial returns of all environmental institutions, especially service ones, such as municipalities and related ministries. This has weakened these institutions and exacerbated all operational crises and weakened

their ability to perform their duties towards the citizens in an appropriate and efficient manner, and this has negatively and directly affected the environment with its various elements, for example, the Gaza municipality is one of the largest municipalities at the national level, which undertakes the provision of various services to about 700,000 people, which issues more than 110,000 invoices per month, but according to officials, it does not collect more than 10,000 bills each month, and therefore the municipality does not find enough revenues to carry out its minimum duties towards the citizens, as well as implementing the plans for development and improvement, such as wastewater treatment plants, seawater desalination units, and the transfer, relocation, and final disposal of solid waste. In addition to the plans for developing and improving the city's shape with green spaces and other cultural and social services. All of them need a large number of manpower, equipment, and supplies that the municipality cannot provide, which is directly reflected in the environmental reality in Gaza city and the other cities in the strip.

In addition to all the previous challenges

regarding the local economic reality. The difficult economic conditions have derived related to external financing, which has also been affected by the internal division, the Israeli occupation and siege, and the political and security conditions experienced by the countries of the region. All of these reasons, as indicated by several studies, have greatly affected the quantity and mechanism of delivering funds and economic aid to the Gaza Strip, which has further complicated matters, particularly regarding the major and strategic environmental projects.

2.3. Community awareness and culture and its relation to the environment:

The citizen's culture is generated and developed with him during his life since childhood. The family, parents, peers, the surrounding environment, kindergarten, school, university, media, laws, legislation, social media, and other factors play a major role in building the citizen's awareness, practice, and behavior. The difficult economic, political, and social conditions are experienced by the residents of the Gaza Strip. In addition to the government weakness,

and the absence of environmental law, accountability, and follow-up, all these problems have significantly affected the culture of the Gazan citizens, which is translated through behaviors and practices preserving the environment with its various components.

The results of a previous study conducted by the writer of this paper, showed that there is frustration, despair, and the absence of feeling among a large number of the citizens of belonging to their homeland (citizenship), and the absence of punishment or real deterrence for offenders and wrongdoers against the environment. In addition to the recklessness towards the effects of environmental pollution and the irrational depletion of resources as a result of a lack of awareness and sufficient knowledge. This also could be out of revenge against the circumstances or the authorities in charge of managing the citizens' affairs, which has often exacerbated and complicated environmental crises.

Tons of solid and liquid waste are disposed of daily and randomly in the streets and roads in the Gaza Strip, and other piles of waste are incinerated randomly to release a huge number of toxic materials into the air. In

addition to the excessive depletion of freshwater, the destruction of the marine environment through pollution or overfishing, and sabotage of agricultural soil through tons of toxic substances that are used as agricultural fertilizers, which endanger public health. The continuous sabotage of public property and many other daily harmful practices is directly related to the culture and awareness of the citizen and not anything else.

2.4. Palestinian environmental laws and legislation:

Following its establishment, the Palestinian National Authority issued several legislations related to the protection and preservation of the environment from pollution and unjust depletion as a human right and a fundamental pillar of sustainable development in Palestinian society. Article 33 of the Palestinian Basic Law states that "A balanced and clean environment is a human right, and preserving and protecting the Palestinian environment for future generations is a national responsibility". It is clear, in the text of the aforementioned article, that the Palestinian legislator has fully and consciously realized the importance of

a clean and balanced environment for human life. A clean environment means a person who does not suffer from contagious diseases that can result from environmental problems [10].

As for the Palestinian constitution, it contains a clear text about the environment and its importance to human life and the future. Regarding this, Article 15 of the constitution states that “A balanced environment is a goal that the country seeks to achieve, and preserving the environment is the responsibility of the country and society, and its violation is subject to penalty «Law». The Palestinian National Authority has paid great attention to the environment, for this reason, it issued Law (7) in 1999 regarding the environment. **These objectives constitute a great ambition for workers in the protection of the environment if serious work is done to achieve them, and these objectives are:**

1. Protecting the environment from pollution in all its forms.
2. Protection of public health and social welfare.
3. Incorporating the basics of environmental protection into economic and social development

plans, besides encouraging sustainable development.

4. Encouraging the collection and dissemination of environmental information and raising public awareness of environmental problems.

Article 3 of this law explicitly states that any person has the right to: A- Submit and follow up on any complaint or specific judicial proceedings, without considering the conditions of private interest, against any person who causes damage to the environment. B- Obtaining the official information necessary to identify the environmental effects of any industrial, agricultural, urban, or other development programs according to the law. Also, Article 5 explicitly states that this law guarantees to people the following: A- The right of every human being to live in a safe and clean environment and to enjoy the greatest possible of public health and welfare. B- Protecting the nation's natural wealth and economic resources, as well as, preserving its historical and cultural heritage without causing side effects that may appear sooner or later as a result of various industrial, agricultural, or construction activities on the quality of life and basic

ecosystems such as air, water, soil, marine, animal and plant wealth. In addition to many chapters and articles that included many laws, legislations, and clear penalties towards protecting the environment with all its elements from various forms of pollution and attrition. [10]

2.5. International environmental agreements that include Palestine:

The Palestinian Basic Law in Article 10 Clause 2 included the rapid accession of Palestine to international conventions. For this part, Environmental Law 71999/ in Article 77 stated that the international environmental agreements, in which Palestine is a party, are an integral part of the national legislation. In addition, the Environmental Law touched upon these agreements, recommending the creation of new legislation and laws related to the environmental issues which form the backbone of these agreements, such as land uses, solid waste, hazardous materials and waste, pesticides, fertilizers, rock, sand extraction, desertification, soil erosion, environment aerobic, environmental disturbance, aquatic environment, marine environment, reserves, natural areas, and archaeological areas. It is worth noting that the Environmental

Quality Authority participates in many meetings of international environmental agreements and international and regional environmental programs, it is also the national focal point for these agreements. The following are the most important environmental agreements that include Palestine, as announced by the Environmental Quality Authority (2016) [11]

- The Framework Convention on Climate Change (UNFCCC).
- Convention to Combat Desertification (UNCCD)
- Convention on Biological Diversity (CBD).
- Basel Convention to control the movement and disposal of transboundary hazardous waste.
- Vienna Convention for the Protection of the Ozone Layer.
- Barcelona Convention for the Protection of the Mediterranean Sea.
- The Intergovernmental Negotiating Committee for a Global Legally Binding Instrument on Mercury.
- Stockholm Convention on Persistent Organic Pollutants (POPs).

- Rotterdam Convention on the Procedure for Approval of Hazardous Chemicals and Pesticides in International Trade.

3. Water and wastewater in the Strip:

The water and wastewater sector are one of the most important elements of the environment, which is continuously studied and analyzed within the framework of assessing the environmental situation in the Gaza Strip. This title is also related to many important points within the framework of the current study, such as the water crisis in the Gaza Strip including the quantity and quality of available water, as well as the mechanisms for developing water work in the sector. In addition to the most important relevant institutions and the role of civil organizations and bodies in protecting water sources and improving their quality, besides developing the wastewater treatment process and improving its products. **In the following, the most important sources and uses of water in Gaza will be reviewed and discussed:**

3.1. Household use water:

Domestic use water is one of the most important components of water sector in Gaza, which is supplied to the citizens for domestic uses, away from that water supplied to farmers or delivered to the industrial sector.

3.1.1. The quantitative problem of water in the Gaza Strip:

The Gaza Strip suffers from severe deterioration in the amount of available water to the citizens of the Strip, as they need more than 210 million cubic meters of freshwater annually for all domestic, agricultural, and industrial purposes. Several technical reports have reported the severe drop in the level of the aquifer, noting that the aquifer is considered as the only source of water that 94% of Gaza Strip residents depend on for their water needs.



While the remaining amount is divided between seawater desalination plants (4%) and the other quantity of water (2%), which is estimated at 12 million cubic meters, arrives via a conveyor line from the Israeli Water Company. The underground reservoir is fed with rainwater which is estimated at 110 million cubic meters annually (about 17 centimeters of water/year in the south of the Gaza Strip and up to 550 centimeters of water/year in the north). Experts estimate the amount of rainwater that feeds the aquifer from the total of that rain at about 7080-million cubic meters annually, through direct feeding of rainwater, agricultural irrigation, and leakage from worn-out networks.

Where a quantity of rainwater is lost through evaporation due to urban expansion and the construction of buildings and roads at the expense of rain traps, sand dunes, and agricultural soil (an estimated 17,000 housing units are being built in the Gaza Strip annually). Another waste of the rainwater goes to the sewage networks through the roofs of buildings or through the streets and sewage worn out networks. By comparing all the above-mentioned statistics, we will

find that a large difference in the water budget in the Gaza Strip has affected the amount of available water to the citizens, and the difference in the budget, which amounts to be more than 130 million cubic meters of water annually, led to a massive drop in the level of groundwater to reach in some areas for more than 20 meters from the normal situation.

This void in the body of the aquifer near the sea coast and due to the high porosity and high permeability of the underground reservoir rocks was compensated, unfortunately, by seawater that reached distances exceeding 4 kilometers in-depth and along the Strip (seawater reached Yarmouk Street in the heart of Gaza City), what is known as the phenomenon of seawater intrusion.

The residents of the Gaza Strip also suffer at the family level regarding the amount of water reaching their homes for daily consumption. The recent technical studies estimate the amount of water that reaches citizens in the Gaza Strip at 6070- liters/person/day, and it may be much less than that in many families, particularly in rural and marginalized areas. While the World Health Organization recommends that

the population should be provided with at least 100l20- liters/person/ day in order to achieve the level of water security required for the family to ensure sufficient water for drinking, personal hygiene, and to meet the basic water needs of all individuals.

The problems of providing the population with municipal water necessary for daily household activities in the Gaza Strip are exacerbated by the absence of electricity and the incompatibility of electricity access with the time of water supply to homes through service providers such as municipalities. Particularly, rural areas or outskirts of the cities have become overcrowded and the demand for water is increasing. Incompatibility of the water arrives at the time of the electricity arrival to the families deprive them of the opportunity to operate the pumps necessary to raise water to the tanks located on the roofs of their homes, which deprives these residents of municipal water for periods that may reach weeks in some cases. This drives many residents to buy water from vendors and hawkers (unsafe in terms of quality) at exorbitant prices. Other people, resort to digging illegal water wells to address the family's

needs, thus living under conditions of water poverty that negatively affect the family's life. Consequently, a state of inequity prevails in the distribution of water in many areas In the Strip. The municipal water reaches the owners of the houses near the municipal well or the ground houses in a larger amount and longer period than others in remote areas or residents of the upper floors, especially in tall buildings and towers. The estimated 16 hours/day of electricity cuts affect the production and distribution of water negatively, as well as limiting the residents' ability to obtain water. In addition, in some areas of the Gaza Strip people only get water once or twice a week.[12]

3.1.2. Water quality:

The Water Sector Regulatory Council follows and monitors water quality indicators through the results of laboratory tests available to service providers and the data provided by the Palestinian Ministry of Health. Note that the laboratory of the Palestinian Water Authority also provides some results, especially for water sources. The Ministry of Health also periodically takes and examines water samples from various regions covering sources, transmission lines, and networks. In

addition to specific points from homes and institutions within a specific sample collection program, knowing that the service provider is not a part of this program [13]. The service provider is informed of the results of the tests if there is something that requires immediate follow-up, such as the presence of contamination. Other than that, the service provider is not aware of the test program, sampling sites, number, results, or types of tests unless he applies for it.

Reports and studies received from the Water Authority and the Coastal Municipalities Water Authority showed that about 97% of the aquifer's water is unfit for drinking due to one or more forms of pollution. As a result of the leakage of partially treated or untreated sewage water into the aquifer with an average of 12 million meters cubic meters per year. Thus, an estimated 35 million cubic meters of sewage flows directly into the sea every year which returns, even partially, to the aquifer through direct seepage. The intrusion of seawater into the aquifer, in addition to the withdrawal of salt and old water located at the bottom of the aquifer or from remote areas in the borders of the Gaza Strip due to the low level

of groundwater due to the excessive withdrawal that exceeds the natural compensation through rainwater that feeds the aquifer, as we explained above. The water of the aquifer with saline water and raising the concentration of sodium chloride (NaCl) in groundwater times what is recommended locally and globally (250 ppm).

Regarding to nitrate pollution (NO), which occurs due to mixing with wastewater or the arrival of large quantities of fertilizers and chemical agricultural pesticides through irrigation or soil washing with winter rains. It was found that more than 83% of the samples examined from the network do not meet the Palestinian specifications. The global recommendation is that nitrate concentrations in drinking water must not exceed the threshold of 5070-mg/L. The results also showed that 38% of the samples taken from the source do not comply with the standards of the World Health Organization and the Palestinian specifications regarding contamination with Total Coliform bacteria [13]. It was also found that 25% of the samples that were taken from the source also do not comply with the standards regarding contamination with fecal coliform bacteria. Also, 47%

of the samples taken from the network, including the main water lines, were contaminated with total coliform bacteria (TC). [13].

Gaza is located in an arid region with scarce water resources. The uncontrolled discharge of untreated sewage to the surface or underground through thousands of cesspits, ponds, canals, and worn-out networks. In addition to the excessive use of unsafe fertilizers and agricultural chemicals and the leakage of huge amounts of solid waste landfill leachate (the sector generates more than 2000 tons of solid waste per day) through non-isolated landfills (each ton produces more than 250 liters of toxic leachate after decomposition). All of these reasons are some of the important factors led to the increase in groundwater and water resources pollution. Also, high population growth rates will inevitably lead, at present or in the future, to

increase pressure on natural resources, especially water.

Sustainability of the water sector in Gaza is the mission of the Palestinian Water Authority in the first place, with real partnership and cooperation with service providers and citizens, in addition to all relevant institutions. Despite the several obstacles, the fair distribution of tasks may overcome these obstacles. Previous experiences have shown that achieving real successes in developing the water sector at the national and local levels is not impossible, as a number of service providers have proven, according to specific indicators, that this success can be achieved if the political and economic conditions will change to support this.

3.1.3. Public water supplies:

Only about 17.9% of the water supplied through the public networks meets the specifications of drinking water according to the World Health Organization, compared to 18.4% in 2017. This percentage represents three different sources (2.1% of groundwater, 11.7%, Mekorot, 4.1% of desalinated water). This deterioration can be explained by the deterioration of groundwater quality.



Based on a previous UNICEF survey conducted by GVC in 2016, the majority of Gaza Strip residents depend on public water supplies for domestic use such as washing and cleaning.



However, 17.7% of households use water supplied through the municipal network for cooking (mainly) as well as for drinking. In addition, 6.9% of people do not know if the water source they are using is safe to drink. This situation is more common in Khan Yunis and the northern governorates, where 25.5% and 24.4% of households, respectively, use domestic water for cooking and drinking. [14]

3.1.4. Desalination operations and desalination plants:

Since the utilized domestic water is often too salty to drink, Gazans have turned to the private sector for safe drinking

water. In Gaza, there are more than 150 private desalination plants selling water at 1030- times more expensive than piped water. Apart from the economic burden caused to the poor people, this situation also generates many health hazards[14].

In 2018, 1,290 water samples were collected from the distribution networks in the Gaza Strip by municipal and health inspectors. The samples were tested for fecal coliform and total coliform. The study showed that 32.7% of the samples contained fecal coliform contamination and 17.4% of them contained total coliform contamination. As for drinking water, the results were as follows: 30% of the samples were contaminated with fecal coliform bacteria and 38% were contaminated with total coliform bacteria. For desalination tank samples, the results showed that 21% of the samples were contaminated with fecal coliform bacteria and 34% with total coliform bacteria [14].

The Coastal Municipalities Water Utility in cooperation with the Palestinian Water Authority, through various donations, started implementing three small-scale and short-term desalination plants:

- Expansion of the seawater desalination plant in Deir al-Balah – Middle Area Governorate.

Completing the establishment of seawater desalination units by reverse osmosis with a capacity of 2000 m³/day, and operating the plant to treat seawater and convert it into potable water.

- Establishing a seawater desalination plant with a capacity of 6000 m³/day:

Completing the seawater reverse osmosis desalination plant with a capacity of 6000 m³/day to serve about 75,000 residents of Khan Yunis and Western Rafah.

- Establishing a seawater desalination plant with a capacity of 10,000 m³/day in Gaza City:

Establishing a new seawater desalination plant with a capacity of 10,000 m³/day to serve 250,000 residents in the western part of Gaza City.

3.2. Water for agricultural purposes:

The water crisis caused great damages to farmers in many ways, some farmers became unable to obtain sufficient quantities of water, which prompted a

large number of them to search for other alternatives, while a number of farmers were forced to collect rainwater and use it or reuse wastewater in irrigation. This caused many serious health problems and led to great pressure on farmers, as some of them tried to move from the western coastal areas that suffer from groundwater deficit and salinity to the eastern areas to reach better quality and abundance of water. Despite the eastern areas is considered a great risk in view of the continuous attacks by the occupation forces against farmers and their lands, as well as the continuous theft of water resources. Also, some farmers started buying water from water suppliers (trucks) at high prices, this caused steep rise to the cost of irrigation with the increase in the cost of fuel required to pump this water.

The continuous decline in the quantities and the level of groundwater has weakened the pumping rates from private and collective wells over time, this led to the prolongation of the pumping periods of irrigation, which in turn increased the cost and added new work burdens on farmers. In addition, the deterioration of water quality and the increase in salinity due to the phenomenon of seawater

intrusion has led to a decrease in crop production, which causes continuous large economic losses for farmers.



The Gaza Strip suffers from many problems at the level of groundwater and its consumption for agricultural, domestic, and other purposes. The municipalities of the Gaza Strip have about 286 Municipal wells, in addition to thousands of wells that are not registered officially, which causes excessive withdrawal that affects seriously the aquifer water level. On the other hand, there are about 30 thousand absorption wells in areas that do not have access to sewage services, which pump wastewater into the ground, causing major and dangerous pollution in the groundwater [15].

3.3. Bottled water:

There are two types of bottled water sources in the Gaza Strip, imported and locally manufactured. Imported

bottles are checked upon arrival at the border crossing for the first time by testing random samples of each brand passed. If the brand does not meet Palestinian standards for bottled water, it will be rejected, destroyed, and will not be allowed to enter Gazan market. Locally manufactured bottled water is also monitored by consumer protection teams firstly as a prerequisite for registered products.



During 2017, 77% of tested samples (TDS, Turbidity, and pH) were matched, while 23% of tested samples (mainly locally manufactured) showed low pH value. All tested samples were in compliance with microbiological standards.[14]

3.4. Rainwater:

Many of the rainwater harvesting and pumping facilities that were built and upgraded during the past five years are now operating and in service. This

provides significant improvement and reduces the risk of floods in different areas of the Gaza Strip. **Significantly, positive effects have been recorded from various hot spots in this area as detailed below:**

- Since March 2018, the sewage treatment plant in North Gaza has been completed and fully operated by June 2018, where all the sewage water collected from the Northern Governorate, amounting to 35,000 m³/day, was diverted directly from the central pumping station towards the station with the new treatment. The lakes in Beit Lahia receive rainwater only and with sustainable hydraulic absorption capacities. This new operating scheme has played a major role in completely eliminating the dangers of lake flooding and life-threatening events for the residents of Beit Lahia during the past years.
- A rainwater retention lake, a pumping station, and a main pressure force to the sea outward in the Rafah area were constructed and operated. The entire intervention led to the solution of one of the cases of chronic floods in Rafah, which was dividing the city of Rafah into two halves along Abu Baker

Street during the rainy seasons of the past years.

- Building and equipping a rainwater harvesting basin in the El-Geneina area of Rafah city will reduce flooding in the eastern part of the city.
- A rainwater drainage link was established at the main pumping station and operated in Khan Yunis to pump rainwater towards the western filtration basin.



This new rainwater management scheme has played a major role in eliminating the risks of lake flooding and life-threatening events in different areas of the Gaza Strip, especially in Beit Lahia. However, there are some concerns that open rainwater collecting pools provide an attractive environment for mosquitoes breeding, thus increasing the risk of disease. There are other concerns related to the pollution of rainwater with wastewater

due to illegal connections to sewage networks which causing groundwater pollution, especially when using wells to inject and filter rainwater. [14]

3.5. Wastewater:



3.5.1.Quantities and specifications:

The sector currently produces more than 170,000 cubic meters of wastewater per day (62 million cubic meters annually). On average, it is estimated that about 40% of the population is not connected to public sewage networks [15]. Also, cesspits and suction wells are considered one of the most important alternatives that are harmful to the environment and commonly used in Gaza as wastewater disposal systems in rural areas. The urban centers are equipped with a large connection to the sewage network, while the overcrowded refugee camps such as Al-Nuseirat, Al-Bureij, Al-Maghazi, and Al-Zawaida, do not have sanitation

facilities [16]. Raw wastewater that is produced from homes, health facilities, factories, or farms contains various forms of physical and chemical pollution (organic, inorganic, heavy metals, petrochemicals, etc.). Also, biological pollution (such as bacteria, parasites, viruses, etc.), which constitutes serious pollution threatens public health and pollutes Groundwater. Table 1 shows the wastewater specifications in the Gaza Strip, according to the latest measurements for the year 2020.

---	Rate ppm	Max value ppm	Min value ppm
Acidic and base pH scale	8.1	8.1	8.0
EC Electrical Conduction Unit	2326.3	2710.0	1387.0
TSS Stuck Solids	438.5	1040.0	120.0
BOD Biological Oxygen Rate	389.2	520.0	240.0

3.5.2. Wastewater treatment plants in the Strip:

There are six sewage treatment plants in the Gaza Strip, a sewage treatment plant in North Gaza, a sewage treatment plant in Gaza - Sheikh Ajlin, the sewage treatment plant in Gaza Valley, a sewage treatment plant in Khan Younis, and a wastewater treatment plant in Rafah, in addition to the Bureij Central Sewage Treatment Plant.



Operating the sewage treatment plants is a complicated mission because the plant requires a stable and continuous electric current or a huge amount of fuel to operate. In addition to sustainable quantities of chemicals required for treatment operations. The treatment plants in the Gaza Strip have always been a direct target of bombing and destruction by the occupation. The fact that most of them are located in a border or open areas limited the work of the stations most of the time. Those

stations already suffer from weak absorptive capacity and low operational efficiency, which make helpless in the face of the increasing amounts of wastewater that reach them daily, this forced them to pump their untreated wastewater directly into the sea.

The stations in the Gaza Strip are also facing the problem of closing the crossings for more than 15 years, which hinders the requirements of the wastewater treatment process and spare parts. In addition to the continuous power cuts and the absence of the necessary funding to purchase the necessary fuel to compensate for the stoppage and to operate auxiliary generators. Therefore, it is very important to neutralize these vital and essential sectors from any restrictions or obstacles, which would directly affect life in the Gaza Strip.

3.5.3. Reuse of wastewater for agricultural irrigation in the Gaza Strip:

In Palestine, as in most countries of the world, there is a growing awareness of the benefits of using treated wastewater as an additional water resource. **This is clearly expressed in the National**

Water Policy, which clearly states the following:

- Treated wastewater is an important resource and must be improved for agricultural purposes, refeeding, and aquaculture.
- The national policy is to treat all produced wastewater of sufficient quality to meet national standards for safe and productive reuse. Also, to support the distribution and productive reuse of treated wastewater.
- The national policy is to enhance the reuse of treated wastewater through sound contractual arrangements between producers and users.

The Treated Wastewater Reuse Project is considered one of the most important projects that support sustainability in the Gaza Strip. For example, the Recovery Wells Project for the North Gaza Sewage and Rainwater Treatment Plant (NGEST) is currently being implemented, through which 35,000 cubic meters of treated water will be recovered to cover the need of 15,000 dunums in the area surrounding the project. The Recovery and Reuse Plan has been designed with a capacity

of 35,600 m³/day from the NGWTP North Wastewater Treatment Plant. As well as to accommodate 69,000 m³/day by 2025.

The treated water will be used to irrigate agricultural areas, which will provide excellent and appropriate solutions for farmers and reduce the severity of the water crisis. Also, it supports the aquifer in a way that enhances the quantity and quality of water. This project is one of the vital and very important projects in the sector that needs constant follow-up and continuous development, especially in the expansion operations to achieve the maximum benefit.

4. Hazardous solid waste:

The total amount of waste collected in the Gaza Strip is more than 1950 tons per day, with a production rate per capita of 0.9 kg/day in summer. Each ton of solid waste produces approximately 250 liters of toxic leachate after its complete decomposition. [18]

Several recent scientific studies on the nature of solid waste in the Gaza Strip concluded that the main composition of municipal solid waste in the Gaza Strip is organic (about 50%), followed by plastic (17% on average), then

paper/cardboard (11%), the rest is metal, glass, sand, etc. Despite this large portion of biodegradable and recyclable materials, very little amount (about 3%) is collected for recycling, and about 1% is actually recycled. Moreover, the only materials currently recycled in Gaza (i.e., waste processed into a secondary raw material for reuse) are organic waste, some plastics (not all types can be recycled in Gaza), and some cardboard. A quantity of minerals is also collected and sent abroad. [17]

The Gazan market for solid waste reuse/recycling is small and unregulated. The majority of the pilot projects implemented in the past 10 years focused on the manufacture and use of compost (organic humus), as well as the recycling of some plastic and paper/cardboard. There is also an increasing interest recently in e-waste, due to the negative environmental consequences and health problems caused by its treatment and disposal. [17]

The sources of environmental pollution with waste are different, the waste of health institutions “medical waste” is considered a hazardous material to human health and to the environment due to its dangerous components. The World Health Organization defines

it as: “Waste generated from health care institutions, research centers, laboratories, and waste from secondary sources, resulting from domestic healthcare (especially in hemodialysis, insulin injections, etc.). Where medical waste is produced in the Gaza Strip hospitals and health centers (with their departments and clinics), medical laboratories, scientific medical research centers, human anatomy centers, research laboratories, animal examinations in universities, blood banks, sample collection services, and nursing homes for the elderly, which are not managed in a healthy and sound manner.

4.1. Collection and transportation of solid waste:

Municipalities and the United Nations Relief and Works Agency for Palestine Refugees (UNRWA) ensure initial collection (from homes to containers) or people dump waste into fixed containers. Then, UNRWA and municipal vehicles collect the waste containers and transport them to temporary landfills or to a central landfill.

Neither the private sector nor the NGOs have any role in collecting solid waste in the Gaza Strip. In the major urban centers of Gaza (the major cities), the

coverage of collection at the source is approximately 100%, while the medium-sized towns have lower rates of solid waste collection than those in urban centers. [17]

4.2 Solid waste classification:

There are different ways to classify solid waste in the Gaza Strip, but we can say that there are **four main categories**:

1. Biodegradable (food waste, animal dung, plants, garden and tree waste)
2. Recyclable (plastic, metal, glass, paper, cardboard, clothing, some tires, batteries)
3. Inert (from construction, demolition, debris, stones)
4. Hazardous (paints, chemicals, pesticides, aerosols, batteries, some medical waste - including infectious waste such as medical waste and animal carcasses, waste components of electrical and electronic equipment).

In general, municipal solid waste concentrates on the following waste fractions: household waste 45.50%, construction industrial waste 20.25%, and commercial sector waste 25.35%-17]]

4.3 Management and final disposal methods in Gaza:

Most municipal solid waste (coming from homes, commercial and public institutions, and some industries) is mixed (not sorted) or recycled during collection. Medical waste and some special waste can be collected separately (16% of foundations separate their chemical waste, 14.2% and 12.3% respectively, separate their sharps and infectious waste). However, there is no separate special unit designated for them so they end up mixed in landfills. Construction and demolition debris is not dumped in special sites and hazardous waste is not officially allowed in current landfills in general, but there are no strict instructions.[18]

The policy of recycling and introducing the three elements (reduce, reuse, recycle) has been mentioned over the past years in many official documents and is officially supported by various educational events and publications. Although, separation at source is not generally implemented (except in some cases and at a very small level). Formally, this percentage represents about 4% of the total waste [18].

The market for waste reuse and recycling of paper, glass, metal, and plastic is still

very small and informal. This is done mainly by itinerant collection (e.g., door-to-door, in refugee camps, at transfer stations, or landfills) and often through multiple merchants (from waste pickers to private facilities). In addition to that, the workshops and companies involved are small size, not officially registered, and depend on market fluctuations (international and domestic prices, changing demand and supply) and operational costs.

4.4 Indiscriminate burning of solid waste in Gaza:

Incineration of solid waste, with all its plastic residues, various complex petrochemical and industrial materials with its dyes, texture enhancers, and complex polymers, produces huge amounts of carcinogenic toxins and highly toxic gases. These materials kill people around us without us noticing, such as dioxin, carbon monoxide, nitrogen oxides, carbon, and formaldehyde. In addition to chlorides, benzyl compounds, freons, hydrocarbons, and many other dangerous toxins that kill humans and the environment. Particularly, the children, pregnant women, and patients, as well as the citizens around the place. This will infect them

with various diseases, respiratory, circulatory, and organ functions, etc...



Burning waste destroys the container and removes its paint, thus ending its life span and losing public money. Also, it destroys the asphalt material beneath the waste which turns into a hole, this weakens the street, after that, the whole street will be eroded. Thus, the burning of waste and this filthy distortion of the general appearance pollutes the buildings and changes their colors, and reaches all those volatile and plankton inside houses, food, clothing, and belongings of the surrounding residents with the burning waste.

4.5 Solid waste dumps:

There are three central landfills in Gaza. The first waste disposal site is located in Al-Fukhari (Sofa) area within

the administrative authority of Khan Yunis Governorate, about 5 kilometers northeast of the former Gaza Airport, 6 kilometers northeast of Rafah, and 800 meters from Israeli borders.

The central Deir Al-Balah landfill was also built-in 1995 and expanded in 2002 with the support of the Federal Republic of Germany. The landfill is located in the eastern part of Deir Al-Balah, near the borderline (1950 armistice line) with Israel. The total area of the landfill in the first phase amounted to 34,900 square meters. The landfill was extended in 2002 to a total area of 59,900 square meters and the height of the piles of waste reached nearly 26 meters in 2018. This landfill has a gravity leachate collection system in two ponds where the leachate is recycled back onto the sink. The annual production leachate is estimated to be about 45,000 m³.

In addition to building Juhur Al-Deek landfill in 1986 and expanding it in 1990, 2000, and 2013. Juhur Al-Deek landfill is located in the southeastern part of Gaza Governorate, near the borderline (the armistice line 1950) with «Israel». In the first phase, the total area of the landfill was 30,000 m², and the landfill was expanded using a new

lining, reaching the total landfill area to 140,000 m². An additional adjacent space of 120,000 m² was acquired in 2018 to use in the near future, given that the current landfill is nearly full. In this landfill, which is the only hazardous waste disposal site in Palestine, there was also a cell for hazardous waste disposal and packaged in concrete boxes.



The landfill is operated by the Gaza Municipality and receives an average of 700 tons/day from Gaza City and the northern Gaza governorates, knowing that the generated waste amounts are estimated at about 1100 tons/day. As for the 400 tons/day waste generated in North Gaza Governorate (Jabalia, Beit Lahia, Beit Hanoun, and Umm Al-Nasr), it is transferred to Juhur Al-Deek landfill instead of the three random landfills in Jabalia, Beit Lahia, and Beit Hanoun. The amount of waste accumulated in

landfills in northern Gaza is estimated at 250 thousand tons. [18]

The implementation of effective and integrated solid waste management in Gaza faces many challenges at the legislative, regulatory, technical, environmental, and financial levels. This situation is further complicated by the lack of statistical data needed for decision-making, planning, and control processes. Also, the complexities of the current political situation add their own challenges, which can cause health disasters due to poor waste management.

5. Energy/electricity in the Gaza Strip:

Currently, the residents of the Gaza Strip need about 600 MW to receive continuous and regular electricity 24 hours a day, but in fact, they only get 180 MW or 120 in the best cases, which Israel supplies directly through ten high-voltage lines and the other 60 MW are produced by them. The power station in the Gaza Strip operates with fuel delivered from Israel and financed by Qatar. As a result, the residents of the Gaza Strip receive electricity on “normal” days for only 8 hours, followed by 8 hours of power cuts, and so on.

In the summer, the power sometimes cuts for 12 hours. The current state of electricity is one of the most important obstacles facing all sectors. For example, the electricity situation in Gaza is considered a major problem for wastewater treatment plants and seawater desalination plants. This affects successively the other sectors such as the marine environment pollution due to untreated sewage, as a result of the treatment interruption due to the lack of the necessary fuel, which is also required for the movement of waste collection and transportation vehicles.

6. Marine environment:

The Gaza Strip is located in the southeastern corner of the Mediterranean Sea, with a coastline of about 41 km in length. The fishing zone in the Gaza Strip has fluctuated over time. According to the Second Oslo Agreement of 1995, the fishing area was 20 nautical miles, then it was limited to 12 nautical miles according to the Bertini agreement in 2002, then it was reduced to 6 nautical miles in 2019, after the events of the “March of Return” in late March 2018. There is an easing of restrictions, including increasing the fishing zone to 15 nautical miles in the

middle of the coastal areas of the Gaza Strip, but things deteriorated after that, and the fishing distance that gives the Gazans a pressure card in the hands of the occupation is manipulated all the time depending on the political and security conditions. The fishing sector in Gaza plays an important role in food security and it's a vital source for a large number of fishermen. Where there are currently 3,951 fishermen registered in the Gaza Strip, this means that about 18,000 people directly depend on fishing for their livelihood. Also, about 110,000 people depend on the fishing sector including fishermen, retailers, exporters, families, and owners of seafood restaurants. Considering that the total population of the Gaza Strip is about 2 million people, nearly 10% of the population depends on the fishing sector. In general, the number of registered fishermen increased from 2448 in 2003 to 3,617 in 2017 and to 3,951 in 2019 [20]

6.1 Fishing areas in Gaza:

There are four fishing areas in the Gaza Strip, (1) Gaza City Port, (2) Deir Al-Balah, (3) Khan Yunis, and (4) Rafah. The four areas are managed by the Ministry of Transport, in cooperation

with the Ministry of Agriculture and the Palestinian Coast Police. The Gaza City



port has marine facilities and facilities for loading and unloading, and the other three fishing sites have limited facilities with a limited landing area in the coastal areas. The total recorded fishing is 81.3% in the Gaza City Port, 5.2% in Deir Al-Balah, 7.3% in Khan Yunis, 6.2% in Rafah. [20]

6.2 Erosion and drift of the beach:

The problem of Gaza beach erosion is due to man-made conditions as confirmed by analysis of historical satellite images since 1972. Rough estimates indicate that the amount of erosion is about 82,000 cubic meters per year, which is approximately equal to the amount confined behind the southern breakwater of Gaza Port. [21]

Drift threatens the buildings, roads, and other structures located directly

on the coast. On the other hand, drift threatens coastal life, affecting people's economic, tourism, and recreational life, as well as daily life. As marine life is indispensable for a coastal country like Gaza.



The Gaza Strip needs many comprehensive studies to analyze the current and future situation of the beach concerning many other factors such as climate change, sea-level rise, sediment movement, and developments regarding the Nile River and the Ethiopian Renaissance Dam. In addition to the effects of the rocky tongues (ports) being built along the coast. These comprehensive studies are the cornerstone from which to improve the general condition of the beach in Gaza.

6.3 Sources of marine pollution:

The daily pumping of more than 120,000 cubic meters of untreated or

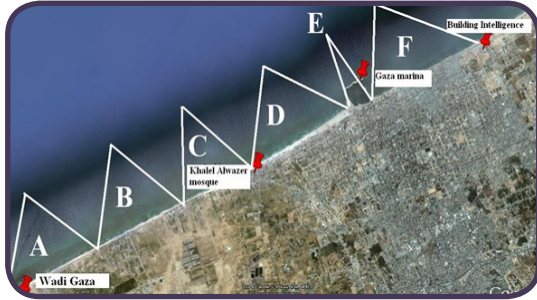
partially treated sewage into the sea of the Gaza Strip directly on the shore, and not at a depth of 500 meters. This pumping of limited quantities of treated sewage caused many injuries to citizens in the Gaza Strip, especially children, as intestinal diseases, rashes, etc.

A study conducted during the last period by Dr. Ahmed Hilles, the author of the current paper, confirmed the pollution of the Gaza City beaches with gastrointestinal parasites, resulting from pumping thousands of cubic meters of untreated wastewater into the beach area. The parasites were used as a tool to detect the level of wastewater pollution in the Gaza Sea. The study showed that the areas adjacent to the sewage estuaries spread along the coast of Gaza City suffer from



very high levels of parasitic pollution. The study showed that the percentage of contamination with human intestinal

parasites in the beach area of Gaza City was 40.4% in seawater samples, 43.6% in wet sand samples, and 40.4% in dry sand samples, the study area to extend between Wadi Gaza in the south and



Al-Khaldi Mosque in the north. [31]

The study also showed that Area A (near Wadi Gaza), Area B (near the estuary of the Sheikh Ajlin wastewater treatment plant), and Area D (near the raw wastewater estuary opposite the chalets resting place) is the most contaminated with human gastrointestinal parasites. Regarding Area C (opposite the Baidar resting place) and Area E (Fishermen's Port basin), they were less contaminated with parasites. While Area F, which comes north of the Fishermen's Port and up to Al-Khaldi Mosque, was free from any parasitic pollution, as the sewage estuary opposite the Al-Shati refugee camp stops working during the summer period, which is the period of

conducting the study.

The study showed that parasites can survive and endure under difficult conditions of heat, drought, and the presence of salts in seashore water and sand for long periods. This making them a continuous source of danger to human health.

The study also showed that the water currents towards the north coming from the south affect the spread and distribution of parasites. Also, it was found that the areas located on the northern side of the wastewater estuaries are more polluted than those areas located on the southern side of the estuaries. The study concluded many important recommendations one of them was the necessity of working seriously on developing the wastewater sector in the Gaza Strip and finding other alternatives and solutions to avoid any pollution or damage to the coastal area.

7. Agriculture in the Gaza Strip:

The agricultural sector in Gaza includes a large group of sub-sectors and activities interrelated in different degrees, namely plant production with its various branches of fruit trees,

citrus, vegetables, field crops, flowers, animal production, and fisheries. **In this context, here are the following facts:**

The area of agricultural land in the Gaza Strip reaches 173 thousand dunums, the areas planted with vegetables are 82 thousand dunums, and the areas planted with fruits are 71,400 thousand dunums. The rest of the agricultural areas are planted with field crops such as wheat, barley, aromatic plants, and export crops. The areas in which the previous varieties are grown are approximately 20 thousand dunums. The largest agricultural areas are located in the governorates of Khan Yunis and Rafah, where there is an expansion in the Gaza Strip in the south which includes the liberated lands, Al-Mawasi, and the eastern lands. In addition to the border area from the north to the south of the Strip, which is estimated at 22,500 dunams. In most cases of conflicts and wars, the lands near the eastern border strip of the Gaza Strip were free from any agricultural activity, which caused great losses to the agricultural sector, as a quarter of agricultural production is concentrated in the border areas. In addition to the fact that most of the animal production is located in those areas.

Specialists from the Ministry of Agriculture indicated that after the Israeli aggression in 2014, agriculture returned to those areas despite the continued harassment and shooting of farmers by the Israeli occupation. The number of salaried workers in the agricultural sector reached about (62,751) workers, while the number of workers from families and employers was (20,145). Agricultural products are relatively self-sufficient in the agricultural sector, for example, vegetables meet the needs of the Gaza Strip by (96%), poultry (95%), olives (80%), and citrus fruits (50%).

The agricultural sector depends on irrigation water as one of the main production inputs, its continuation depends on the electric current required to operate the wells and ensure the flow of water in the main and secondary pipelines, in light of water scarcity and the lack of rainfall during the winter in Palestinian lands and the Gaza Strip in particular. On the other, the possibility of marketing and storing agricultural products declined due to the inability to operate the refrigerators used to preserve food commodities and this problem exacerbates in the summer and high temperatures.

Regarding such facts, the crisis is threatening the farmers and prompting a large number of them to think seriously to abandon this vital sector due to the enormous challenges and losses, as the electricity and water crises are accompanied by the measures imposed by the Israeli occupation forces on importing raw materials, such as iron pipes that are used in the construction of greenhouses. Also, the repeated bombing and bulldozing operations during the attacks and wars led to the destruction of crops.



The agricultural sector has a humanitarian and a developmental dimension, as it provides job opportunities for large segments of society, as recent reports indicate that the percentage of workers in the agricultural sector reaches 6.6% of the total who work in the sector (58,307 people). Statistics also show that the

percentage of women's participation in agricultural activity ranges between 30% and 39% of the total agricultural workers, which reflects the great role of women in this sector. This constitutes a source of income for hundreds of thousands of Palestinian families, in addition to its role in securing the family's provisions of vegetables and fruits.

Palestinian farmers, especially those working in agricultural land near the separation fence in the Gaza Strip, suffering from repeated attacks by the Israeli occupation forces over the past two decades. During their work, farmers are exposed to the risk of death or injury, as well as incurring huge financial losses when their agricultural lands and properties are targeted. The information indicates that the Israeli occupation forces-imposed restrictions on access or movement near a security border on the residents of the areas adjacent to the separation fence since the beginning of the Al-Aqsa Intifadah in September 2004. These restrictions were tightened in September 2005 when the occupation forces began unilaterally withdrawing from the Gaza Strip, which is known as «Access Restricted Areas». The buffer zones that

the occupation trying to make reality as military zones are prohibited to the Palestinians. The buffer zone is located in the east and north of the Gaza Strip, and it is fertile agricultural land, where the occupation practices activities of spraying with insecticides that reach Palestinian crops near the border at irregular times and destroying their crops. In addition to opening rainwater dams to destroy their agricultural lands seasonally. These areas sometimes reach a distance of 400 meters away from the borders separating the Palestinian territories occupied in 1948. Note that 70% of the agricultural areas in the Gaza Strip are located in the eastern and northern areas close to the borders, and therefore this significant erosion in the area of agricultural land poses a threat directly to the food and economic security of the population of the Strip.

Other problems related to the quantity and quality of irrigation water available in the Strip pose a major challenge to the agricultural sector in Gaza. In addition to the problems of plant diseases, weather conditions and climate changes, and the effects of the blockade imposed on the Strip, which has deprived farmers of many

agricultural requirements necessary to develop their agricultural performance to ensure improved productivity.

7.1. Sources of soil pollution:

There are many direct and indirect sources of soil pollution in Gaza, some of them are natural sources and others are human sources, like the Israeli aggression on Gaza. The sources of soil pollution in the Gaza Strip are chemicals used as agricultural pesticides or fertilizers, sewage leakage through worn-out networks or through musty wells used in areas not connected to public sewage networks, seawater intrusion, remnants of the Israeli bombing, and leachate from landfills, as shown in Figure 21.

7.2 Agrochemicals:

Despite the chemical pesticides have the greatest impact in protecting production by preventing crops from agricultural pests, misusing them affects negatively humans and the environment. Using these chemical pesticides continuously in an excessive and unplanned manner leads to significant pollution in the environment and affects public health. [25]

Several specialized scientific studies warned of the long-term damages of agricultural pesticides on the environment and public health, they indicated that these damages may last decades before their effects completely disappear. These results came after researchers and scientists from the University «La Bruges de Lac» discovered that the harmful effect of pesticides on the environment remains more than four decades after banning these pesticides. They conducted analysis on a lake near a grape-growing region in southern France. The researchers said that they found in the bottom of this lake remains of materials were used in manufacturing insecticides against pests in the twentieth century.

Insecticides are dangerous chemicals used to exterminate insects and plant pests, they have a toxic effect to varying degrees on humans, animals, and plants. Also, they include arsenic, nicotine, phosphorous, cyanide, chlorine compounds, and there are some types of compounds used to get rid of rodents such as zinc phosphide, thallium sulfate, and Chlorophacion.

It is known that a small number of arsenic compounds or a small drop of organophosphorus solution is sufficient

to exterminate humans and animals. Organophosphorus substances are very toxic, but their effect gradually diminishes, and some of them are less toxic, like DDT. Many studies conducted in a number of countries confirmed that fruits contain a residual effect of pesticides higher than what is permitted, in turn, this poses a great danger to humans and their environment. Those local, regional, and international studies warned of the dangers of those pesticides, emphasizing the importance of rationalizing their use because of causing acute and chronic poisoning of humans and animals, in addition to deformities, cancers, and deaths.

Numerous studies proved that most of the materials used as agricultural pesticides are prohibited and harmful, including in the first-place organic pesticides, which are the most dangerous. In addition to the chlorine group, which has a long-term effect and wide impact on the health of the environment, humans, and animals. Three separate studies have examined the effects of pesticides on IQ levels. The results showed that infants who live near farms that use pesticides or in houses where household pesticides are used have a lower IQ than children

who live in an environment without pesticides.

The Gaza Strip imported 133 million shekels of chemicals (pesticides and fertilizers) during 2016. Many studies and reports proved that government agencies and relevant authorities in the Gaza Strip do not have the capabilities and capacities for monitoring and controlling the quantity and quality of chemicals used by farmers in the Gaza Strip, which has very dangerous effects on individuals and the environment. This makes agriculture in the Gaza Strip away from the concept of safe farming and the production of healthy crops free of harmful substances.

8. Air in the Gaza Strip:

The overcrowding in the Gaza Strip (about 6000 people live in every square kilometer) poses a major challenge to the quantity and quality of air pollution in the Strip. Random burning of solid waste inside cities or even in central waste dumps produces a huge amount of pollution as mentioned previously. Most areas of the sector, especially rural areas, are connected to each other by a network of roads and dirt paths that are a major source of dust, which is one of the most important air pollutants. In addition to huge

amounts of dust and dirt filled with iron and aluminum oxides, and other compounds resulting from grinding and crushing rocks resulting from the demolition and destruction of buildings, residential facilities, headquarters, and government facilities in the Gaza Strip as a result of the wars. This directly affects workers in the field of rock crushing, in addition to the destructive effects of these pollutants on the population in the vicinity of quarries, agricultural soil, and plants.

There are about 80,000 cars in Gaza, the annual fuel consumption to drive these cars is about 17,000 cubic meters of petrol and 11,000 cubic meters of diesel. The global permitted limit for the concentration of CO₂ in the air is 350 parts per million. In Gaza, it reaches from 300 to 650 in most areas, this increase in carbon dioxide in the atmosphere is attributed to the expansion in the use of fossil fuels, which is assumed to be the main cause of global warming that negatively affects many physical, biological and human systems.

Reducing CO₂ emissions from waste incineration and traffic in Gaza would be the most useful mitigation measure in this context; this reduction can be achieved by eliminating old vehicles

from the streets and performing regular maintenance on vehicles that are in good condition. It is necessary to improve public transport infrastructure to encourage people to use these transportations, which will help reduce carbon dioxide. One of the most effective measures is to plant more trees on the side of the roads because trees absorb carbon dioxide during photosynthesis. [28]

9. Noise pollution in the Strip:

Noise is the interference of a group of loud, squeaky, and unwanted sounds. It is considered a source of the environmental nuisance that endangers human health, so that nuisance has been called «noise pollution». Knowing that not every sound is considered noise, and sound is measured in a unit called decibels (dB) to express the intensity of the sound compared to our human ability to bear hearing it.

The last Israeli aggression and all the wars against the Gaza Strip make it witness severe noise pollution. This pollution has numerous sources as a result of the intense military attacks and using all kinds of weapons, bombs, and missiles. Noise pollution has become a constant source of inconvenience and psychological pressure caused by the

occupation for the residents of the Gaza Strip through flying drones massively at low heights over cities, villages, and residential neighborhoods all the time. In addition to warplanes that passing constantly over the Strip, causing huge noise all the time.

The daily human activities represented in transportation, industry, agriculture, and others related to the convergence of housing and crowding of residential neighborhoods, in addition to the undisciplined culture of some residents, such as holding loud parties until late at night and shooting in happy and sad public and private occasions. All these behaviors contribute, one way or another, to creating noise pollution. The noise caused by the frequent run of electrical generators due to power cuts is another type of pollution in the Strip.

10. The role of the Israeli occupation towards the environment in the Gaza Strip:

10.1. Israeli blockade and closure of crossings:

As it was previously shown, the Israeli occupation is the main obstacle in life with all its details for the Palestinians

in all areas of their presence. The siege imposed on Gaza since mid-2006 until the release of this paper, constitutes a stifling crisis with manifold levels on all residents of the Strip, especially since Gaza is considered as a Narrow part of the Palestinian geography with its limited capabilities and scarce resources. Updating situation



memorandum recently submitted by the Euro-Mediterranean Human Rights Monitor after eleven years of the siege on the situation in Gaza warned that: “All vital sectors in Gaza are witnessing an unprecedented collapse and deterioration with long-term damage.” The memorandum addressed various aspects of life in Gaza, which has been affected by the blockade, such as the fallen environmental reality and the deteriorating health situation, as there is a shortage of medical supplies. In addition to the worsening economic recession, which naturally has its

impact on the social conditions of the residents of Gaza. The memorandum also broached the fuel and salaries crisis, which exacerbated the blockade.

The Israeli blockade on the Gaza Strip has deprived the Strip of many strategic projects in the various environmental sectors. In addition to preventing entry of many equipment, devices, and tools that are required to develop the environmental performance in the Strip [33].

10.2. Wars against the Gaza Strip (remnants of war and pollution of hazardous materials):

Wars have a large effect on the Gaza Strip in the short and long term, directly and indirectly, in all fields and sectors (infrastructure and superstructure, environment, health, agriculture, energy sector, economy, education, and various sectors of society, including NGOs).

Thousands of tons of missiles, bombs, and explosives, which inevitably contain many toxic substances and heavy, dangerous, and carcinogenic elements such as tungsten, cobalt, nickel, cadmium, and other internationally prohibited and chemically complex

substances. This has proven to be globally harmful to the environment with all its components, which actually thrown on the Gaza Strip during the war to destroy and pollute the agricultural soil, groundwater, and the air around us. All of these pollutants are constantly hitting the Gaza Strip during the wars of occupation against Gaza. This occupation, which categorically refused to send a competent environmental fact-finding mission that was approved by the United Nations and which agreed at the time to visit Gaza and conduct a full environmental field survey immediately after the 2014 war at the official request of the Environmental Quality Authority. This puts the occupation in front of certain and unquestionable proof that he used weapons and dangerous and internationally prohibited materials against the Gaza Strip, and he refuses any international party to intervene to reveal the truth and expose the hidden.

The presence of thousands of destroyed houses, buildings, and facilities everywhere among the citizens of the Gaza Strip after each war means providing suitable conditions for aggravated the crisis of spreading insects and microbes in the Strip. This will turn the Strip into a large swamp

for the growth and reproduction of a huge number of pathogens and vectors in a short time. Many insects, microbes, stray animals, rodents, and rats find habitats, and environments suitable for food, growth, reproduction, and to build their nests and dwellings under that rubble.

Also, the destruction of thousands of meters of drinking water lines, networks, and connections to all overcrowded residential neighborhoods. Targeting the drinking water desalination plants causing a massive, intentional, and systematic destruction of sewage networks, wastewater treatment plants, and lift pumps portends an inevitable environmental disaster to the population in the Strip. As happened during the last war (2021), which shortly preceded the preparation of this paper [30].

Tons of solid waste have accumulated among residential neighborhoods due to the difficulty of working during wartime. In addition to the accumulation of thousands of displaced citizens during each war in the main cities, which will have a huge impact on the health situation in the Gaza Strip. Also, the summer heat or the cold winter has a big role

in exacerbating the problem. Besides the direct and massive destruction of wastewater networks, which leads to the leakage of millions of cubic meters of untreated sewage water into the soil and into the underground tank is the only source of water in the Gaza Strip and consequently more pollution in all its forms.



Millions of tons of rubble and cement blocks resulted from bombing and destroying thousands of residential, commercial, and government buildings in the Gaza Strip, totally or partially. It means the need for thousands of cranes and tankers to operate for months after each war in an attempt to clean up the bombing areas, not to mention the reconstruction and building of what was originally destroyed. All this means more concentrated environmental pollution of air, soil, and water, in addition to noise pollution, visual

pollution, and depletion of resources that are intensely scarce.

The power outages due to the violent bombing and targeting of electricity columns and lines everywhere mean an increase in the complexity of all the environmental details related to electricity. The stoppage of sewage treatment plants and desalination plants, the spread of fuel-based electricity generators, and other serious environmental challenges will rapidly increase due to exacerbate health and environmental conditions, as well as economic, social, and even security. [30]

The environment in the wars in Gaza has always been the weakest link and the direct target. To be added to the list of innocent targets in Gaza as a result of the brutal and deadly Zionist aggression. The environment in Gaza suffering for years due to the siege, previous wars, excessive attrition, and the absence of real development. Now things have become more complicated, regarding the new situation, all previous development and improvement plans will be canceled or postponed to be replaced by repair, relief, and reconstruction plans. This means a huge decline and slowdown in development

compared to the rapid and unstoppable population growth.

Enormous environmental details that cannot be listed or reviewed in a brief paper, many intensive and comprehensive scientific studies that require advanced international devices, equipment, and laboratories must be seriously and truly implemented in Gaza to build on their results in all directions [30].

In conclusion of talking about the different environmental sectors and the current situation in the Gaza Strip, which is too long to talk about and not enough to mention all the relevant details and facts. All health problems represented in the range of morbidity and mortality were evident as an inevitable reflection of the environmental situation in the Gaza Strip. In this paper, we sufficed with mentioning the most important features and the most prominent facts related to each component of the environment in the Gaza Strip. We can build a reference that can be built upon and rely on its contents to develop future interventions at all levels and in all institutions, using what we have from long experience in this field and based on a large number of recent and reliable research and reports.

11. The role of NGOs towards the environment in the sector:

The Gaza Strip is living in a unique and complex situation that is different from others around the world. This makes the NGOs an important pillar in the Gaza Strip. NGOs are the second sector of the society besides the government. The society consists of civil society organizations and NGOs, an estimated 1,431 NGOs are in the Gaza Strip. These organizations receive annual funding from multiple sources, provide thousands of paid jobs through the implementation of many projects in all areas, and contribute significantly to fill the gap of unemployment, employment, finance, development, and development. It is considered one of the most important pillars of society that plays a vital role in all sectors of society. This role shows in light of the poor performance of the government and the sagging performance of state institutions after the internal division, which cast a thick and heavy shadow on all aspects of the lives of the Gazans, including the environment sector. Here are some of the most important responsibilities and roles of NGOs that must be activated and adopted in Gaza.

11.1 Building and developing environmental NGOs:

The process of building and developing the community environmental institution is a major and thorny challenge facing all NGOs, especially modern ones, where the environmental institution must develop and arrange its identity, structure, cadres, internal papers and special capabilities. This reflects its external image through which it can achieve the best networking and building the best bonds of cooperation with all partners, and developing the best results and outputs for all parties, reflecting the entire environmental reality in Gaza.

Through experience, it has been found that many environmental NGOs operating in Gaza urgently need to equip their staff, build their capabilities and develop their potential in various fields, including trained and able-to-work units dedicated to writing environmental projects and bringing funding to high skills in all respects (strong English, writing and formulating strong proposals, skills and expertise in formulating environmental ideas and translating environmental challenges, gaps and community needs into activities, opportunities, projects,

etc.). Environmental NGOs must keep controls on its standards to understand the concerns, needs and aspirations of the citizen in what related to the environmental field so they can fulfill it. They must take in consideration, choosing the cadres very carefully. Then build and develop their abilities in what agree with the objectives and field of work of the institution. As well as the building of the institution's policy, laws, codes of conduct, controls and structures are tightly, coherent, integrated and in line with national environmental and non-environmental laws and are consistent with international laws and policies that will increase the employment opportunities of an institution to ensure effective and genuine participation in improving the environmental reality in Gaza.

11.2 Building plans, policies and programs (cooperation with government institutions):

It highlights on the very important role for environmental community institutions in building and developing international and local alliances. These alliances build and develop the strategic environmental policies, programs and plans of the state, which will contribute

to the building of environmental laws and legislation that serve the executives in the sector. It shows a clear role for NGOs in conducting effective, clear and real environmental studies and surveys that directly reflect the real environmental reality of society, the state and the world.

It is the responsibility of environmental community institutions to conduct clear and comprehensive research and reports that properly reflect the true picture of reality, in all environmental aspects such as: research and studies on green economy and sustainable development, others in the water sector and its quality and ways to develop and improve it, integrated management of solid waste and ways of recycling and remanufacturing, studying the current situation of biodiversity in the sector Gaza, the beach dome, marine environment development and tourism investments, research on wildlife in the Gaza Strip, studies on agriculture and organic production, research, projects and surveys including analysis of infrastructure related to sewage and household water systems, drainage and collection of rainwater. In addition, studying the general situation of traditional and renewable energy and

the process of folding It is seen and felt and adapted to the reality in Gaza, and many other areas of research and study. These studies, research, comprehensive surveys and reports can be adopted as an important and clear reference to build a clear vision of the environmental reality in the sector, helping to improve the development process in the country by identifying needs, challenges and gaps that are translated into activities, projects and interventions. As well as studying what the world has produced in the same context with the aim of obtaining the latest strategies, ideas, and plans, and what is in progress with the local realities of the sector. Besides studying international experiences and the surrounded countries and their success, effectiveness, and applicability.

NGOs can develop a clear vision of the challenges and needs that help to develop strategic plans in the right way that meets those needs and addresses all those challenges and thus develop the community environmentally appropriately.

As shown in this sequence begins with the implementation of studies and research examining the current situation of the target sector, which will determine the challenges and needs

facing this sector, resulting in clear objectives that can be translated into activities and programs describing the policies and strategies of the institution, which eventually reach projects and implement them on the ground for the development of society.



Sequence of building the activities and plans of environmental NGOs in Gaza

11.3. Protecting laws and legislation and supporting executives:

There is an important role for NGOs in protecting environmental laws and legislation through their own plans, methodologies of action and codes of conduct through which they protect the environment with its various components of attrition and pollution, as well as through the compatibility of the laws of the institutions themselves with the laws and legislation of the state. NGOs can be considered components of the promotion, application, and enforcement of various environmental laws. They support the ease of access and proper application of state laws to all components of society.

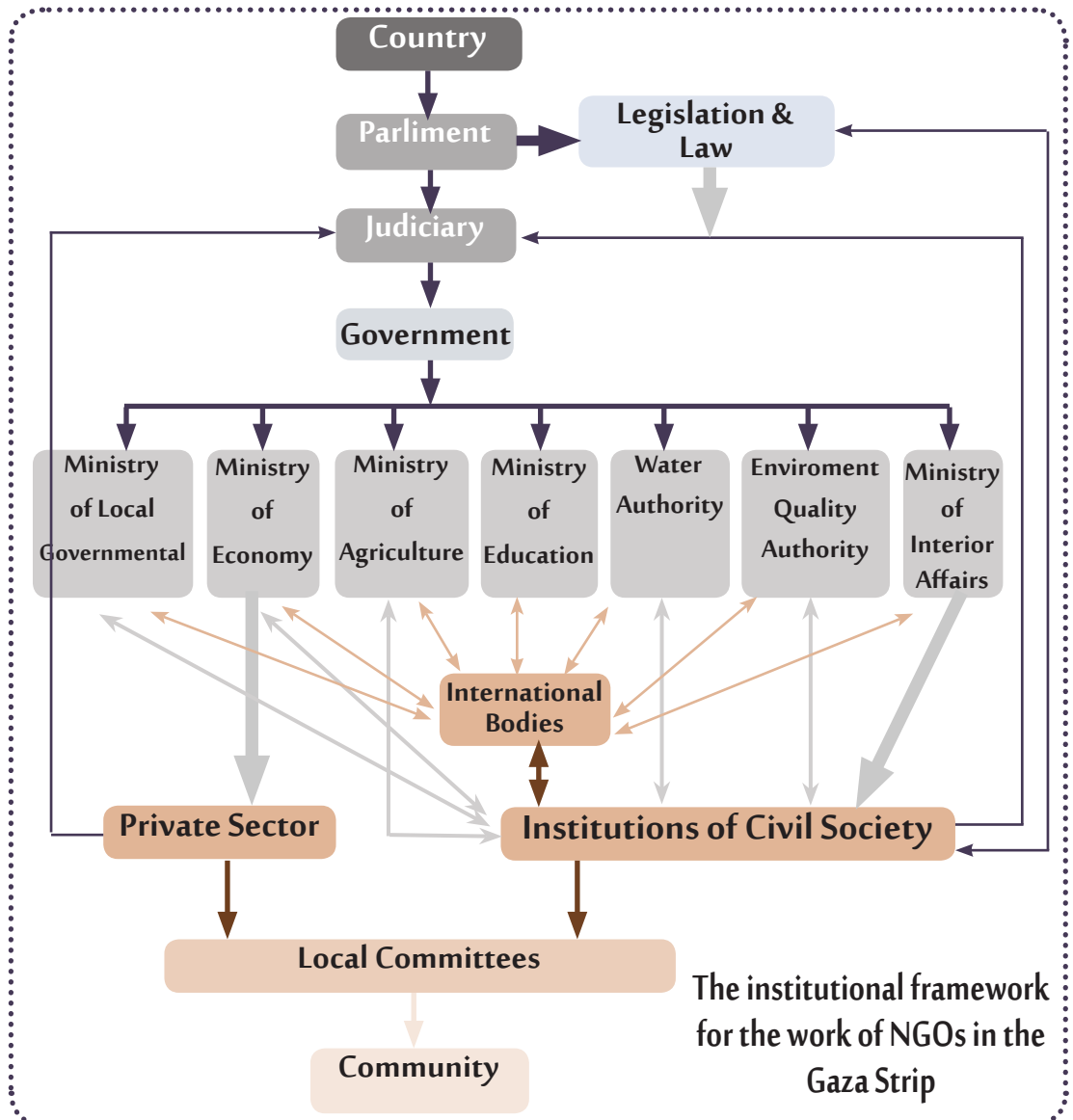
11.4. Lobbying, advocacy and implementation of initiatives (community participation):

The role of NGOs in creating local environmental committees that represent the community and reach all its details and segments, these committees consist of a group of members of the community that have the motivation and passion to give to develop and improve the environment in the country. It is also the responsibility of NGOs to monitor the status in society

and identify the needs and necessities. This to improve the lives of individuals within the community in environmental terms such as: establishing and creating the environmental police, working to educate citizens and hold accountable abuses against the environment and society, working to implement initiatives to protect the coast, working to promote the principles of the green economy and the import of environmentally friendly goods, developing concepts of circular economy, recycling and reuse, as well as developing projects that promote environmental protection and development, community awareness, and environmental education programs and campaigns.

The role of pressure and advocacy is not only limited to these needs, but also has a duty to put pressure on the government and the world through international courts and partner institutions around the world. This happens by developing a strong, clear and effective language to talk to the international community to mitigate the violations of the Israeli occupation against the Gaza Strip. Also, it puts a pressure on society to improve the public culture with regard to the development and preservation of the environment. This results in development in all other

sectors. The figure below shows outline of the mechanisms of work, networking, lobbying, advocacy and implementation of projects through various environmental institutions in Gaza, from the top of the pyramid represented by the state to the rules represented by society:



11.5. Implementation of environmental projects (relief and development):

The role of NGOs is clear and effective in the preparation, writing and implementation of environmental projects when the organization has a clear, realistic and real vision based on urgent needs and addresses fundamental challenges, as well as strong staff and cadres and relationships with experts and specialists. This high capacity of the Foundation is reflected in the provision of projects that reflect the realities, challenges and circumstances of society.

NGOs are responsible for attracting funding for the development of the environmental realities of the Gaza Strip through the implementation of projects under the following: projects to develop and improve the quality of drinking water, soil study and improvement projects, solid waste recycling projects, NGOs development projects, sewage and rain reuse projects, waterfront restoration and development projects, state enterprise development projects, support projects, improvement of public awareness and community culture, and community rehabilitation projects, as well as many important projects that will promote society and the state.



Important definitions in accordance with the Palestinian Environment law (7) of 1999:

Environment: The biosphere that includes living organisms and their contents of air, water, soil, the facilities on the earth, and the interactions between these components.

Air: The mixture of invisible odorless tasteless gases (such as nitrogen and oxygen) that surrounds the earth.

Soil: The superficial crust of the land in which it is cultivated, built on, or dug in, and includes all types of land.

Water: Water that is found on the surface of the earth or in its interior, whether fresh, saline or semi-saline.

Environmental pollution: Any direct or indirect change in the properties of the environment that may damage one of its elements or upset its natural balance.

Air pollution: Any change in the properties and components of natural air may harm the environment.

Water pollution: Any change in the properties and components of water may harm the environment.

Polluting materials and factors: Any gaseous, liquid, or solid substances, including smoke, vapors, odors, radiation, heat, glare, noise, or vibrations that may lead to environmental pollution or deterioration.

Hazardous Substances: Substances or compounds of materials with dangerous properties that cause harm to the environment, such as toxic materials, radioactive materials, biologically infectious materials, or explosive or flammable materials.

Hazardous waste: Residues of various activities and processes or their ashes that retain the properties of hazardous materials which have no subsequent uses, such as nuclear waste, medical waste, and waste resulting from the manufacture of any of the pharmaceutical preparations, medicines, organic solvents, dyes, paints, pesticides, or other hazardous materials.

Solid Waste: Any waste other than hazardous waste. Or garbage arising from various domestic, commercial, agricultural, industrial, urban activities, and sediments resulting from wastewater treatment plants.

Wastewater: Water polluted by solid, liquid, gaseous substances, energy, or microorganisms produced from homes, buildings, or various installations.

Groundwater: Flowing, running or stagnant water under the surface of the earth.

Environmental damage: The damage resulting from the practice of any activity that leads to damage the public health, public wellbeing, and the environment.

Environmental Impact: Anything that has a positive or negative effect as a result of activities resulting from a project or facility on the various environmental elements.

Pollution Prevention: Measures and procedures taken to prevent pollution.

Pollution Reduction: Measures and procedures taken to limit or reduce the spread of pollutants.

Environmental Protection: Preserving the elements of the environment, limiting its pollution, upgrading or developing it, and preventing pollution or depletion in all its forms.

Waste management: Collecting various wastes and transporting them to specific places for recycling, treatment, or disposal.

Environmental disaster: The accident caused by natural factors or human-caused, which results in severe damage to the environment, and the response to it requires capabilities that may exceed the local capabilities.

Environmental disturbance: The resulted physical or moral damage from noise, noise, vibration, radiation or odors resulting from human activities, installations, means of transportation, etc., which affect the human practice of his normal life and property.

Environmental Control: Procedures undertaken by the competent authorities to ensure that people and bodies respect the established environmental standards and instructions to ensure that they are not violated or exceeded.

Environmental Degradation: Any effect on the environment or its elements that leads to damage and distorts its nature, drains its resources and harms living organisms.

Environmental Awareness: Dissemination of knowledge that promotes principles and values that raise the level of public awareness necessary to preserve the environment and its elements.

Natural Reserves: Areas designated for the protection of certain types of living organisms or any other ecological systems of natural or aesthetic value and whose removal, influence or destruction is prohibited.

Environmental approval: An official document issued by the Environmental Quality Authority expressing an environmental opinion regarding the establishment or practice of any activity that requires environmental approval.

Environmental Impact Assessment: A detailed study to estimate the environmental impact of any activity.



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